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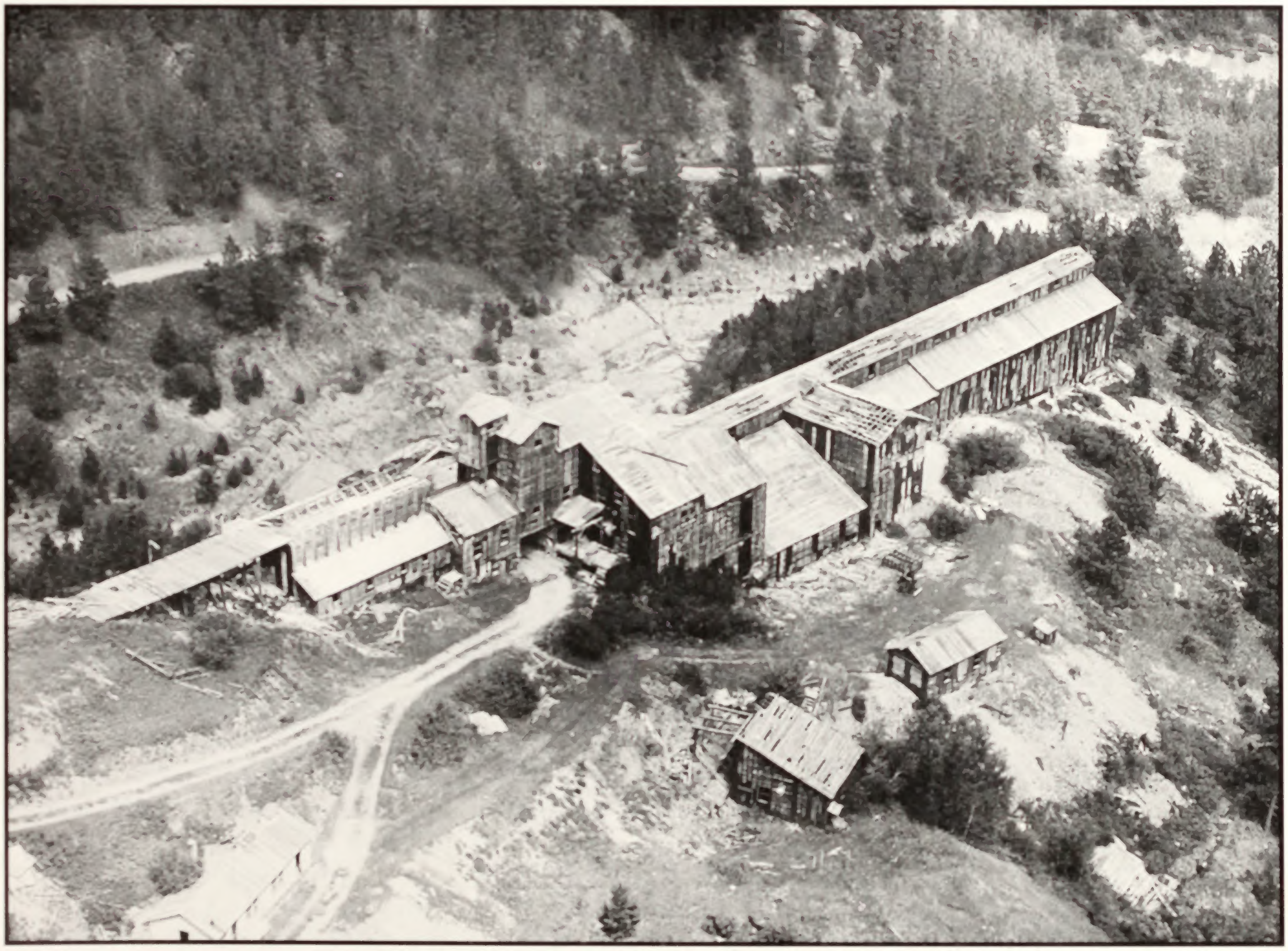
Final Environmental Impact Statement
Zortman and Landusky Mines
Reclamation Plan Modifications and Mine Life Extensions



Historic Ruby Mill near the town of Zortman

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation; rangelands; timber; minerals; watershed; fish and wildlife; wilderness; air; and scenic, scientific, and cultural values.

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ABA	Acid-Base Accounting
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ACO	Administrative Compliance Order
ADT	Average Daily Traffic
AGP	Acid-Generating Potential
AIRFA	American Indian Religious Freedom Act
AMD	Acid Mine Drainage
ANB	Average Number Belonging
ANFO	Ammonium Nitrate and Fuel Oil
ANP	Acid Neutralizing Potential
AP	Acid Potential
APE	Area of Potential Effect
ARD	Acid Rock Drainage
ARM	Administrative Rules of Montana
ATSDR	Agency for Toxic Substance and Disease Registry
BACT	Best Available Control Technology
BAT	Best Available Technology Economically Achievable
BCI	Bat Conservation International
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
BP	Before Present
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environment Response, Compensation and Liability Act
CERCLIS	CERCLA Information System (potential Superfund sites list)
CERT	Council of Energy Resource Tribes
CFR	Code of Federal Regulations
CMR	Charles M. Russell National Wildlife Range
COE	U.S. Army Corps of Engineers
CPA	Company Proposed Action
CWA	Clean Water Act
DEQ	Montana Department of Environmental Quality
DHES	Montana Department of Health and Environmental Sciences
DMR	Discharge Monitoring Reports
DNRC	Montana Department of Natural Resources and Conservation
DOJ	Department of Justice
DSL	Montana Department of State Lands
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FBCC	Fort Belknap Community Council
FLPMA	Federal Land Policy and Management Act of 1976
GWPCS	Groundwater Pollution Control System
HDPE	High Density Polyethylene
HELP	Hydraulic Evaluation of Landfill Performance

IHS	Indian Health Service
IMP	Island Mountain Protectors
KOP	Key Observation Point
LAD	Land Application Disposal
LCNHT	Lewis and Clark National Historic Trail
MBF	Thousand Board Feet
MCA	Montana Code Annotated
MDFWP	Montana Department of Fish, Wildlife and Parks
MEPA	Montana Environmental Policy Act
MFSA	Montana Major Facility Siting Act
MGWPCS	Montana Groundwater Pollution Control System
MMCF	Million Cubic Feet
MMRA	Montana Metal Mine Reclamation Act
MNHP	Montana Natural Heritage Program
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPDES	Montana Pollutant Discharge Elimination System
MPM	Montana Principal Meridian
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NAG	Non-Acid Generating
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NNP	Net Neutralization Potential
NP	Neutralizing Potential
NPDES	National Pollutant Discharge Elimination System
NPNHT	Nez Perce National Historic Trail
PA	Programmatic Agreement
PSD	Prevention of Significant Deterioration
PVC	Polyvinyl Chloride
PWSA	Public Water Supply Act
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFRA	Religious Freedom Restoration Act
RMA	Recreation Management Area
RMP	Resource Management Plan
ROD	Record of Decision
RSPS	Reclamation Surface Performance Study
RUSLE	Revised Universal Soil Loss Equation
SHPO	Montana State Historic Preservation Office
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USDOC	U.S. Department of Commerce
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VRM	Visual Resource Management
WQA	Water Quality Act
WSA	Wilderness Study Area
ZMI	Zortman Mining, Inc.

UNITS OF MEASURE

mg/l	milligrams per liter
mg/Kg	milligrams per kilogram
tpy	tons per year
lb/ton	pounds per ton
ppm	parts per million
gpm	gallons per minute
cm/sec	centimeters per second
cy	cubic yards
cfs	cubic feet per second
Kg/day	kilograms per day
ft/day	feet per day
ft^2/day	square feet per day
mph	miles per hour
$\mu g/m^3$	micrograms per cubic meter
μg/Kg	micrograms per kilogram
dB	decibel
g	gravity
g/Kg	grams per kilogram
KT	kiloton

CHAPTER 4.0

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION TO IMPACT METHODOLOGY

This Chapter addresses the environmental consequences, or impacts, of each of the seven alternatives described in Sections 2.5 through 2.11. In accordance with the Bureau of Land Management's (BLM) National Environmental Policy Act (NEPA) Handbook (BLM Handbook H-1790-1), the critical elements of the human environment to be addressed in this analysis are presented in the sections which follow this introduction. However, the following elements have been reviewed and would not be effected by the proposed action or alternatives: prime or unique farm lands; wild and scenic rivers; and wilderness or wilderness study areas.

Types of Impacts

Impacts are assessed for each environmental and human resource with regard to direct effects, indirect effects, cumulative impacts, and impact significance. Significance, as referenced in the Council on Environmental Quality NEPA regulations, requires considerations of both context and intensity (40 CFR 1508.27). In other words, how does an impact fit in the local and regional context, and how adverse or beneficial is the effect on human and environmental resources?

Significance criteria are used by each resource specialist when an impact can be evaluated in quantitative terms, for example: a numerical or regulatory standard; number of acres of disturbance; nuisance level; years of economic effect; or population change that is deemed significant. This is then the threshold, measure, or standard against which an impact is compared to determine it's "significance." However, quantitative criteria may not always be available for impacts comparison. In these instances, resource specialists rely on relevant information sources, experience at the Zortman and Landusky mines and other similar mine sites, and professional judgement to determine if an impact is "significant."

The Baseline, or Basis for Impact Assessment at Zortman/Landusky

As described and illustrated in Chapter 1, little relative surface disturbance, other than exploration roads, was present in the current mine areas prior to 1979. The area around the Ruby pit, mill, and along Ruby Gulch was the notable exception. Therefore, the baseline discussion in Chapter 3, Affected Environment, focuses on conditions prior to the era of large-scale, modern mining and disturbance, which began in 1979 (see DSL 1979b). For impact assessment the baseline, or basis for analysis, is the 1979 conditions present in the study area prior to commencement of modern mining operations. Each environmental resource discussion will chronicle impacts from activities in the past (1979-Present), and then go on to discuss future impacts of each alternative.

Impact Methodology

Impacts are discussed, and then rated, based primarily on technical and professional judgement in view of this particular project, its setting and context, other projects resource specialists have reviewed, and the effects of this project in both a site-specific and regional sense. A review of EIS scoping issues was performed by each environmental resource specialist prior to this analysis to assure that all relevant concerns expressed by the public and concerned entities were addressed.

For the impact analyses to be meaningful, and to allow a significance determination, they are defined in terms of magnitude, incidence, and duration. "Magnitude" refers to the extent of the impact. Where possible, resource specialists have used numerical terms, such as the number of acres disturbed, to describe the magnitude of impact resulting from each alternative. When quantitative terms are not available or cannot be developed, resource specialists may define the impact magnitude relative to the effects associated with other alternatives.

"Incidence" is the frequency of impact occurrence. Some impacts may occur continuously, for the duration (or longer) of mining and reclamation. Other impacts, such as noise from mine pit blasting, may occur only on a periodic or sporadic basis.

"Duration" of impact refers to the time within which the impact will occur. For instance, air quality impacts from mining operations would dissipate quickly once mining operations stop, but groundwater contamination would likely persist for many years beyond the cessation of mine activities. To help differentiate impact durations, resource specialists may distinguish between "short term" and "long term" impacts, using criteria specific to each resource analysis.

Impact Direction

Impacts are also described in terms of the direction of change. This direction of resource change may be reflected by an improvement in the environmental resource. Resource specialists would term this trend "beneficial." Alternatively, continued or increased environmental degradation would be an "adverse" trend. However, it is important to remember that the direction of change, whether adverse or beneficial, is always relative to the baseline conditions existing prior to the start of modern mining operations in the Little Rocky Mountains. It is also important to remember that the impacts described are residual impacts; that is, those which would occur even after agency-required (DEQ/BLM) or proponent-committed (ZMI) mitigation measures take place. Alternative 1, the No Action alternative, does not incorporate any mitigations beyond those required by the existing permits.

In developing the analysis of impacts for this document each resource specialist initially presents their particular methodology to assess impacts. Then, the 1979-Present impacts are compiled and presented for a historical perspective and to understand the current state of the environment at the project site. These impacts are documented by field observations, field sampling data and analyses, air photos, maps, and reports. Finally, each alternative (1-7) and its predicted impacts are disclosed. NEPA and MEPA also require an assessment of the following:

Cumulative impacts: Cumulative impacts for this Final EIS are those from past, present, and reasonably foreseeable future actions that have or are expected to occur in the project area, aside from the Zortman and Landusky mining and reclamation. These include: 1) historic mining disturbances in Montana Gulch, Beaver Creek, and Pony Gulch, and the Hawkeye Mine; plus mill tailings in King Creek, Alder Gulch, and Ruby Gulch; 2) impacts from 1979 through the Present; 3) impacts resulting from full implementation of each alternative; and 4) Reasonably Foreseeable Future Actions, as described in Chapter 2 under each alternative. It is important to note that no other major non-mining actions are projected for this part of the Little Rocky Mountains which need be included in the cumulative impact analysis.

Unavoidable adverse impacts: These are adverse impacts that would not be mitigated below significance.

Short-term use/long-term productivity: This discussion identifies the tradeoffs between short-term use and long-term productivity of the resources involved in the alternative.

Irreversible or irretrievable commitments of resources: Irreversible resource commitments are those that cannot be reversed back to the original status of the resource. For example, once an ore body is mined and the precious metals are removed it can never be replaced. Irretrievable resource commitments are those that are lost for a period of time. For example, the loss of wildlife habitat associated with a facility disturbance would be irretrievable until the project is complete and reclamation has taken place.

4.1 GEOLOGY AND TOPOGRAPHY

The methods used to evaluate geologic and topographic impacts are presented first, including the guidelines under which the impact analysis is conducted. Section 4.1.2 presents an overview of the impacts to geologic and topographic resources resulting from mining activities during the years ZMI has operated the Zortman and Landusky mines. Sections 4.1.3 through 4.1.9 describe the impacts associated with the three non-expansion alternatives (1, 2, and 3) and the four expansion alternatives (4, 5, 6, and 7).

4.1.1 Methodology

The evaluation of impacts to the geologic resources and topography of the Little Rocky Mountains is based on quantitative and qualitative analysis. Quantitative assessments of impacts are possible where the magnitude of impact is known or relatively predictable. For instance, the extent that topographic relief has already been modified in some areas of the Little Rocky Mountains is easily determined by comparing the elevation of selected areas prior to mining with the elevation of those same locations after approximately 15 years of mining. The magnitude of this impact is presented by a numerical elevation change. A quantitative assessment simplifies the comparison of alternatives. The magnitude of impact to geological resources is estimated based on the amount of material (i.e., clay, limestone, etc.) needed to fulfill the construction and reclamation requirements for each alternative.

Significance determinations are primarily based on the quantities and types of geologic resources consumed, and the extent of topographic modification. These are direct effects caused by implementation of a particular alternative. "No impact" only applies if geologic resources would not be mined for reclamation or construction purposes; there would be no resultant topographic modification.

Context is very important to the geologic significance determination. This is well illustrated by comparing the impacts on precious mineral resources against the impacts on reclamation resources. The clays and limestones used in construction and reclamation are available in large quantities locally, either within the existing permit boundaries or at nearby quarries or borrow sources. They are available in virtually limitless quantities regionally. Because there is no potential for depletion of these resources by the alternative actions, the impact to these resources is not significant. However, gold and silver are considered precious metals with limited quantities available in the study area or even worldwide. Extraction of these metals by mine operations is a significant impact by virtue of the depletion of a limited resource.

Topographic impacts are presented by evaluating the magnitude of alteration to the landscape and areas disturbed by the mining or reclamation activities. Most topographic disturbances to remove geologic resources are considered an adverse impact. Exceptions would include actions taken to restore landforms to their original, pre-mining topography.

A qualitative assessment is used where numerical determinations or estimates are not possible or within the scope of this analysis. As an example, the geologic hazard of a landslide has a higher probability of occurrence in Upper Alder Gulch than it does on Goslin Flats. The absolute difference in stability for the two areas is not known but it is reasonable to conclude that the Goslin Flats site presents a lower landslide risk than a site in a relatively steep valley like Upper Alder Gulch. Geologic hazard significance is based on whether a facility has been, or could be, engineered to acceptable and appropriate safety standards.

The seven alternatives are evaluated for direct and indirect resource effects. Each impact is presented in terms of the change affected, where possible by: 1) a disclosure of the magnitude of the effect, as described above; 2) the relative length of time the effect will last, with short-term effects being those that occur during mining and reclamation, and long-term duration being an impact extending longer than mining or reclamation, and 3) the likelihood the impact will occur and on what frequency. The likelihood of an impact occurring is only mentioned where the impact is less than certain. The factors or events causing the effect are described. All assumptions used in assessing impacts to geologic and topographic resources are listed or available in the project files. Estimates of impacts, where used, are identified.

Cumulative impacts are presented by summing the impacts from past (pre-1979), present (1979 through implementation of each alternative), and reasonably foreseeable mining actions. Unavoidable adverse impacts, such as topographic modifications, are identified for each alternative. Statements are made for each alternative analysis concerning the relationship between short-term resource use and long-term productivity, and the extent that the resource commitments are irreversible or irretrievable.

Not all geologic resources described in Section 3.1 are evaluated for impacts under each alternative, either because the potential for impact is not a concern for this project (paleontological resources) or there would be no impact under any of the alternatives (coal, gas, oil). The following two sections summarize the potential for impacts to these resources.

4.1.1.1 Paleontological Resources

No documentation is available to suggest that any significant paleontological resources have been noted, disturbed, or removed during activities associated with the Zortman and Landusky mines. Paleontological significance is based on the type and species of fossil found, and their relative abundance. Generally, invertebrate fossils are found in the Madison Group limestones in great abundance; their frequency and occurrence has been well documented, and fossils from these formations are not of value to the collector or scientific community.

Fossils of extinct vertebrate species tend to have more scientific and collectible value, hence greater significance, because they are found in much less abundance than most invertebrate fossils. ZMI has mined clay for use in facilities construction and reclamation covers from the Seaford and Williams quarries, both of which have the potential to contain vertebrate fossils. Clay at the Seaford pit is from the Bearpaw shale, which has produced fossil dinosaurs, fossil fish, and other vertebrate and invertebrate species. However, no significant fossil finds have been reported from the Seaford pit or the Williams pit.

The potential for an impact and the degree of impact to vertebrate paleontological resources is not quantifiable, since it is not known whether these resources exist at the clay quarries and in what quantity or availability. The only alternative which would be certain to not have an impact on vertebrate fossils at the clay pits is Alternative 1, since no additional clay would be mined to support mining or reclamation activities. The potential for adverse impact would increase, if fossils are present, with each alternative in proportion to the amount of clay projected for mine construction and reclamation activities. Some impacts to invertebrate paleontological resources would almost certainly occur for alternatives 3 through 7, since limestone would be mined for reclamation covers. However, these impacts would not be significant because of the prevalence of invertebrate fossils and fossil species in the limestone formations that would be mined, and the abundance of documentation on this fossil record.

4.1.1.2 Other Geologic Resources

As described in Section 3.1.7.5, some other important geologic resources are found in north-central Montana, including near the Little Rocky Mountains. Coal, and oil and gas deposits, have been produced from sedimentary formations in the region. Two exploration oil wells have been drilled in the Township near the Zortman Mine, with poor results, and some producing gas wells have been drilled in the Claggett Shale formation about 10 miles south of Landusky. Coal has been reported at one location on the flank of the Little Rocky Mountains uplift near Zortman, but this is not considered to be a viable reserve. For these reasons, it is expected that none of the alternatives would have an impact on these geologic resources.

Caves are an abundant geologic feature in the limestones of this region and the Little Rocky Mountains. Azure Cave is one well documented site which has been determined to have significant value, in part because of its geologic and mineralogic features. Potential impacts to Azure Cave are described in Section 4.13.2.

4.1.2 Impacts from Mining, 1979 to Present

Mining in the Little Rocky Mountains during the past sixteen years has irreversibly altered the landscape and consumed local geologic resources. The following sections describe the impacts associated with current (1979 to the present time) mining operations.

4.1.2.1 Geologic Resources

Mining at the Zortman and Landusky mines has resulted in the irretrievable commitment of gold and silver ore, "waste" rock excavated during ore removal, clay, and a small amount of limestone. The only significant impact results from the depletion of gold and silver from the area, as these metals are considered precious and present in very limited quantities worldwide. Waste rock (various sedimentary, metamorphic and igneous lithologies), clay, and limestone are present in essentially limitless quantities in the local and regional area, and the commitment of these resources in the Zortman and Landusky mining operations is of little consequence.

Approximately 20 million tons of gold and silver bearing ore have been removed from the Zortman Mine during the years 1979 to 1995, and about 110 million tons of ore have been removed from the Landusky Mine by ZMI during the same years. It is estimated that about 1.4 million ounces of gold and 5.5 million ounces of silver have been recovered from that ore during the years 1979 through 1995. ZMI has removed over 75% of the gold and silver ever produced from the Little Rockies Mining District, with an estimated combined value of about $600 million (assuming gold valued at $400/Troy ounce and silver valued at $6/Troy ounce). Additional gold and silver ore is known to occur in the Little Rockies Mining District, as evidenced by ZMI's proposed expansion plans and the belief that other ore deposits, such as that found in Pony Gulch, exist in the vicinity of the Zortman and Landusky mines. Lower grade ores which may not be feasible to mine using current technologies are also present. It is not possible to estimate the percentage of available gold and silver which has been removed from the Little Rockies by present mining operations, but it is reasonable to assume that the ore removed represents a significant portion of a limited resource.

Clay has been mined at the Seaford and Williams clay pits for use in facilities construction and as reclamation materials. About 4.2 acres have been disturbed by clay mining at the Seaford pit, with approximately 250,000 yd^3 of clay removed for use at the Zortman Mine. About 26 acres have been disturbed at the Williams clay pit for use at Landusky facilities. It is not known how much clay has been removed from the Williams clay pit for Landusky facilities. Topographic modifications to both clay pits have been significant because of the large-scale disturbance of source areas which were previously relatively undisturbed.

The King Creek limestone quarry north of the Landusky Mine was disturbed prior to 1979 for use in a public service project not affiliated with the Landusky Mine. Approximately 3 acres of disturbance has resulted from the quarry operations.

4.1.2.2 Topography

Ore and waste rock removal by ZMI has significantly altered the local topography of the southern portion of the Little Rocky Mountains. Mining operations have reduced the elevation and modified the shape of some landforms by blasting and excavation of ore, waste rock and reclamation materials. New landforms have been created by mining (open pits) and redistribution of ore and waste rock (leach pads, waste rock facilities). The resultant landscape is flattened, with select high areas removed and some topographic depressions filled in.

The most dramatic and significant impact to topography is the result of hardrock mining in the ore zones at both mines. The elevation of the pre-mining land surface at the current Zortman Mine pit was over 5,200 feet mean sea level (msl). As shown in Chapter Two on a typical north-south Zortman Mine cross section in Figure 2.8-5, two prominent hills have been reduced in elevation by 200 feet or more to an existing ground surface less than 5,000 feet msl in some areas.

Topographic alteration to the Landusky Mine landscape has been greater than at Zortman because about five times as much ore and waste rock has been removed during the past 16 years of ZMI mining. The elevation of the pre-mining land surface at the current Landusky Mine pit was about 5,400 feet msl at the highest point. As shown in Chapter Two on a typical cross section of the Landusky Mine in Figure 2.8-8, one prominent hill has been reduced in elevation by approximately 500 feet to an existing ground surface less than 4,900 feet msl, while another high point has been reduced by about 300 feet, from over 5,100 feet msl to an existing ground elevation of about 4,800 feet msl.

The topographic alterations create far-reaching, indirect impacts beyond the direct aesthetic effects. The changed topography has resulted in significant modification to the natural water balance and quality of water resources in the area. For instance, exposed waste rock dumps, mine pits, and heap leach pads have increased infiltration of surface water and reduced natural runoff. In addition, the type of surface has changed from undisturbed with low infiltration capability to highly porous disturbances of broken up rock and sediment. Water infiltrating through these surfaces is able to readily dissolve minerals and degrade water quality. Therefore, as a result of the topographic changes imposed by mining, seepage to groundwater has increased and the quality of water resources has decreased. Pit walls exposed by mine pit development have been shown to generate acid when contacted by surface water or groundwater seepage, increasing the potential for water quality degradation. The impacts to water resources resulting from mining operations are further explored in Section 4.2.

Irreversible commitments of geologic resources have occurred, particularly the removal of various minerals (clay, limestone, and precious metals) for gold and silver production, and facility construction and reclamation. The topographic modifications to disturbed areas are irretrievable impacts because the landscape cannot be returned to its pre-mining topography.

4.1.2.3 Geologic Hazards

There is little risk of failure due to seismic activity for facilities at the Zortman and Landusky mines. This assessment is based on the fact that the Little Rocky Mountains are situated in an area of low earthquake hazard. This means the likelihood of earthquakes occurring, and of those earthquakes to be of significant magnitude, is very low. Based on the probabilistic earthquake acceleration and velocity map for the United States (Algermisson *et al.* 1990), the Little Rocky Mountains are within the lowest risk area designated (Earthquake Zone 1). The National Geophysical and Solar Terrestrial Data Center of the National Oceanic and Atmospheric Administration conducted a search of recorded earthquakes within a radius of 200 miles of the mining area (Golder Associates 1992). The largest earthquake of record, with a Magnitude of 5, occurred in 1968 approximately 77 miles away (that is, the estimated distance of the earthquake loci or center to the Little Rocky Mountains). The horizontal acceleration at the Zortman Mine from this event would have been approximately 0.01 g, a unit expressing a percentage of the earth's gravitational pull. Three relatively recent earthquakes have occurred, ranging from 20 to 60 miles from the southern Little Rocky Mountains, all with a magnitude of 3 or less. Algermisson *et al.* (1982) report that the Little Rocky Mountains would have a 10% chance in 50 years of exceeding a 0.04 g acceleration due to earthquake. The low probability that an earthquake of sufficient magnitude to affect facilities at the mines will occur indicates that the facility failure risk due to earth shaking is low.

There are no known inherently unstable areas within the existing permit boundaries for either mine, although rockslides and landslides are always a potential hazard where steep slopes and ridges are common, such as in the interior of the Little Rocky Mountains. Pit walls have not been resloped or regraded, and are estimated to reside at a 1H:1V slope, with benches every 60 feet. The potential for pit wall weathering or rock spalling is significant at these slopes. Wall failure is dependent on factors such as the inherent competence of the rock, water seepage infiltration, freeze/thaw action, and joint and fracture patterns.

There is always a potential that an existing facility containing large quantities of ore and waste rock could cause earth movement as a result of load capacities exceeding the strength of the formation on which the facility is located. Overloading could result from earth movement or slumping, or less commonly an actual slip in the lithologic units (fracturing or faulting) usually influenced by water infiltration and saturation. Many of the waste rock facilities at the Zortman and Landusky mines were constructed by dumping unconsolidated materials, which would have a greater likelihood to settle and shift than constructed facilities. In addition, many of the facilities have been constructed or dumped at 2H:1V slopes or greater. The greater the slope angle, the greater the risk of failure. (See Figure 4.1-1 for an illustration of slope angles and grades, and to compare relative differences in final reclamation requirements.) However, there is no evidence that such an event is likely or probable at either mine; no facilities which have already been constructed and loaded to capacity have failed. Geotechnical studies were conducted to design existing facilities to standard engineering safety and stability factors. It is important to remember, though, that deep-seated instability is not always readily predictable or detected.

4.1.3 Impacts from Alternative 1

Geologic Resources: Impacts to geologic resources would be limited under this alternative to the currently permitted actions. Because no additional gold and silver mining would be permitted at either mine impacts to geologic resources would occur as a result of actions associated with facilities reclamation. The existing Zortman Mine permit does not require the use of clay or limestone in reclamation covers, so no additional disturbance would occur at the Seaford clay pit, and a limestone quarry would not be developed in the local area. No impact would occur. Limited clay and non-acid generating waste rock were required for reclamation of the Mill Gulch waste rock dump, Gold Bug waste rock repository, and 91 leach pad dike. No additional use for limestone and/or clay exists under this alternative for the Landusky Mine. Again, no additional impact would occur.

Topography: There would be no additional topographic impact at either mine under this alternative because no additional mining would be permitted and existing disturbances would be unaltered. Mine pits would remain at existing form, depth, and area of disturbance. Pit walls would remain at approximately 45 degree slopes. These topographic alterations would persist for a long duration until natural erosive forces reduce topographic relief.

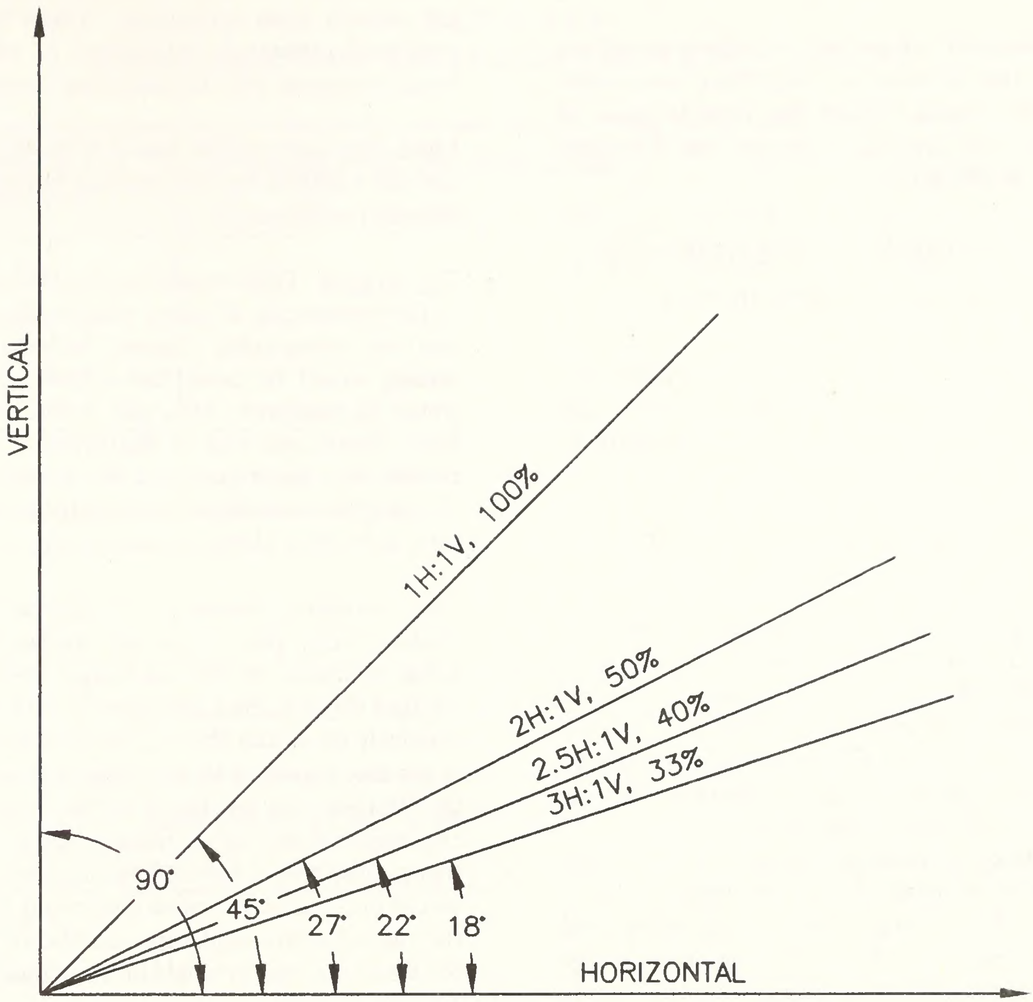
Geologic Hazards: Because no new mining would occur, and facilities would remain at essentially their current configuration, the concern over geologic hazards would be as described in Section 4.1.2.3 for the existing conditions. The potential for pit wall slumping or failure would be significant. Some facilities, particularly those constructed of unconsolidated materials at relatively steep slope angles, have the potential to move as materials settle and erode. Much of the exposed pit walls would be expected to continue to generate acid, as described in Section 4.2.3.

4.1.3.1 Cumulative Impacts

Cumulative impacts would be as described for the existing conditions since this alternative would result in no additional impact to geologic resources or topographic modifications, and there are no reasonably foreseeable future actions to increase impacts. Disturbance at the Seaford clay pit would remain at about 4.2 acres, and disturbance at the Williams clay pit would remain at about 26 acres. Disturbance at the King Creek limestone quarry would remain at about 3 acres. The cumulative impact to the topography in the Little Rocky Mountains would remain as current conditions. There would be no increase or decrease of risk associated with geologic hazards compared to present conditions, but there would remain an increased risk relative to baseline conditions. This increased risk above baseline conditions is a result of the creation of more and steeper cliff faces (mine highwalls) and placement of rock fill, in the form of waste rock facilities and leach pads, with less inherent stability than undisturbed ground. Cumulative, indirect effects to water quality resulting from topographic modifications are described in Section 4.2.3.

4.1.3.2 Unavoidable Adverse Impacts

There are no unavoidable adverse consequences to geologic resources predicted from this alternative. Existing topographic modifications would remain. Significant unavoidable adverse consequences to other resources such as water, soils, vegetation, and habitat would occur as an indirect result of these topographic alterations. These impacts are described in subsequent sections of this Chapter.



EXPLANATION: SHOWN ARE VARIOUS RECLAMATION SLOPES, GRADES AND ANGLES. THE FIRST NUMBER SHOWN ON EACH LINE IS THE SLOPE, GIVEN IN HORIZONTAL MEASUREMENT TO VERTICAL MEASUREMENT. FOR INSTANCE, 1 HORIZONTAL FOOT TO 1 VERTICAL FOOT. THE PERCENTAGE IS THE GRADE OF THE SLOPE. ANGLES ARE PRESENTED IN DEGREES OF CURVATURE.

RECLAMATION SLOPES, GRADES AND ANGLES

FIG. 4.1–1

173ERSGA

4.1.3.3 Short-term Use/Long-term Productivity

Long-term productivity of geologic resources would not be affected by this alternative. Significant and viable mineral deposits would remain for consideration of future mine ventures. Geologic resources would provide no short-term, beneficial use.

4.1.3.4 Irreversible or Irretrievable Resource Commitments

There are no additional irreversible or irretrievable commitments of geologic resources under this alternative. Resource commitments would remain as described in Section 4.1.2.2.

4.1.4 Impacts from Alternative 2

Geologic Resources: Impacts to geologic resources would be limited under this alternative to the currently permitted actions and mining of material needed for enhanced reclamation described in Section 2.6. Because no additional gold and silver mining would be permitted at either mine impacts to geologic resources would only occur as a result of actions associated with company-proposed facilities reclamation. All impacts associated with extraction of reclamation materials would occur in the near-term and be of short duration, extending until reclamation is completed. Table 4.1-1 summarizes the quantities of reclamation materials (other than cover soil, see Section 4.3) used for each mine.

The Seaford clay pit would be disturbed an estimated 3 additional acres to remove an estimated 242,000 yd^3 of clay for reclamation covers at the Zortman Mine. This estimate of clay used is based on the assumption that sulfur concentrations would exceed 0.5% at all waste rock facilities, leach pads, and mine pit exposures which have not already been reclaimed. These facilities, with a combined estimated disturbance of 300 acres, would require capping with Reclamation Cover A (see Section 2.6.2.2). It is assumed that facilities already reclaimed would not have sulfur concentrations in excess of 0.5% and would not need clay in the reclamation cover. This alternative does not include the use of limestone or other non-acid generating rock in reclamation covers, so a limestone quarry would not be impacted in the local area.

The Williams clay pit would be disturbed an estimated 6 additional acres to remove approximately 516,000 yd^3 of clay for reclamation covers at the Landusky Mine. This estimate is based on the assumption that sulfur concentrations would exceed 0.5% at all waste rock facilities, leach pads, and mine pit exposures which have not already been reclaimed. These facilities, with a combined estimated disturbance of 640 acres, would require capping with Reclamation Cover A.

Limestone and suitable non-acid generating waste rock are not required for reclamation at either Mine under this alternative.

Topography: There would be no additional modification to the topography of either mine under this alternative and no topographic impact, because no additional mining would be permitted and existing disturbances would be unaltered. Mine pits would remain at existing form, depth, and area of disturbance. Pit walls would remain at approximately a 45 degree slope. These topographic alterations would persist for a very long time as erosion slowly reduces topography.

Some additional mining would occur at the Seaford and Williams clay pits to provide reclamation materials. Little alteration of the landscape would occur at the Seaford clay pit, since the amount of clay to be mined is relatively small and the site has already been disturbed. A greater degree of topographic impact would occur at the Williams clay pit, based on the estimated volume of clay required and the resultant disturbance. Impacts to topography would be of long duration. Reclamation would limit natural erosive forces and therefore reduce the rate of future landscape modification. The road to the limestone quarry would be reclaimed to approximate original contour.

Geologic Hazards: Because no new mining would occur, and facilities would remain at essentially their current configuration, the concern over geologic hazardous would be as described in Section 4.1.2.3 for the existing conditions. The potential for pit wall slumping or failure would be significant. Some facilities, particularly those constructed of unconsolidated materials at relatively steep slope angles, have the potential to move as materials settle and erode. Much of the exposed pit walls would be expected to continue to generate acid, as described in Section 4.2.3.

4.1.4.1 Cumulative Impacts

No reasonably foreseeable actions are anticipated which would increase the impacts to geologic and topographic resources from this alternative, although future mining is not precluded by this alternative. Cumulative effects would result from the added impacts noted above to the

TABLE 4.1-1
RECLAMATION MATERIALS FOR ALTERNATIVE 2

Alternative 2 Resources	Additional Acres New Disturbance			Cubic Yards of Material		
	Zortman	Landusky	Total	Zortman	Landusky	Total
Clay	3	6	9	242,000	516,000	758,000
Limestone	0	0	0	0	0	0
Non-Acid Generating[1]	---	---	---	0	0	0

[1] Materials in this category would probably consist of waste rock which meets the non acid generating criteria for this alternative, as described in Section 2.6.2.

TABLE 4.1-2
RECLAMATION MATERIALS FOR ALTERNATIVE 3

Alternative 3 Resources	Additional Acres New Disturbance			Cubic Yards of Material		
	Zortman	Landusky	Total	Zortman	Landusky	Total
Clay[1]	0	0	0	0	0	0
Limestone[1,2]	0	0	0	0	0	0
Non-Acid Generating[3]	65	0	65	750,000	1.7 million	2.45 million

[1] Some clay and limestone could be required for use in water management systems, such as capture ponds and drains. Impacts to borrow sources would be minimal and have not been estimated.

[2] Limestone may be used in capillary break of the reclamation covers required by Alternative 3 as long as it is not placed directly on top of GCL. This is because direct contact with calcium carbonate-laden solution can increase the GCL permeability. However, other sources should provide sufficient quantities such that limestone is not required.

[3] Materials in this category would consist of material which meets the non acid generating criteria for this alternative, as described in Sections 2.7.2.1 and 3.1.8. These may include limestone, waste rock, gravels from Goslin Flats, subsoils or historic mine tailing. Note that under this alternative no new waste rock would be generated, but waste from existing facilities such as the Montana Gulch dump could be used if the geochemical criteria are met.

Seaford and Williams clay pits. Total disturbance at the Seaford clay pit from past and current mining would be 7.3 acres. Total disturbance at the Williams clay pit from past and current activities would be 32 acres. Disturbance at the King Creek limestone quarry would remain at about 3 acres.

The cumulative impact to the topography in the Little Rocky Mountains would remain as current conditions. There would be no increase or decrease of risk associated with geologic hazards compared to present conditions, but there would remain an increased risk relative to baseline conditions. Cumulative, indirect effects to water quality resulting from topographic modifications are described in Section 4.2.4.

4.1.4.2 Unavoidable Adverse Impacts

The disturbances of geologic resources at the Seaford and Williams clay pits are an unavoidable consequence of mining these reclamation materials. Topographic modifications at the Seaford and Williams clay pits would also be unavoidable. Significant unavoidable adverse consequences to other resources such as water, soils, vegetation, and habitat would occur as an indirect result of the topographic alterations. These impacts are described in subsequent sections of this Chapter.

4.1.4.3 Short-term Use/Long-term Productivity

The geologic resources used under this alternative would provide a limited beneficial short-term use as reclamation materials to protect other environmental resources such as surface water and groundwater. Long-term productivity of geologic resources would not be affected. Significant and viable deposits of gold, silver, clay and limestone would remain for consideration of future mine ventures.

4.1.4.4 Irreversible or Irretrievable Resource Commitments

Removal of clay for use in reclamation covers constitutes an irretrievable commitment of resources. Because these resources are available locally and regionally in essentially unlimited quantities, the impact is not significant. Other resource commitments would remain as described in Section 4.1.2.2.

4.1.5 Impacts from Alternative 3

Geologic Resources: Impacts to geologic resources would be limited under this alternative to the currently permitted actions and agency-mitigated reclamation procedures as described in Section 2.7. Because no additional gold and silver mining would be permitted at either mine, impacts to geologic resources would occur as a result only of actions associated with facilities reclamation. All impacts associated with extraction of reclamation materials would occur in the near-term and be of short duration, extending until reclamation is completed. Table 4.1-2 summarizes the quantities of reclamation materials (except for topsoil and subsoils, see Section 4.3) used for each mine.

The most significant modifications incorporated into Alternative 3 are the use of water balance and water barrier reclamation covers for most facilities and backfilling of pits to free-draining levels. These covers rely on subsoil and/or non-acid generating rock layers beneath the topsoil to provide greater evapotranspiration and vegetative root development. A geosynthetic clay liner is used as a water barrier instead of clay or plastic. These reclamation covers, described in Section 2.7.2.2, were developed in an attempt to increase the potential for successful surface reclamation at the mines, while at the same time decreasing overall environmental impact to other resources. One result of this modification is a decrease in impact to geologic resources and topography, particularly at the clay pits because clay is not a component of the covers used in this Alternative. Clay pits would only be used if needed in construction of capture ponds and drainage ditches. However, the use of these covers would also result in new disturbance to Goslin Flats to provide subsoils and possibly non-acid generating materials.

A suitable non-acid generating material is required for those facilities which would be capped with water balance or water barrier covers, and also for pit benches. The following acres of disturbance would require reclamation with the appropriate reclamation cover at the two mines:

Zortman Mine

• Water Balance Covers	163 acres
• Water Barrier Covers	94 acres
• Pit Benches	25 acres
• Non-Acid Areas	58 acres
• Total	340 acres

Landusky Mine
- Water Balance Covers 267 acres
- Water Barrier Covers 243 acres
- Pit Benches 59 acres
- Non-Acid Areas 146 acres
- Total 715 acres

[Regarding the above acreages, it is important to note that all disturbances at the mines would be reclaimed, in accordance with the Montana Metal Mine Reclamation Act. However, not all disturbances, such as land application disposal areas, require the use of additional reclamation cover material. Therefore, the acres of disturbance to be covered with additional reclamation material do not add up to the total anticipated acres of disturbance at each mine.]

As shown on Table 4.1-2, approximately 750,000 yd^3 of non-acid generating material would be required for reclamation of Zortman Mine facilities, and 1.7 million yd^3 of non-acid generating material would be required for reclamation of the Landusky Mine facilities. Non-acid generating material for Zortman Mine reclamation would come from removal and use of the Ruby Gulch tailing, and new disturbance at Goslin Flats to produce topsoil, subsoils, and gravel for use in reclamation covers. Other sources for Zortman Mine materials could include non-acid generating waste rock from existing facilities or limestone from the outcrop at LS-2, west of the town of Zortman in the existing mine permit area. If the Goslin Flats is used as a borrow source for gravels and other materials, up to 65 new acres of disturbance could occur to provide the needed volume of non-acid generating material. (Note that more disturbance, up to 250 acres total, including the above 65 acres, could occur at Goslin Flats to provide the needed volumes of subsoils and topsoil. See Section 4.3.5 for more information.)

Suitable material for Landusky Mine reclamation could be obtained from a variety of sources, including existing stockpiles of non-acid generating waste rock, suitable waste rock from removal of the Montana Gulch dump, the August No. 2 waste rock dump, or limestone from a quarry in Montana Gulch within the existing permit boundary. No new disturbance outside the current permit boundary would occur to provide non-acid generating materials for the Landusky Mine reclamation.

Topography: There would be some minor modification to the topography of both mines, resulting from implementation of this alternative. Modifications would result from partial backfilling of the Zortman pit with waste rock and spent ore to approximately the 4,900 foot level. The Landusky pits would be backfilled to about the 4,740 foot level. Pit walls would remain at approximately a 45 degree slope. Resloping of spent ore heaps and waste rock facilities to a 3H:1V slope would alter the landforms by reducing angles and enlarging facility footprints. The drainage cutout at the Landusky pit would create a V-shaped notch approximately 120 feet deep at the greatest extent so as to reach the level of the backfill in the pit and create a free-draining surface to Montana Gulch. An acceptable alternative action would be to increase the extent of backfill in the Landusky pit. The depth of the drainage notch is proportionately reduced the higher the floor is raised in the pit. Other advantages of increasing the pit backfill include a thicker cover on potentially acid generating pit benches. These topographic changes would persist a very long time as natural erosive forces slowly reduce topography.

No new disturbance for reclamation materials would occur at clay pits, except minor amounts which may be needed to construct water management systems. Limestone would probably not be required for use in reclamation covers since other sources exist which could more easily be obtained. Therefore, the only disturbance at limestone quarries would also be for materials used in water management systems (for example, underdrains, passive treatment systems, etc.). Limestone quarries would be located within existing permit boundaries.

Geologic Hazards: The risk to Zortman and Landusky mine facilities from geologic hazards would be reduced from those presented under Alternatives 1 or 2. The reduction in risk is a result of particular reclamation mitigations. Flattening of waste rock facility and ore heap slopes would increase stability and thus reduce the potential for these facilities to move laterally by gravity or settlement, or to fail catastrophically as a result of foundation failure. Mine pit and limestone quarry wall slopes would not be flattened, but requirements to cover and revegetate benches could help reduce other, indirect effects such as the formation of acid drainage.

The increased thickness of reclamation covers on pit benches at both mines would reduce adverse indirect impacts. For instance, surface water would have less contact with potentially acid generating surfaces of pit walls and benches, and impacts to water quality would be reduced. These impacts are more fully assessed in subsequent sections of this Chapter.

4.1.5.1 Cumulative Impacts

No reasonably foreseeable actions are anticipated which would increase the impacts to geologic and topographic resources, although future mining is not precluded by this alternative. Cumulative effects would result from new disturbance at Goslin Flats, estimated at 65 acres to retrieve sufficient amounts of gravel (about 650,000 yd^3) for use in Zortman Mine reclamation covers. Disturbance at the Seaford and Williams clay pits would remain at 4.2 and 26 acres, respectively, unless minor amounts of clay are used in water management systems. No additional disturbance would occur at the King Creek quarry north of the Landusky Mine, and cumulative disturbance would remain at about 3 acres. Some new disturbance for water management systems could occur at the LS-2 and Montana Gulch limestone sites on the Zortman and Landusky mines sites, but limestone should not be required for use in the reclamation covers. These new disturbances would represent cumulative disturbance as well, since these sites have not yet been accessed for limestone.

The cumulative impact to the topography in the area of the Zortman and Landusky mines would be altered somewhat as a result of reclamation activities. Topographic impacts would occur primarily from the reduction in sideslopes of spent ore heaps and waste rock facilities, backfilling of mine pits, and the drainage notch created at the Landusky Pit leading to Montana Gulch.

Overall, the topographic modifications would result in increased risks of slope failure compared to baseline conditions. The cumulative effect of more protective reclamation covers and pit bench reclamation would be to lessen adverse indirect impacts to water quality and quantity.

4.1.5.2 Unavoidable Adverse Impacts

The disturbance of geologic resources at Goslin Flats is an unavoidable consequence of mining these reclamation materials. Topographic modifications at Goslin Flats would be unavoidable. However, this modification would consist essentially of lowering an already relatively flat surface across the entire 65 acres. The contrast would not be significant in the long term.

4.1.5.3 Short-term Use/Long-term Productivity

The geologic resources used under this alternative would provide a beneficial short-term use as reclamation materials to protect other environmental resources such as surface water and groundwater. Long-term productivity of geologic resources could be affected, as follows. A significant and viable mineral deposit is proven to exist in deeper zones below the Zortman and Landusky Mine pits. Pit backfilling would place a significant load of "waste rock" on top of these deposits. In the case of the Zortman Mine pit, an estimated 11 million tons of material would be backfilled. This material would have to be removed for a future mine operation to access deeper ore reserves, adding significant, possibly prohibitive startup costs to any new mine venture.

4.1.5.4 Irreversible or Irretrievable Resource Commitments

Removal of gravels from the Goslin Flats site, and limestone if needed, for use in reclamation covers constitutes an irretrievable commitment of resources. Because these resources are available locally and regionally in essentially unlimited quantities, the impact is not significant. If pit backfill effectively prohibits future mining it could result in an economically irreversible loss of the precious metal deposits. Other resource commitments would remain as described in Section 4.1.2.2.

4.1.6 Impacts from Alternative 4

Geologic Resources: Impacts to geologic resources would be based on the activities associated with expansion of the Zortman and Landusky mines and ZMI's proposed reclamation procedures for new and existing disturbances. These activities were described in Section 2.8. Approximately 80 million additional tons of ore and 60 million additional tons of waste rock would be generated at the Zortman Mine. Approximately 7.6 million tons of ore and 7 million tons of waste rock would be generated at the Landusky Mine. Assuming an average content of 0.020 ounces of gold per ton of ore, and a historic recovery efficiency of 55% of the gold present, approximately 960,000 ounces of gold would be produced. For reference, only about 1.7 million ounces of gold have been produced from the Little Rockies Mining District during it's entire history of mining. ZMI and its predecessors has produced about 75% of that total. All impacts associated with mine expansion and extraction of reclamation materials would occur in the near-term and be of short duration, extending until reclamation is completed.

Table 4.1-3 summarizes the quantities of construction and reclamation materials (except for cover soil, see Section 4.3) used for each mine.

TABLE 4.1-3
RECLAMATION AND CONSTRUCTION MATERIALS FOR ALTERNATIVE 4[1]

Alternative 4 Resources	Additional Acres New Disturbance			Cubic Yards of Material		
	Zortman	Landusky	Total	Zortman	Landusky	Total
Clay	10	7	17	1.17 million	650,000	1.82 million
Limestone	13	3	16	741,000	35,000	776,000
Non-Acid Generating[2]	---	---	---	2.9 million	2.0 million	4.9 million

1 Estimates prepared by Zortman Mining Inc. for application for mine permit amendment.

2 Materials in this category would consist of waste rock which meets the non acid generating criteria for this alternative, as described in Section 2.8.1.1. Most of the Landusky waste rock would have to come from existing facilities, suitable waste rock generated at the Zortman Mine, or a limestone quarry as there would be little waste rock generated during new mining at the Landusky Mine which meets the geochemical classification criteria.

TABLE 4.1-4
RECLAMATION AND CONSTRUCTION MATERIALS FOR ALTERNATIVE 5

Alternative 5 Resources	Additional Acres New Disturbance			Cubic Yards of Material		
	Zortman	Landusky	Total	Zortman	Landusky	Total
Clay	11.5	9	20.5	1.12 million	786,000	1.9 million
Limestone	14	3	17	790,000	35,000	825,000
Non-Acid Generating[1]	---	---	---	1.09 million	1.60 million	2.69 million

1 Materials in this category would probably consist of waste rock which meets the non acid generating criteria for this alternative, as described in Section 2.9.2.1. Landusky waste rock would have to come from existing facilities, suitable waste rock generated at the Zortman Mine, or a limestone quarry as there would be no waste rock generated during new mining at the Landusky Mine which meets the geochemical classification criteria.

The resource requirements listed in Table 4.1-3 were developed by ZMI as part of the mine permit amendment applications for the Zortman and Landusky mines. ZMI would use clay in construction of the Goslin Flats heap leach pad and for facilities reclamation. The Seaford clay pit would provide approximately 347,000 yd^3 of clay for liner construction and 800,000 yd^3 of clay for reclamation covers. The Williams clay pit would be disturbed to remove approximately 650,000 yd^3 of clay for reclamation covers. Impacts to clay resources at both sites are low.

For the Zortman Mine expansion and reclamation, this analysis assumes that all clay would be mined at the Seaford pit. The Thermopolis Shale is present in large volumes near the surface at the site of the proposed leach pad at Goslin Flats, but clay from this source may not be usable in reclamation because of high sulfide concentrations.

Reclamation materials for Alternatives 1 through 3 were estimated based on the assumption that suitable non-acid generating (NAG) waste may not be available for use as capillary break in reclamation covers. However, this alternative includes expanded mining activities at both the Zortman and Landusky mines, and a program by ZMI to characterize waste rock generated during mining activities which could be used in reclamation covers. As a result, it is assumed that all material used for capillary break in reclamation covers would come from new waste rock generated during mining activities, or from existing waste rock dumps which have suitable quality material. Off-site mining of suitable capillary break material would probably not be necessary.

Approximately 741,000 yd^3 of limestone would be used for construction or reclamation of the Goslin Flats leach pad at the Zortman Mine. Limestone for the Zortman Mine would come from approximately 13 acres of disturbance at a new quarry, LS-1, developed just northwest of Shell Butte. ZMI has estimated that only 35,000 yd^3 of limestone would be required for reclamation of Landusky Mine facilities. This material would come from approximately 3 additional acres of disturbance at the King Creek quarry. Total disturbance at this quarry from past and proposed mining operations would be 6 acres.

Suitable NAG waste rock is required for those facilities which would be capped with Reclamation Covers B or C. ZMI has estimated that 2.9 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Zortman Mine. This material represents approximately 3.2% of the total waste rock volume that would be generated during expanded mining operations, and an estimated 34% of the suitable waste rock (NAG, or "Blue Waste") that would be produced. In other words, based on ZMI's proposed definition of NAG waste, sufficient quantities should be available for use in reclamation covers.

ZMI has estimated that 2.0 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Landusky Mine. This material represents approximately 30% of the total waste rock volume that would be generated during expanded mining operations at this mine. However, ZMI has estimated that only 220,000 yd^3 of NAG waste would be produced during expanded mining operations. This represents a shortfall in reclamation materials which would have to be made up from existing waste rock stockpiles, increased use of limestone in reclamation covers, and/or the use of suitable waste produced during the Zortman Mine expansion.

The heap leach pad would be constructed on Goslin Flats, an open area south of the town of Zortman where Ruby Creek and other ephemeral drainages come together. The decrease in gradient at this location has led some prospectors to speculate that gold could be present in minable quantities in placer deposits on the Flat. The potential for this area to contain gold, and for the Goslin Flats leach pad to cover or displace placer deposits, was evaluated by Onstream Resource Managers, Inc. (1993). Data collected and documented in this reference provides evidence that gold is present in alluvial deposits at Goslin Flats in concentrations greater than those typically found in the earth's crust. However, the highest concentrations of assays done for samples from Goslin Flats are well below the lowest grade of gold placer deposit which is being commercially mined today. In addition, the samples with the highest grades are from an area which would not be affected by the Goslin Flats leach pad and supporting facilities. There would be no significant impact to mineral resources of any value by construction and operation of a heap leach pad on Goslin Flats.

Topography: There would be some modification to the topography of both mines resulting from implementation of this alternative. Expanded mining operations would create larger and deeper mine pits at both facilities. As seen on Figure 2.8-5, ZMI has projected that mining in the Zortman pit complex would extend the pit depth over 400 feet, to below 4,600 feet msl. Partial backfilling to facilitate drainage would create a final pit floor elevation of approximately 4,800 feet msl.

Figure 2.8-8 in Chapter Two illustrates the modifications which would occur at the Landusky Mine. Continued mining would extend the pit depth another 200 feet or more in some areas, to approximately 4,500 feet msl. Approximately 20 more acres would be disturbed. ZMI would partially backfill the Landusky pit complex to the 4,600 foot level to facilitate drainage to the August drain tunnel, which discharges into Montana Gulch.

Some additional mining would occur at the Seaford and Williams clay pits, and King Creek limestone quarry to provide reclamation materials. New disturbance would occur at LS-1, the proposed site to quarry limestone for the Zortman Mine. Approximately 10 acres would be disturbed at the Seaford Clay pit. This disturbance would be greater than that anticipated under the first three alternatives. Approximately 7 acres would be disturbed at the Williams Clay pit. This disturbance would be greater than projected for Alternatives 1 or 2, and much more than projected for Alternative 3.

The topographic modification at LS-1, the proposed limestone quarry for the Zortman Mine, would be significant because it would represent a new disturbance of about 13 acres and alteration of the landscape. The topographic impact to the King Creek quarry would, however, be minimal. Roads to limestone quarries would be reclaimed to approximate original contour. These topographic changes would persist a very long time as natural erosive forces slowly reduce topography. Reclamation would limit natural erosive forces and therefore reduce the rate of future landscape modification.

Two new major facilities would be constructed which would impact the area topography. A waste rock repository constructed in Carter Gulch would modify the existing shape in this area by filling in the upper portions of this valley. The increase in surface elevation of approximately 450 feet would occur in the repository center, which would change from 4,600 feet msl to 5,050 msl. The Goslin Flats leach pad would create a new landform up to 140 feet above the existing landscape. Both actions represent a significant direct impact to existing topography. Impacts to visual resources associated with these landscape alterations are described in Section 4.8. The new ore conveyor system extending from the mine area to Goslin Flats would result in some disturbance along its route, but there would be no significant topographic alteration. The visual impacts from this facility are also described in Section 4.8.

Geologic Hazards: The risk to Zortman and Landusky mine facilities from geologic hazards would be low, and relatively lower than the risks for Alternatives 1 or 2, but higher than that presented by Alternative 3. The difference stems primarily from reclamation provisions to reslope existing waste rock facilities and ore heaps. This alternative only calls for resloping of some but not all facilities (new and existing) to 3H:1V where topography allows, to meet specific design criteria for stability, and where the reslope would not result in material being pushed into drainage areas. Therefore, some facilities would continue to have slopes steeper than 3H:1V, and up to 2H:1V. Facilities remaining at these steeper slopes would not be considered unstable or a high failure risk, but slope reduction does reduce the potential for failure.

The Goslin Flats leach pad would be designed to meet or exceed all standard engineering safety factors. The facility would be located in an area which is not known to have been affected by rockslides or other mass wasting events. The fairly level terrain of Goslin Flats suggests the potential for leach pad movement is low. The geologic units underlying the surface dip gently, further reducing the potential for slip between different lithologies. However, gentle slopes of the geologic formations do not preclude a slip failure. Slip planes of 8% are present at the Golden Sunlight Mine near Whitehall, Montana, where significant mass movement occurred on historic landslide surfaces.

The geology of Goslin Flats area does provide for easier containment and management of leach pad solution if leaks develop, such as through liner rupture. Some of the underlying lithologies have a significant natural carbonate content, which would help to buffer acidic drainage. The underlying shales would provide relatively tight, impermeable boundaries to downward migration of leachate. A solution recovery system using pumpback wells or trenches would be technically feasible to implement. Similar pumpback well systems are currently operating at the Montana Tunnels Mine near Jefferson City, Montana and the Golden Sunlight Mine, thereby demonstrating not only the ability of such systems to work but the real potential for leaks to develop.

4.1.6.1 Cumulative Impacts

Reasonably foreseeable actions which would increase the cumulative impacts to geologic and topographic resources are limited to new mining operations and exploration activities. The upgraded and new powerline which would be constructed from Malta to Goslin Flats would not be expected to significantly impact geologic resources or topography. All of these potential developments were described in Section 2.8.4. Cumulative impacts from these developments, combined with past and present impacts and effects caused by implementation of Alternative 4, are summarized here.

Two million tons of ore could be mined at the Pony Gulch deposit. This action would raise the ore total mined at the Zortman Mine up to about 102 million tons. It is reasonably foreseeable that another 12.2 million tons of ore would be mined from pits at the Landusky Mine, raising the total ore removed from this operation to about 136 million tons. New or expanded ore processing and waste rock storage facilities would have to be prepared to accommodate the above developments. It is likely that these actions would take place on already permitted ground, but there would be some resultant landscape alteration. Impacts due to open pit mining in a previously undisturbed or little disturbed area would be significant.

Additional construction and reclamation materials would also be required for these developments, thereby increasing disturbances at the Seaford and Williams clay pits, and the King Creek and LS-1 limestone quarries. Alternative 4 implementation would raise the total disturbance from past and proposed mining at the Seaford pit to about 14.2 acres. Total disturbance from this alternative combined with past mining at the Williams pit would be about 33 acres. Total disturbance at the King Creek quarry from past, proposed and reasonably foreseeable development activities would be 10 acres. A new limestone source, with a disturbance of up to 7 acres, could be developed for reasonably foreseeable Landusky mine expansions. Total disturbance at the LS-1 quarry would be the 13 acres associated with Alternative 4 activities.

The cumulative impact to the topography in the area of the Zortman and Landusky mines would be altered as a result of new and reasonably foreseeable reclamation activities. Approximately 10 million tons of waste rock would be backfilled to the Zortman pit, resulting in a final pit floor elevation of approximately 4,850 feet msl. Approximately 1 million tons of waste rock would be backfilled to the Landusky pit, resulting in a final pit floor elevation of 4,600 feet msl. Some spent ore heaps and waste rock facilities would be reduced in slope.

Mine exploration activities are also reasonably foreseeable, as described in Section 2.8.4.3. Approximately 128 acres of disturbance could occur for road construction, drill pad development, and exploration trenches. Exploration disturbances would be reclaimed and impacts should not be significant.

Overall, the topographic modifications would result in increased risks of slope failure compared to baseline conditions. Nevertheless, significant impacts would occur to environmental resources in the event of facility failure. The cumulative effect of more protective reclamation covers and pit bench reclamation would be to lessen adverse indirect impacts to water quality, as described in Section 4.2.6.

4.1.6.2 Unavoidable Adverse Impacts

The disturbances of geologic resources at the Seaford and Williams clay pits, and King Creek and LS-1 limestone quarries are an unavoidable consequence of mining these reclamation materials. Topographic modifications in the mine areas, and at the Seaford and Williams clay pits, and King Creek and LS-1 limestone quarries would be unavoidable.

4.1.6.3 Short-term Use/Long-term Productivity

The geologic resources used under this alternative would provide a beneficial short-term use as reclamation materials to protect other environmental resources such as surface water quality. Long-term productivity of geologic resources would not be affected.

4.1.6.4 Irreversible or Irretrievable Resource Commitments

Removal of clay and limestone for use in reclamation covers constitutes an irretrievable commitment of resources. Because these resources are available locally and regionally in essentially unlimited quantities, the impact is not significant. Removal of gold and silver from the ore deposits is a significant and irretrievable commitment of resources. The increased pit disturbances are additional, irretrievable commitments of resources.

4.1.7 Impacts from Alternative 5

Geologic Resources: Impacts to geologic resources would be based on the activities associated with expansion of the Zortman and Landusky mines and the agencies' expansion modifications and reclamation mitigations. Modifications and mitigations to ZMI's proposed mine operations were described in Section 2.9. These modifications do not impact the type and amount of ore and waste rock generated during mine operations, as summarized in Section 4.1.6. All impacts associated with mine expansion and extraction of reclamation materials would occur in the near-term and be of short duration, extending until reclamation is completed. Table 4.1-4 summarizes the quantities of construction and reclamation materials (except for cover soil, see Section 4.3) used for each mine.

This Alternative would require the use of Reclamation Covers A, B, and Modified C. The following acres of disturbance would require reclamation with the appropriate reclamation cover at the two mines:

Zortman Mine

• Reclamation Cover A	210 acres
• Reclamation Cover B	365 acres
• Modified Cover C	120 acres
• Total	695 acres

Landusky Mine

• Reclamation Cover A	320 acres
• Reclamation Cover B	180 acres
• Modified Cover C	150 acres
• Total	650 acres

[Regarding the above acreages, it is important to note that all disturbances at the mines would be reclaimed, in accordance with the Montana Metal Mine Reclamation Act. However, not all disturbances, such as land application disposal areas, require the use of additional reclamation cover material. Therefore, the acres of disturbance to be covered with additional reclamation material do not add up to the total anticipated acres of disturbance at each mine.]

These estimates are based on the assumption that sulfur concentrations would exceed 0.5% at the footprints of removed waste rock facilities and leach pads. The acres requiring reclamation include existing disturbances and new disturbances resulting from implementation of Alternative 5.

Clay would be used in construction of the Upper Alder Gulch heap leach pad. Approximately 300,000 yd^3 of clay would be needed for liner construction. The Seaford clay pit would also be disturbed to remove an estimated 820,000 yd^3 of clay for reclamation covers. Total disturbance to the Seaford clay pit from this alternative would be 1.12 million yd^3 of clay removed. The Williams clay pit would be disturbed to remove approximately 786,000 yd^3 of clay for reclamation covers.

Limestone or suitable NAG waste rock is required for those facilities which would be capped with Reclamation Covers B or Modified C. This analysis indicates that slightly more limestone would be required for construction and reclamation of the Upper Alder Gulch leach pad than for the Goslin Flats leach pad presented in Alternative 4. Approximately 790,000 yd^3 of limestone would be used for reclamation of the Upper Alder Gulch leach pad (with the remainder of the capillary break material in this facility composed of suitable NAG waste rock). Limestone for the Zortman Mine would come from approximately 14 acres of disturbance at a new quarry, LS-1, developed just northwest of Shell Butte. Limestone requirements for reclamation of the Landusky Mine would be as described in Alternative 4 with almost no impact to limestone resources. About 35,000 yd^3 of limestone would be required for reclamation of Landusky Mine facilities. This material would come from approximately 3 additional acres of disturbance at the King Creek quarry.

Approximately 1.09 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Zortman Mine. This material represents approximately 1.3% of the total waste rock volume that would be generated during expanded mining operations, and an estimated 31% of the suitable, non-acid generating waste rock that would be produced using the more restrictive geochemical characterization program (see Section 2.7.2.1). Sufficient quantities should be available for use in reclamation covers.

It is estimated that 1.6 million yd^3 of suitable NAG waste would be needed as capillary break in reclamation covers for the Landusky Mine under this Alternative. This material represents approximately 23% of the total waste rock volume that would be generated during expanded mining operations at this mine. However, it is assumed that no waste rock generated during expanded mine operations at Landusky would be suitable for use in reclamation covers, based on projected lithologies developed and the more restrictive geochemical classification program. There would be a shortfall in reclamation materials which would have to be made up from existing waste rock stockpiles, material derived from the fill removal at the head of King Creek, increased use of limestone in reclamation covers, and/or the use of suitable waste produced at the Zortman Mine expansion.

Topography: There would be some modification to the topography of both mines resulting from implementation of this alternative. Expanded mining operations would create larger and deeper mine pits at both facilities. As seen on Figure 2.8-5, ZMI has projected that mining in the Zortman pit complex would extend the pit depth over 400 feet, to below 4,600 feet msl. This alternative would require backfilling of the Zortman pit with 9 million tons more of spent ore, tailings, and waste rock, combined with ZMI's scheduled 6 million tons, to bring the final pit floor elevation to 4,900 ft msl or higher. As described in Section 4.2.7, this action would indirectly benefit water quality by creating a free draining surface and reducing the amount of surface water infiltration through the pit floor.

Figure 2.8-8 in Chapter Two illustrates the modifications which would occur at the Landusky Mine. Continued mining would extend the pit depth another 200 feet or more in some areas, to approximately 4,500 feet msl. This alternative would require ZMI to backfill the Landusky pit complex to an elevation of 4,850 feet msl or higher. This action would require the use of approximately 14.0 million tons of spent ore, waste rock, or other material as backfill. Another modification would result from the removal of rock fill at the head of King Creek to allow for freely flowing pit drainage into this surface water system. This would restore flow to the natural pre-mining drainage, an impact discussed in Section 4.2.7.

Some additional mining would occur at the Seaford and Williams clay pits, and King Creek limestone quarry to provide reclamation materials. New disturbance would occur at LS-1, the proposed site to quarry limestone for the Zortman Mine. About 11.5 acres would be disturbed at the Seaford clay pit. This disturbance would be greater than that anticipated under the first four alternatives. About 9 acres would be disturbed at the Williams clay pit. This disturbance would be greater than that anticipated under the first four alternatives.

The 14 acre disturbance at LS-1, the proposed limestone quarry for the Zortman Mine, would be significant because it would represent a new disturbance and alteration of the landscape. However, the topographic impact to the King Creek quarry would be minimal, as described under Alternative 4. Roads to limestone quarries would be reclaimed to appropriate original contour. Impacts to topography would persist for a very long time as erosion slowly reduces topography. Reclamation would limit natural erosive forces and therefore reduce the rate of future landscape modification.

Two new major facilities would be constructed which would impact the area topography. The topographic change caused by construction of a waste rock repository in Carter Gulch was described in Section 4.1.6. A new heap leach facility would be constructed in the Upper Alder Gulch. A conceptual design of this facility indicates it would extend for over 3,000 feet along the valley and raise the valley floor (i.e, the final surface of the leach pad) by more than 400 feet at its greatest thickness. Although there has been mining disturbance in Alder Gulch, the size and extent of the new facility would create a significant topographic impact. Impacts to visual resources associated with these landscape alterations are assessed in Section 4.8.

Geologic Hazards: Risks from geologic hazards would be relatively comparable to those described for Alternative 3. Facilities would be designed to accepted standards of engineering safety. More stable facilities would result from this alternative's modified reclamation requirement to reslope all waste rock facilities and heap leach pads to no more than a 3H:1V slope. The slope flattening on these facilities would decrease the potential for facility settlement or movement.

The Upper Alder Gulch heap leach pad design described in Section 2.9.1 calls for a constructed heap slope of 3H:1V, which would withstand any foreseeable ground movements. These facilities would be constructed on bedrock so that the risk of failure in the underlying lithologies should be low. The Upper Alder Gulch area is more susceptible to rockslides and slumps off the steep valley walls than facilities in areas like Goslin Flats. The steep terrain of the Upper Alder Gulch would create difficulties in foundation preparation and liner installation. There would be a greater potential for slippage between the clay and synthetic layers of the leach pad liner. Also, solution control and corrective action in the Upper Alder Gulch site would be more difficult to implement than on Goslin Flats.

However, placement of the leach pad on bedrock raises the potential to create other problems. Bedrock at the Upper Alder Gulch location is probably mineralized and possibly contains a significant amount of sulfide minerals. Exposure of the bedrock to the atmosphere, even briefly, and infiltration water could create the potential for generation of acid rock drainage. Once the leach pad is constructed on the bedrock surface, it would be difficult to mitigate new ARD without facility removal.

Alternative 5 incorporates a mitigation to increase the clay thickness in Reclamation Cover C from 3 inches to a minimum of 6 inches when compacted. This cover modification would increase the performance capabilities and reduce the potential for cover failure.

4.1.7.1 Cumulative Impacts

Reasonably foreseeable actions which would increase the cumulative impacts to geologic and topographic resources are limited to new mining operations and exploration activities. These were described in Section 2.9.4. The upgraded and new powerline which would be constructed from Malta to the Zortman Mine area would not be expected to significantly impact geologic resources or topography. Cumulative impacts from these developments, combined with past and present impacts and effects caused by implementation of Alternative 5, are summarized here.

No additional mining would be immediately foreseeable at the Zortman Mine. It is reasonably foreseeable that another 12.2 million tons of ore would be mined from existing pits at the Landusky Mine, raising the total ore removed from this operation to about 136 million tons. New or expanded ore processing and waste rock storage facilities would have to be prepared to accommodate this development. It is likely that this action would take place on already permitted ground, but there would be some resultant landscape alteration. The cumulative impact to the topography in the area of the Zortman and Landusky mines would be altered as a result of new and reasonably foreseeable reclamation activities. However, this significant impact results from the past, present, and Alternative 5 disturbances; the reasonably foreseeable action does not substantively add to the impact significance.

Additional construction and reclamation materials would also be required for these developments, thereby increasing disturbances at the Seaford and Williams clay pits, and the King Creek and LS-1 limestone quarries. This action would raise the total disturbance from past and proposed mining at the Seaford pit to about 15.7 acres. Total disturbance from this alternative combined with past mining at the Williams pit would be about 35 acres. Total disturbance at the King Creek quarry from past and current activities would be 10 acres. A new limestone source, with a disturbance of up to 7 acres, could be developed for reasonably foreseeable Landusky mine expansions. Total disturbance at the LS-1 quarry would be the 14 acres associated with Alternative 5 activities, primarily the use of limestone in leach pad reclamation.

Overall, the topographic modifications would result in increased risks of slope failure compared to baseline conditions. Nevertheless, significant impacts would occur to environmental resources in the event of facility failure. The cumulative effect of more protective reclamation covers and pit bench reclamation would be to lessen adverse indirect impacts to water quality, as described in Section 4.2.7.1.

4.1.7.2 Unavoidable Adverse Impacts

The disturbances of geologic resources at the Seaford and Williams clay pits, and King Creek and LS-1 limestone quarries are an unavoidable consequence of mining these reclamation materials. Topographic modifications in the mine areas, and at the Seaford and Williams clay pits, and King Creek and LS-1 limestone quarries would be unavoidable.

4.1.7.3 Short-term Use/Long-term Productivity

The geologic resources used under this alternative would provide a beneficial short-term use as reclamation materials to protect other environmental resources such as surface water quality. Long-term productivity of geologic resources would not be affected.

4.1.7.4 Irreversible or Irretrievable Resource Commitments

Removal of clay and limestone for use in reclamation covers constitutes an irretrievable commitment of resources. Because these resources are available locally and regionally in essentially unlimited quantities, the impact is not significant. Removal of gold and silver from the ore deposits is a significant and irretrievable commitment of resources. The increased pit disturbances are additional, irretrievable commitments of resources.

4.1.8 Impacts from Alternative 6

Geologic Resources: Impacts to geologic resources would be based on the activities associated with expansion of the Zortman and Landusky mines and the agencies' expansion modifications and reclamation mitigations. Modifications and mitigations to ZMI's proposed mine operations were described in Section 2.10. These modifications could impact the type and amount of ore and waste rock generated during mine operations, as summarized in Section 4.1.6. ZMI has indicated that costs for placement of the waste rock repository in Ruby Flats would raise the "cutoff" grade of ore; therefore about 156,000 fewer ounces of gold would be produced. All impacts associated with mine expansion and extraction of reclamation materials would occur in the near-term and be of short duration, extending until reclamation is completed. Table 4.1-5 summarizes the quantities of reclamation materials used for each mine.

TABLE 4.1-5
RECLAMATION AND CONSTRUCTION MATERIALS FOR ALTERNATIVE 6

Alternative 6 Resources	Additional Acres New Disturbance			Cubic Yards of Material		
	Zortman	Landusky	Total	Zortman	Landusky	Total
Clay	12	9	21	1.06 million	786,000	1.85 million
Limestone	13	3	16	741,000	35,000	776,000
Non-Acid Generating[1]	---	---	---	1.88 million	1.60 million	3.48 million

[1] Materials in this category would consist of waste rock which meets the non acid generating criteria for this alternative, as described in Section 2.10.2.1. Landusky waste rock would have to come from existing facilities, suitable waste rock generated at the Zortman Mine, or a limestone quarry as there would be no waste rock generated during new mining at the Landusky Mine which meets the geochemical classification criteria.

TABLE 4.1-6
RECLAMATION AND CONSTRUCTION MATERIALS FOR ALTERNATIVE 7

Alternative 7 Resources	Additional Acres New Disturbance			Cubic Yards of Material		
	Zortman	Landusky	Total	Zortman	Landusky	Total
Clay	4	0	4	347,000	0	347,000
Limestone[1]	13	3	16	741,000	35,000	776,000
Non-Acid Generating[2]	---	---	---	2.03 million	1.8 million	3.83 million

[1] Limestone may be used in capillary break of the reclamation covers required by Alternative 7 as long as it is not placed directly on top of the GCL. This is because direct contact with calcium carbonate-laden solution can increase the GCL permeability. However, other sources should provide sufficient quantities such that limestone is not required. Materials shown are therefore only for construction and some water management systems, such as underdrains.

[2] Materials in this category would consist of material which meets the non acid generating criteria for this alternative, as described in Sections 2.11.2.1 and 3.1.8. These may include limestone, new waste rock, gravels from Goslin Flats, subsoils or historic mine tailing, or waste rock from existing facilities.

This Alternative would require the use of Reclamation Covers A, B, and Modified C. The following acres of disturbance would require reclamation with the appropriate reclamation cover at the two mines:

Zortman Mine
- Reclamation Cover A 220 acres
- Reclamation Cover B 465 acres
- Modified Cover C 103 acres
- Total 788 acres

Landusky Mine
- Reclamation Cover A 320 acres
- Reclamation Cover B 180 acres
- Modified Cover C 150 acres
- Total 650 acres

[Regarding the above acreages, it is important to note that all disturbances at the mines would be reclaimed, in accordance with the Montana Metal Mine Reclamation Act. However, not all disturbances, such as land application disposal areas, require the use of additional reclamation cover material. Therefore, the acres of disturbance to be covered with additional reclamation material do not add up to the total anticipated acres of disturbance at each mine.]

These estimates are based on the assumption that sulfur concentrations would exceed 0.5% at the footprints of removed waste rock facilities and leach pads. The acres requiring reclamation include existing disturbances and new disturbances resulting from implementation of Alternative 6.

The Seaford clay pit would be disturbed to remove an estimated 1.06 million yd^3 of clay for reclamation covers and construction of the Goslin Flats heap leach pad liner. This estimate also includes material for construction of a liner in the Ruby Flats waste rock repository. As described for Alternative 4, Goslin Flats may also serve as a ready source of clay for construction and reclamation. Ruby Flats may also have materials suitable for use in construction and reclamation. The Williams clay pit would be disturbed to remove approximately 786,000 yd^3 of clay for reclamation covers.

This analysis assumes that the volume of limestone estimated in Section 2.8 for construction and reclamation of the Goslin Flats leach pad would also be appropriate for Alternative 6. Approximately 741,000 yd^3 of limestone would be used for reclamation of the Goslin Flats leach pad, with the remainder of the capillary break composed of suitable NAG waste rock. Limestone for the Zortman Mine would come from approximately 13 acres of disturbance at a new quarry, LS-1, developed just northwest of Shell Butte. Limestone requirements for reclamation of the Landusky Mine would be as described in Alternative 4. About 35,000 yd^3 of limestone would be required for reclamation of Landusky Mine facilities. This material would come from approximately 3 additional acres of disturbance at the King Creek quarry.

Approximately 1.88 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Zortman Mine. This material represents approximately 3% of the total waste rock volume that would be generated during expanded mining operations, and an estimated 54% of the suitable, non-acid generating waste rock that would be produced using the agencies' more restrictive geochemical characterization program (see Section 2.7.2.1).Sufficient quantities should be available for use in reclamation covers.

It is estimated that 1.6 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Landusky Mine under this Alternative. This material represents approximately 23% of the total waste rock volume that would be generated during expanded mining operations at this mine. However, it is assumed that no waste rock generated during expanded mine operations at Landusky would be suitable for use in reclamation covers, based on projected lithologies developed and the more restrictive geochemical classification program. There would be a shortfall in reclamation materials which would have to be made up from existing waste rock stockpiles, material derived from excavation of the drainage notch, increased use of limestone in reclamation covers, and/or the use of suitable waste produced at the Zortman Mine expansion.

Topography: There would be some modification to the topography of both mines resulting from implementation of this alternative. Expanded mining operations would create larger and deeper mine pits at both facilities. The estimated extent of pit development was shown in Chapter Two on Figures 2.8-5 and 2.8-8. Impacts from Zortman Mine pit development would be as described for Alternative 4 and reclamation of the pits would be as described for Alternative 5. Approximately 15 million tons of material would be backfilled in the pit, resulting in a final pit floor elevation of about 4,900 feet msl or higher. The Landusky Mine pit development would result in the impacts described for Alternative 3. Reclamation for this pit would require backfilling of about 3.6 million tons to approximately the 4,740 foot level. Pit walls would remain at approximately a 45 degree slope. A significant topographic impact would result from the creation of a drainage notch between the August pit and Montana Gulch at the Landusky mine, directing surface water to Montana Gulch.

Some additional mining would occur at the Seaford and Williams clay pits, and King Creek limestone quarry to provide reclamation materials. New disturbance would occur at LS-1, the proposed site to quarry limestone for the Zortman Mine. Approximately 12 acres would be disturbed at the Seaford clay pit, a greater impact than for any other alternative. Approximately 9 additional acres would be disturbed at the Williams clay pit.

The topographic modification at LS-1, the proposed limestone quarry for the Zortman Mine, would be a significant impact because it would represent a new disturbance and alteration of the landscape. The change to the LS-1 topography from the disturbance of about 13 acres would be the same as for Alternative 4. Approximately 3 acres would be disturbed to provide limestone from the King Creek quarry to the Landusky Mine. Roads to limestone quarries would be reclaimed to approximate original contour. Impacts to topography would persist for a very long time as erosion slowly reduces topography. Reclamation would limit natural erosive forces and therefore reduce the rate of future landscape modification.

Two new major facilities would be constructed which would impact the area topography. A waste rock repository constructed in Ruby Flats would have a significant impact on the existing topography in this area. This waste rock facility would rise to an elevation of 4,100 feet msl or higher, approximately 250 to 300 feet above the existing landscape. A new heap leach facility would be constructed on Goslin Flats, just west of the Ruby Flats waste rock facility. The leach pad would rise approximately 140 feet above the existing landscape. Topographic impacts from these new facilities would be significant since they represent abrupt alterations to existing topography and disturbance in areas previously undisturbed by mining activities. Impacts to visual resources associated with these landscape alterations are assessed in Section 4.8.

Geologic Hazards: Risks from geologic hazards would be relatively comparable to but less than those described for Alternative 4. Facilities would be designed to accepted standards of engineering safety. More stable facilities would result from this alternative's modified reclamation requirement to reslope all waste rock facilities and heap leach pads to no more than a 3H:1V slope. The slope flattening on these facilities would decrease the potential for facility slump or settlement. Waste rock facility engineering for the Ruby Flats site would be easier, with less risk of facility failure, than a valley-fill site like Carter Gulch. Solution control, liner and cover installation, and groundwater corrective action, if needed, would all be easier to implement at the Ruby Flats than in a site like Carter Gulch.

Alternative 6 incorporates a mitigation to increase the clay thickness in Reclamation Cover C from 3 inches to a minimum of 6 inches when compacted. This cover modification would increase the performance capabilities and reduce the potential for cover failure.

4.1.8.1 Cumulative Impacts

Reasonably foreseeable actions which would increase the cumulative impacts to geologic and topographic resources are limited to new mining operations and exploration activities. These were described in Section 2.10.4. The upgraded and new powerline which would be constructed from Malta to Goslin Flats would not be expected to significantly impact geologic resources or topography. Cumulative impacts from these developments, combined with past and present impacts and effects caused by implementation of Alternative 6 would be similar to those presented for Alternative 4 in Section 4.1.6.1. These include mining of a deposit at Pony Gulch and additional expansion of the Landusky Mine pits.

Additional construction and reclamation materials would also be required for these developments, thereby increasing disturbances at the Seaford and Williams clay pits, and the King Creek and LS-1 limestone quarries. This action would raise the total disturbance from past and proposed mining at the Seaford pit to about 16.2 acres. Total disturbance from this alternative combined with past mining at the Williams pit would be about 35 acres. Total disturbance at the King Creek quarry from past, proposed and reasonably foreseeable activities would be 10 acres. A new limestone source, with a disturbance of up to 7 acres, could be developed for reasonably foreseeable Landusky mine expansions. Cumulative disturbance at the LS-1 limestone quarry, approximately 13 acres, would be a result of Alternative 6 implementation.

Overall, the cumulative topographic modifications would result in increased risks of slope failure compared to baseline conditions. Nevertheless, significant impacts would occur to environmental resources in the event of facility failure. The cumulative effect of more protective reclamation covers and pit bench reclamation would be to lessen adverse indirect impacts to water quality, as described in Section 4.2.8.1.

4.1.8.2 Unavoidable Adverse Impacts

The disturbances of geologic resources at the Seaford and Williams clay pits, and King Creek and LS-1 limestone quarries are an unavoidable consequence of mining these reclamation materials. Topographic modifications in the mine areas, on Goslin Flats and Ruby Flats, at the Seaford and Williams clay pits, and King Creek and LS-1 limestone quarries would be unavoidable.

4.1.8.3 Short-term Use/Long-term Productivity

The geologic resources used under this alternative would provide a beneficial short-term use as reclamation materials to protect other environmental resources such as surface water quality. Long-term productivity of geologic resources would not be affected.

4.1.8.4 Irreversible or Irretrievable Resource Commitments

Removal of clay and limestone for use in reclamation covers constitutes an irretrievable commitment of resources. Because these resources are available locally and regionally in essentially unlimited quantities, the impact is not significant. Removal of gold and silver from the ore deposits is a significant, irretrievable commitment of resources. The increased pit disturbances are additional, irretrievable commitments of resources.

4.1.9 Impacts from Alternative 7

Geologic Resources: Impacts to geologic resources are based on the activities associated with expansion of the Zortman and Landusky mines and the imposed expansion modifications and reclamation mitigations. Approximately 80 million additional tons of ore and 60 million additional tons of waste rock would be generated at the Zortman Mine. Approximately 7.6 million tons of ore and 7 million tons of waste rock would be generated at the Landusky Mine. Assuming an average content of 0.020 ounces of gold per ton of ore, and a historic recovery efficiency of 55% of the gold present, approximately 960,000 ounces of gold would be produced. For reference, only about 1.7 million ounces of gold have been produced from the Little Rockies Mining District during it's entire history of mining. ZMI and its predecessors has produced about 75% of that total.

Modifications and mitigations to ZMI's proposed mine operations were described in Section 2.11. These modifications do not impact the type and amount of ore and waste rock generated during mine operations. All impacts associated with mine expansion and extraction of reclamation materials would occur in the near-term and be of short duration, extending until reclamation is completed. Table 4.1-6 summarizes the quantities of reclamation materials used for each mine.

Water balance and water barrier covers would be used for reclamation of existing and new facilities. These covers rely on subsoil and/or non-acid generating rock layers beneath the topsoil to provide greater evapotranspiration and vegetative root development. A geosynthetic clay liner is used as a water barrier instead of clay or plastic. These reclamation covers, described in Section 2.11.2.2, were developed in an attempt to increase the potential for successful surface reclamation at the mines, while at the same time decreasing overall environmental impact to other resources. One result of this modification is a decrease in impact to geologic resources and topography, particularly at the clay pits because clay is not a component of the water barrier covers. The Seaford clay pit would be disturbed to remove an estimated 347,000 yd^3 of clay for construction of the Goslin Flats heap leach pad. The Williams clay pit would only be disturbed to provide materials for capture pond and drainage ditch construction.

A suitable non-acid generating material is required for those facilities which would be capped with water balance or water barrier covers, and also for pit benches. The following disturbances would require reclamation at the two mines:

Zortman Mine

• Water Balance Covers	400 acres
• Water Barrier Covers	263 acres
• Pit Benches	50 acres
• Non-Acid Areas	135 acres
• Total	848 acres

Landusky Mine

• Water Balance Covers	267 acres
• Water Barrier Covers	257 acres
• Pit Benches	59 acres
• Non-Acid Areas	170 acres
• Total	753 acres

[Regarding the above acreages, it is important to note that all disturbances at the mines would be reclaimed, in accordance with the Montana Metal Mine Reclamation Act. However, not all disturbances, such as land application disposal areas, require the use of additional reclamation cover material. Therefore, the acres of disturbance to be covered with additional reclamation material do not add up to the total anticipated acres of disturbance at each mine.]

These estimates are based on the assumption that sulfur concentrations would exceed 0.5% at the footprints of removed waste rock facilities and leach pads. The acres requiring reclamation include existing disturbances and new disturbances resulting from implementation of Alternative 7.

As shown on Table 4.1-6, approximately 2.03 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Zortman Mine. Material needed for capillary break represents less than 3.5% of the total waste rock volume that would be generated during expanded mining operations, and an estimated 58% of the suitable, non-acid generating waste rock that would be produced using the more restrictive geochemical characterization program (see Section 2.11.2.1). Sufficient quantities would be available for use in reclamation covers.

It is estimated that 1.8 million yd^3 of suitable NAG waste would be used as capillary break in reclamation covers for the Landusky Mine under this Alternative. This material represents approximately 24% of the total waste rock volume that would be generated during expanded mining operations at this mine. However, it is assumed that no waste rock generated during expanded mining operation at Landusky would be suitable for use in reclamation covers, based on the expected geochemistry of the rock types to be mined and the more restrictive geochemical characterization program. There would be a shortfall in reclamation materials which would have to be made up from existing waste rock stockpiles, material derived from excavation of the drainage notch, increased use of limestone in reclamation covers, and/or the use of suitable waste produced at the Zortman Mine expansion. Except for limestone, geochemical testing would be required to demonstrate the suitability of any of these materials for use in reclamation covers.

It is assumed that the volume of limestone estimated by ZMI for reclamation of the Goslin Flats leach pad would be appropriate for Alternative 7. Approximately 741,000 yd^3 of limestone would be used at the Goslin Flats leach pad, with the remainder of the capillary break composed of suitable NAG waste rock. Limestone for the Zortman Mine would come from approximately 13 acres of disturbance at an outcrop of limestone west of the town of Zortman, called the LS-2 site (see Figure 2.5-1). If there are insufficient quantities of limestone available at this site then ZMI would be able to access the LS-1 site north of Shell Butte. However, there should be sufficient supplies at LS-2.

About 35,000 yd^3 of limestone would be required for reclamation of Landusky Mine facilities. This material would come from approximately 3 acres of new disturbance at the Montana Gulch site, located on the southwest edge of the existing mine permit boundary.

Topography: There would be some modification to the topography of both mines resulting from implementation of this alternative. Expanded mining operations would create larger and deeper mine pits at both facilities, resulting in significant topographic impacts at the two mines. As seen on Figure 2.8-5, ZMI has projected that mining in the Zortman pit complex would extend the pit depth over 400 feet, to below 4,600 feet msl. Approximately 12 million tons of material would be backfilled in the pit, resulting in a final pit floor elevation of about 4,800 feet msl.

Figure 2.8-8 in Chapter Two illustrates the modifications which would occur at the Landusky Mine. Continued mining would extend the pit depth another 200 feet or more in some areas, to approximately 4,500 feet msl. Approximately 20 more acres would be disturbed. The final pit floor elevation would be raised to about 4,740 feet msl at the south edge of the pit complex as a result of placing about 3.6 million tons of backfill into the pits. A significant topographic impact would result from the creation of a drainage notch between the August pit and Montana Gulch to create a freely draining pit surface. Material excavated from construction of the notch could be used as pit backfill or leached as ore.

Some additional mining would occur at the Seaford clay pits and Montana Gulch limestone quarry to provide construction and reclamation materials. New disturbance would also occur at LS-2, the proposed site to quarry limestone for the Zortman Mine. Approximately 4 acres would be disturbed at the Seaford clay pit. No new disturbance would occur at the Williams clay pit.

The topographic modifications at LS-2, the proposed limestone quarry for the Zortman Mine, and the Montana Gulch quarry for the Landusky Mine, would be significant impacts because they would represent a new disturbance and alteration of the landscape. The change to the LS-2 topography from the disturbance of about 13 acres would include development of quarry highwalls and road cuts to access the quarry. Approximately 3 acres would be disturbed to provide limestone from the

Montana Gulch quarry to the Landusky Mine. Roads to limestone quarries would be reclaimed to approximate original contour. Impacts to topography would persist for a very long time as erosion slowly reduces topography. Reclamation would limit natural erosive forces and therefore reduce the rate of future landscape modification.

Two new major facilities would be constructed which would impact the area topography. A waste rock repository constructed on top of existing facilities would have an impact on the existing topography in this area. This waste rock facility would rise to an elevation of 5,140 feet msl south of the mine pit, up to 320 feet higher than existing topography in some areas (Golder Associates, Inc. 1995). However, the topography in this area has already been substantially altered by mining, thereby lessening the significance of any new disturbance.

A new heap leach facility would be constructed on Goslin Flats. The leach pad would rise approximately 140 feet above the existing landscape. Topographic impacts from the new leach pad would be significant since it represents an abrupt alteration to existing topography and disturbance in an area previously undisturbed by mining activities. The new ore conveyor system extending from the mine are to Goslin Flats would result in disturbance along the route, including topographic alterations to create access roads and to install support systems. Impacts to visual resources associated with these landscape alterations are assessed in Section 4.8.

Geologic Hazards: As with other alternatives, facilities would be designed to accepted standards of engineering safety. More stable facilities would result from this alternative's modified construction and reclamation requirements. The new Zortman Mine waste rock facility and heap leach pad would be constructed at average slopes of 3H:1V. Other facilities at both mines not covered by the new waste rock repository or backfilled to the pits would be reclaimed to 3H:1V slopes. The slope flattening on these facilities would decrease the potential for facility slope instability.

Engineering for the waste rock facility in this alternative would be more difficult than, for instance, a facility in Ruby Flats. Seepage control, cover installation, and groundwater corrective action, if needed, would all be more difficult to implement.

The new waste rock facility would be constructed over existing facilities at the Zortman Mine which were not initially anticipated to hold large quantities of additional waste rock overburden. For this reason, ZMI conducted a stability analysis of the proposed repository (see Golder Associates, Inc. 1995). All facilities were projected to meet the appropriate safety factors.

Another potential concern for the new waste rock repository would be settlement. Settlement would be greater for the thick lifts of waste rock than thin lifts. However, with slow placement over the years most of the settlement would occur during construction. Settlement is projected to range from 0.2 to 0.5 percent, with most settlement occurring during the first few years after construction is complete. Waste rock would be placed in lifts ranging from 5 feet to 25 feet thick, in an effort to minimize settlement. In higher settlement risk areas, such as between existing heaps, waste would be placed in 5 foot lifts. Following these and other construction and reclamation procedures described in Section 2.11.1.5 and 2.11.2.5 should result in no significant problems from facility settlement. Also, the tops of the heaps would be crowned with the center higher to compensate for settlement.

The increased thickness of reclamation covers on pit benches at both mines would reduce adverse indirect impacts. For instance, surface water would have less contact with potentially acid generating surfaces of pit walls and benches, and impacts to water quality would be reduced. These impacts are more fully assessed in subsequent sections of this Chapter.

4.1.9.1 Cumulative Impacts

Reasonably foreseeable actions which would increase the cumulative impacts to geologic and topographic resources are limited to new mining operations and exploration activities. These were described in Section 2.11.4. The upgraded and new powerline which would be constructed from Malta to Goslin Flats would not be expected to significantly impact geologic resources or topography. Cumulative impacts from these developments, combined with past and present impacts and effects caused by implementation of Alternative 7, are presented here.

Two million tons of ore could be mined at the Pony Gulch deposit. This action would raise the ore total mined at the Zortman Mine up to about 102 million tons. It is reasonably foreseeable that another 12.2 million tons of ore would be mined from pits at the Landusky Mine, raising the total ore removed from this operation to about 136 million tons. New or expanded ore processing and waste rock storage facilities would have to be prepared to accommodate the above developments. It is likely that these actions would take place on already permitted ground, but there would be some resultant landscape alteration. Impacts due to open pit mining in a previously undisturbed or little disturbed area would be significant.

Increased disturbance would occur at the Seaford clay pit. This action would raise the total disturbance from past and proposed mining at the Seaford pit to about 8.2 acres. There would be no increased effect at the Williams clay pit or King Creek quarry. Total disturbance at these facilities would be projected to remain at about 26 acres and 3 acres, respectively. Cumulative disturbance at the LS-2 limestone quarry, about 13 acres, and Montana Gulch limestone quarry, about 3 acres, would result solely from implementation of Alternative 7.

The cumulative impact to the topography in the area of the Zortman and Landusky mines would be altered as a result of new and reasonably foreseeable reclamation activities. Approximately 15 million tons of waste rock would be backfilled to the Zortman pit, resulting in a final pit floor elevation of 4,900 feet msl. Approximately 5 million tons of waste rock would be backfilled to the Landusky pit, resulting in a final pit floor elevation of 4,740 feet msl. Some spent ore heaps and waste rock facilities would be reduced in slope. A significant new landscape alteration would be the drainage notch constructed between the August/Little Ben mine pit and Montana Gulch.

Overall, the cumulative topographic modifications still would result in increased risks of slope failure compared to baseline conditions. Nevertheless, significant impacts would occur to environmental resources in the event of facility failure. The cumulative effect of more protective reclamation covers and pit bench reclamation would be to lessen adverse indirect impacts to water quality and other resources.

4.1.9.2 Unavoidable Adverse Impacts

The disturbances of geologic resources at the Seaford clay pit, and LS-2 and Montana Gulch limestone quarries are an unavoidable consequence of mining these reclamation materials. Topographic modifications in the mine areas, on Goslin Flats, at the Seaford clay pit, and limestone quarries would be unavoidable.

4.1.9.3 Short-term Use/Long-term Productivity

The geologic resources used under this alternative would provide a beneficial short-term use as reclamation materials to protect other environmental resources such as surface water quality. Long-term productivity of geologic resources would not be affected.

4.1.9.4 Irreversible or Irretrievable Resource Commitments

Removal of clay and limestone for use in construction and reclamation constitutes an irretrievable commitment of resources. Because these resources are available locally and regionally in essentially unlimited quantities, the impact is not significant. Removal of gold and silver from the ore deposits is a significant and irretrievable commitment of resources. The increased pit disturbances are additional, irretrievable commitments of resources.

4.2 WATER RESOURCES AND GEOCHEMISTRY

The primary goals of this impact analysis are to estimate whether the alternatives will (1) mitigate existing water quality problems, and (2) prevent the development of similar water quality degradation. The analysis of the first three (no expansion) alternatives concentrates on the ability of the proposed reclamation measures to mitigate existing and possible future water quality problems.

4.2.1 Methodology

4.2.1.1 Infiltration Modeling

The Hydraulic Evaluation of Landfill Performance (HELP) model was used in this analysis to provide a semi-quantitative assessment of the effectiveness of proposed reclamation covers at minimizing infiltration. HELP is a deterministic water balance model that uses climatic, soil and design data to determine the water budget of a landfill (Schroeder et al. 1988). The facilities evaluated for reclamation are not landfills, but the HELP model is applicable because the performance goals (minimize infiltration and leachate generation) are the same as for a landfill. The HELP model provides a useful tool for relative comparisons between capping scenarios; however, due to the many assumptions inherent in the modeling, the calculated volumes of infiltration and discharge should be considered as estimates only. Please see Appendix G for a discussion of inputs and assumptions used in the HELP modeling.

Discharge at the toe of a facility is made up of infiltration through the facility, surface water draining underneath the facility, and groundwater springs or seeps discharging from beneath the facility. These additional sources of flow are expected to be reduced to varying degrees depending on the reclamation cover used on the waste rock and leach pad facilities and in reclamation of the mine pits. The volume of groundwater discharge beneath a particuiar facility has been estimated by modeling infiltration under current non-reclaimed conditions and subtracting this volume from total seepage measured in the field at the toe of the facility. Estimates of total seepage for each alternative have then been made based on the infiltration modeling for each reclamation cover type and by adjusting the groundwater seepage volume depending on the type and extent of reclamation proposed for the upgradient recharge area.

4.2.1.2 Water Quality at Mine Sites

Waste rock piles and leach pads are composed of heterogeneous materials. When water and oxygen percolate through such materials, they react with sulfides and other soluble minerals (see acid rock drainage sidebar, Chapter 1). Some of the pathways followed by the infiltrating water generate acid rock drainage, others may result in little or no acid formation or dissolution of metals. The latter pathways will generate leachates that actually dilute acid rock drainage. Placement of covers having low permeability clay layers or thick soil profiles is intended to reduce the volume of water and associated oxygen infiltrating into the waste rock and heap leach piles, thereby reducing the rate of acid rock drainage formation.

The success of capping may be measured in concentrations or loads of chemical constituents found in the water draining from mine facilities. A concentration is the mass of a chemical constituent in a unit volume and is commonly expressed in milligrams per liter (mg/l). A load is the mass transported per unit time and is calculated by multiplying the mass by the total flow. Loads are commonly expressed in pounds per day (lbs/day). An increase in concentration of a contaminant can be beneficial if the overall load decreases.

It is predicted that acid and metal concentrations measured in the toe drain leachates emanating from the bottom or "toe" of facilities may actually increase or, at best, remain roughly unchanged for the first few years after capping. The constituent loads, however, are expected to be reduced quite rapidly. It is anticipated that concentrations may also decrease in the toe-drain leachates several years after capping. This pattern has been demonstrated at capped mine waste rock piles in northern Australia (Gibson and Pantelis 1988; Harries and Ritchie 1984; Bennett, et al. 1989; Ritchie 1994), at the Heath Steele Mines in New Brunswick, Canada (Bell, Riley and Yanful 1994) and at the Bersbo site in Sweden (Håkansson, et al. 1994). However, these assumptions about the effects of capping on future concentrations and loads are quite tentative. There were very few studies located during development of this EIS that reported actual monitoring results following capping, especially over extended time periods. The Australian studies already mentioned give general guidance, but represent very different precipitation (tropical), evapotranspiration, slopes and underlying sediment conditions as compared to the Zortman and Landusky sites. Also the Australian caps contained a sandy loam layer above the clay layer to aid in moisture retention. In a tropical climate, the clay would remain saturated, and it appears that its success in reducing contamination has been largely due to the reduction in oxygen transport through the cap rather than the reduction of water infiltration. Even the Australian experiences have been relatively short-term; data are available from capped waste rock for less than ten years. Ritchie (1994) states that it is still uncertain whether the environmental impact may return to its pre-capping level within 30 years time. The Canadian waste pile covers were also intended to retain a high degree of water saturation, as well as having a low hydraulic conductivity. The Canadian authors state (Bell, Riley and Yanful 1994):

> *"While a saturated fine-grained soil layer, having a hydraulic conductivity of 10^{-7} cm/sec or less, can provide an effective barrier to the movement of both water and oxygen, studies indicate that a single soil layer that is initially saturated will, when placed on a waste rock pile, ultimately desaturate by drainage and moisture losses due to evaporation. As the soil desaturates, the diffusion coefficient of oxygen will increase with time, resulting in increased oxygen diffusion into the pile. Furthermore, a single cover soil designed to have a low hydraulic conductivity could dry out and crack over time, especially if the soil has a high clay content."*

The Zortman/Landusky facilities may respond quite differently to capping than either the Australian or Canadian examples.

Older unremediated waste rock piles have a greater chance of having ferrous iron (Fe^{+2}) oxidized to ferric iron (Fe^{+3}) in significant quantities. Ferric iron is the primary oxidant of sulfides when the pH is below about 3.5. Thus it is likely that capping would not be as successful at slowing the rate of acid rock drainage at older, more oxidized facilities, as it may be at younger less oxidized sites.

Mining activity and earth moving in particular, can result in high sediment loads in downgradient waterways which can smother bottom-dwelling aquatic organisms and destroy their habitat. Such sediment loads are usually restricted to runoff resulting from extreme periods of precipitation. Acid rock drainage also releases acidity and relatively high metal concentrations, both of which may be chemically toxic to aquatic plants and animals and to the fish that feed on them. Toxic responses such as fish kills may result from acute events like an accidental release from a process chemical pond, or from chronic, long-term, exposure resulting from contact with waste rock or tailing leachates. Long-term ingestion of acid rock drainage-contaminated water may also be toxic to mammals such as livestock.

4.2.1.3 Post-Reclamation Water Quality

Post-reclamation surface water quality has been estimated by studying the present measured concentrations and flow volumes emanating from facilities, and evaluating the impact attained by reclaiming the facilities and the open pit areas for each alternative. Wherever possible, current water quality conditions from monitoring stations at or directly below the toe drains have been used, but in many cases, existing data are restricted to monitoring stations immediately above a capture pond or at some distance downstream where flow is received from one or more upstream facilities. Surface water quality and quantity have been used as the primary medium to evaluate the effectiveness of proposed reclamation and the impacts to water resources. This is due to the fact that impacts to alluvial groundwater parallel those to surface water (see Section 3.2.6). Also, discernable differences in water quality impacts between individual alternatives and reclamation criteria will be restricted predominately to the surface water system. Potential impacts to groundwater are analyzed and discussed in a more qualitative manner for each of the alternatives. Monitoring stations referred to can be located on Exhibit 1 for the Zortman Mine and Exhibit 2 for the Landusky Mine.

In many cases, a large percentage of the flow observed downgradient of facilities appears to be derived from groundwater recharge from the undisturbed catchment surrounding the facilities or groundwater recharged within the open pits, discharging to the surface beneath the facility. The ratio of flow infiltrating through the facilities to that derived from the surrounding catchment and beneath the facilities plays a significant part in estimating the degree of improvement in water quality as a result of capping. Where facilities take up the majority of the headwaters of their drainages or receive the majority of their groundwater recharge from the open pit areas, it is expected that the proportion of baseflow underneath the facilities would decrease significantly as surface recharge is diverted by the various reclamation covers.

Extensive review of the mine water quality literature shows that accurate and precise predictions of post reclamation water quality cannot be made given the current state of the art. Because mineralogy and other factors affecting the potential for acid rock drainage are highly variable from site to site, predicting the potential for acid rock drainage is currently difficult, costly and of questionable reliability (USEPA 1994). Given that some of the Zortman/Landusky wastes have already had quantities of lime or limestone added to the facilities (e.g., the Gold Bug repository and the Mill Gulch dump), reliable prediction is made even more tentative. As such, estimates of post-reclamation water quality have been made primarily by professional judgement after considering all the factors discussed above.

Anticipated water quality from spent ore piles was discussed in Section 3.2.2. As mentioned, after the ores have been leached, and immediately after the cessation of pad flushing, leachates would likely have alkaline pH's, relatively high TDS concentrations and high concentrations of elements mobile at alkaline pHs such as arsenic, selenium and molybdenum. However, as remnant sulfides react, subsequent leachates may become acidic and metal-laden. The impacts analysis for spent ore piles presented in this document considers the later acid rock drainage-generating phase when comparing future impacts, not the early alkaline leachate phase. Kinetic tests and actual field measurements from existing spent ore heaps show that spent ore is likely to generate acid.

The majority of the streams within the Little Rocky Mountains are not perennial and therefore do not support fish populations. Water quality in the lower reaches of most of the streams surrounding the Little Rocky Mountains is of moderately good quality. This appears to be at least partially the result of the Madison Limestone; over which most drainages flow, intercepting some flow and/or, buffering the upstream drainage water quality. Existing surface water and groundwater at Goslin Gulch is of moderate to poor quality due to water rock interaction with sediments or bedrock made up of mineral rich continental and marine shales. As discussed in Section 3.2.5.2, the water quality of the regional limestone aquifer surrounding the Little Rocky Mountains does not appear to be impacted by mining related activities once outside the confines of the mountains although local recharge by acid rock drainage (ARD) contaminated waters has occurred. Natural water quality within the shales underlying Goslin Gulch has high TDS and high salinity, and is not suitable for most agricultural or domestic purposes.

4.2.1.4 Significance Criteria

Beneficial uses of water resources in the Little Rocky Mountains include domestic water supply, recreation, terrestrial wildlife drinking supply, limited macroinvertebrate habitats and some fish. As a result, significance criteria selected to assess impacts to water resources include the following: EPA maximum freshwater criterion, continuous criteria, and Human Health criteria for consumption of water and organisms (40 CFR Part 131). Criteria for a suite of metals often associated with acid rock drainage are included in Table 4.2-1. Other significance criteria used to assess impacts to water resources under each alternative include the following:

- Acreage of drainage area disturbed
- Volumes and quality of water requiring capture and treatment
- Control of further groundwater contamination
- Impacts to beneficial use

Recent water quality data and estimated future surface water quality at downstream monitoring stations (points of beneficial use) are shown on Table 4.2-1. Disturbed or diverted drainage area acreages for each alternative are summarized on Tables 4.2-2(a) and 4.2-2(b). Schematic figures in Sections 4.2.10.2 and 4.2.10.3 illustrate how each alternative is expected to approach these criteria in the long-term.

4.2.1.5 Alternatives Ranking

The analysis and eventual ranking of each alternative has been partially based on predicted surface water quality at the toe of waste rock piles and leach pad dikes. The ranking is also based on estimated volumes that would require capture and treatment under each alternative and the expected impacts to groundwater resources. Downstream surface water quality is primarily a product of the effectiveness of the upstream capture and treatment systems (Table 4.2-1). Predictions of water quality at selected points of interest (points of beneficial use) have been carried out based on trends in downstream water quality established from historic monitoring data. Due to the expected effectiveness of the capture systems and contingency measures under the Water Quality Improvement Plan (see Appendix A), little difference in impact is expected between alternatives at these downstream locations. However, short-term downstream water quality is expected to vary depending on the amount of suspended solids released during construction of facilities in the drainages. The ranking assigned to cumulative impacts is also taken into consideration for each alternative. Positive and negative attributes of each alternative are tabulated in a summary table (presented in Section 4.2.10.3), and a ranking is assigned based on the detailed review of these attributes in the following text.

TABLE 4.2-1
EXISTING AND ESTIMATED POST RECLAMATION DOWNSTREAM SURFACE WATER QUALITY

	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
WATERQUALITYSTANDARDS										
Max Freshwater Criterion (Acute)	>7.0			0.12 @ 100mg/l hardness	0.082 @ 100mg/l hardness	0.018 @ 100mg/l hardness	0.36	1.4 @ 100mg/l hardness		
Continuous Criterion (Chronic)	>7.0			0.11 @ 100mg/l hardness	0.0032 @ 100mg/l hardness	0.012 @ 100mg/l hardness	0.19	0.16 @ 100mg/l hardness		
Human Health - consumption of water and organisms	*1			-	-	-	0.018	0.61		
ZORTMAN										
Ruby Gulch - Station Z-1B (Above Zortman Town Site)										
	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrate	Comments
Existing Conditions	5.3	1,160	764	2.81	0.04	0.73	0.073	0.35	1.54	7/24/95
Estimated Baseline	6.5-8.0	-	100-200	-	-	-	-	-	-	Baseline from Station Z-1
Alternatives 1-7 estimated concentrations	7.0-8.0	100-200	10-50	<0.01-0.2	<0.01-0.2	<0.01-0.2	<0.005-0.2	<0.01	<0.05-1.0	(Significant improvement expected)
Z-34 (Below the Proposed Ruby Flats Waste Rock Repository										
	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L		Comments
Existing Conditions	7.9	516	128	<0.01	<0.01	<0.01	<0.005	<0.01	1.09	5/10/95
Estimated Baseline	7.5-8.5	-	-	-	<0.01	-	-	-		
Alternatives 1-5 and 7	7.0-8.0	300-600	100-300	<0.01	<0.01	<0.01	<0.005	<0.01-0.03	<0.05-1.0	(No significant change expected)
Alternative 6	6-7	500-1000	200-600	<0.01	<0.01	<0.01-0.03	<0.005-0.15	<0.01-0.15	<0.05-1.5	Minor degradation primarily due to exposing bedrock to further oxidation

Note:
- Standard or data not established
*1 No induced variations to exceed 0.5 pH within the range 6.5 to 9.0, natural pH above 7 must be maintained.
EPA 40 CFR Part 131 Water Quality Standards
All metals analyses are total recoverable metals

TABLE 4.2-1 - EXISTING/ESTIMATED POST RECLAMATION DOWNSTREAM SURFACE WATER QUALITY (Continued)

ZORTMAN										
Alder Gulch Z-16 (Above Zortman Town Site)	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	7.4	189	65	0.09	0.02	<0.01	<0.005	<0.01	<0.05	5/17/94
Estimated Baseline	7.0-8.0	-	25-100	-	<0.02	-	-	-	-	
Alternatives 1-3, 6 and 7	7.0-8.0	100-200	20-80	<0.01-0.1	<0.02	<0.01	<0.005	<0.01	<0.05	(no significant change expected)
Alternatives 4 and 5	6-7	150-300	60-100	0.5-1.0	0.02	<0.01-<0.03	<0.005-0.15	<0.01-0.15	<0.05-1.0	Minor degradation due to water bypassing capture systems
Goslin Gulch Z-22 (Downstream of Goslin Gulch Leach Pad)	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	7.5	1,390	773	0.01	0.01	<0.01	<0.005	<0.01	<0.05	5/10/93
Estimated Baseline	6.5-8.0	-	700-1000	-	0.005-0.03	-	-	-	-	
Alternatives 1-3 and 5	7.0-8.0	1,000-2,000	500-1,000	<0.01	<0.01	<0.01	<0.005	<0.01	<0.05	(No change expected)
Alternatives 4, 6 and 7	6.0-7.0	1,200-3,000	700-2,000	0.01	0.01	<0.01-0.03	<0.005-0.15	<0.01-0.15	<0.05-1.0	Minor degradation primarily due to exposing bedrock to oxidation
Lodgepole Creek Z-7	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	8.0	215	18	0.01	0.002	0.001	0.001	0.01	<0.05	8/3/95
Estimated Baseline	7-8	-	10-50	-	<0.01	-	-	-	-	
Alternatives 1-7	7-8	100-250	10-30	<0.01	<0.01	<0.01	<0.005	<0.01	<0.05	(No change expected)

Note: Some short-term elevated concentrations of suspended solids could occur as a result of construction of the LS-1 limestone quarry under Alternatives 4,5, and 6.

TABLE 4.2-1 - EXISTING/ESTIMATED POST RECLAMATION DOWNSTREAM SURFACE WATER QUALITY (Continued)

LANDUSKY										
Rock Creek L-23 (At Landusky Town Site)										
	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	7.9	213	60	0.02	<0.01	<0.01	<0.005	<0.01	<0.05	7/25/95
Estimated Baseline	6.5-7.5	-	10-75	-	<0.01	-	-	-	-	From L-27 Upstream
Alternatives 1-7	7-8	100-300	10-100	<0.01	<0.01	<0.01	<0.005	<0.01	-	(No significant change expected)
Mill Gulch L-7 (Above Confluence With Rock Creek)										
	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	7.7	1,300	778	0.08	<0.01	<0.01	0.005	0.02	7.89	7/25/95
Estimated Baseline	7.6	100-200	16	0.08	-	-	-	-	-	
Alternatives 1-7	7-8	200-600	200-400	<0.03	<0.01	<0.01	<0.005	<0.01	<0.05-2.0	(Reduction in concentrations as majority of precipitation is diverted to surface runoff)
Montana Gulch L-2 (Above Confluence With Rock Creek)										
	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	7.7	675	359	0.41	<0.01	<0.01	0.025	0.05	0.88	5/9/95
Estimated Baseline	8.4	330	61	-	0.20	-	-	-	-	
Alternatives 1 and 2	7-8	500-800	300-500	<0.3	<0.01	<0.01	<0.005	0.04	<0.05-0.1	(No significant change expected)
Alternatives 3, 4, 5, 6, and 7	7.0-8.0	400-600	200-350	<0.03	<0.01	<0.01	<0.05	<0.01	<0.05	Improvement due to reduction of Gold Bug and August Adit flow contributors of elevated metals

TABLE 4.2-1 - EXISTING/ESTIMATED POST RECLAMATION DOWNSTREAM WATER QUALITY (Concluded)

LANDUSKY										
King Creek L-6 (Near Reservation Boundary)										
	pH	TDS mg/L	Sulfate mg/L	Zinc mg/L	Lead mg/L	Copper mg/L	Arsenic mg/L	Nickel mg/L	Nitrate + Nitrite	Comments
Existing Conditions	7.4	452	159	0.03	<0.002	0.001	0.004	<0.01	<0.05	8/2/95
Baseline	7.5	306	95	-	<0.01	-	-	-	-	
Alternatives 1-4, 6 and 7	7-8	200-400	100-200	0.01-0.03	<0.01	<0.01	<0.005	<0.01	<0.05	(No significant change expected)
Alternative 5	6.5-8.0	300-600	100-300	0.01	<0.01	<0.01	<0.005	<0.01	<0.05-1.0	(Some slight increase in concentrations of nitrate due to rehabilitation of pit floor)

TABLE 4.2-2(a)
DRAINAGE AREA DISTURBANCES (acres) AND ESTIMATED VOLUMES OF WATER REQUIRING CAPTURE AND TREATMENT IN THE SHORT-TERM (20 years) AT THE ZORTMAN MINE

				ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3		
Drainage Name	Watershed Total Area (Acres)	Facility Type In Drainage	Impacted Flow Currently Being Captured (gpm)	Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]	Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]	Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]
Ruby Gulch[1]	1333	Pits		65.1	4.9		65.1	4.9		65.1	4.9	
		Waste Rock		17.4	1.3		17.4	1.3		0.0	0.0	
		Heap Leach		87.1	6.5		87.1	6.5		53.4	4.0	
		TOTAL	80	169.6	12.7	88-98	169.6	12.7	78-88	118.5	8.9	36-46
Carter Gulch[2]	281	Pits		6.7	4.6		6.7	4.6		6.7	4.6	
		Waste Rock		16.0	11.0		16.0	11.0		0.0	0.0	
		Heap Leach		0.0	0.0		0.0	0.0		0.0	0.0	
		TOTAL	10	22.7	15.7	4-7	22.7	15.7	4-7	6.7	4.6	0-4
Alder Spur[3]	302	Waste Rock		0.0	0.0		0.0	0.0		0.0	0.0	
		Heap Leach		28.6	9.5		28.6	9.5		28.6	9.5	
		TOTAL	10	28.6	9.5	11-14	28.6	9.5	11-14	28.6	9.5	5-7
Alder Gulch[4]	2182	Heap Leach	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goslin Gulch	1313	Leach Pad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ruby Creek[6]	5758	Waste Rock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Camp Creek[7]	2779	Waste Rock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lodgepole Creek[8]	4522	Pits	0.0	26	0.6	0.0	26	0.6	0.0	26	0.6	0.0
TOTALS			100			103-119			93-109			41-57

TABLE 4.2-2(a)
DRAINAGE AREA DISTURBANCES (acres) AND ESTIMATED VOLUMES OF WATER REQUIRING CAPTURE AND TREATMENT IN THE SHORT-TERM (20 years) AT THE ZORTMAN MINE

Drainage Name	Watershed Total Area (Acres)	Facility Type In Drainage	ALTERNATIVE 4			ALTERNATIVE 5			ALTERNATIVE 6			ALTERNATIVE 7		
			Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]	Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]	Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]	Disturbed Acres[a]	% of Total Drainage Area[b]	Estimated Volume Requiring Capture (gpm)[c,d]
Ruby Gulch[1]	1333	Pits	113	8.5		113	8.5		113	8.5		113	8.5	
		Waste Rock	8.0	0.6		0.0	0.0		8	0.6		88.4	6.6	
		Heap Leach	87.1	6.5		53.4	4.0		53.4	4		34	2.6	
		TOTAL	208.1	15.6	58-68	166.4	12.5	44-54	174.4	13.1	44-54	235.4	17.7	39-49
Carter Gulch[2]	281	Pits	6.7	2.4		6.7	2.4		6.7	2.4		6.7	2.4	
		Waste Rock	162	57.6		162	57.6		0.0	0.0		16.0	5.7	
		Heap Leach	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
		TOTAL	168.7	60.0	63-76	168.7	60.0	63-76	6.7	2.4	0.0	22.7	8.1	2-6
Alder Spur[3]	302	Waste Rock	0.0	0.0		0.0	0.0		0.0	0.0		54.6	18.1	
		Heap Leach	28.6	9.5		28.6	9.5		28.6	9.5		2.2	0.7	
		TOTAL	28.6	9.5	4-6	28.6	9.5	4-6	28.6	9.5	4-6	56.8	18.8	8-10
Alder Gulch[4]	2182	Heap Leach	0.0	0.0	0.0	180	8.2	54-73	0.0	0.0	0.0	0.0	0.0	0.0
Goslin Gulch	1313	Leach Pad	250	19	15	0.0	0.0	0.0	250	19	15	250	19	28
Ruby Creek[6]	5758	Waste Rock	0.0	0.0	0.0	0.0	0.0	0.0	116.9	2	7	0.0	0.0	0.0
Camp Creek[7]	2779	Waste Rock	0.0	0.0	0.0	0.0	0.0	0.0	86.1	3	7	0.0	0.0	0.0
Lodgepole Creek[8]	4522	Pits	67	1.5	0.0	67	1.5	0.0	67	1.5	0.0	67	1.5	0.0
TOTALS					140-165			165-209			77-89			77-93

[a] "Disturbed Acres" is the sum of the acres of facilities active under each alternative (see Chapter 2 adjusted for coverage of facilities overlapping each other).

[b] Drainage areas were defined as shown in points (1) through (8) below.

[c] Volumes from ZMI monitoring records.

[d] Volume based on HELP modeling of reclamation covers and reclamation of recharge areas (e.g. pits).

Drainage Areas Defined as Follows:

1 Downstream to the Town of Zortman
2 Downstream to Confluence with Alder Gulch
3 Downstream to Confluence with Alder Gulch
4 Downstream to Confluence with Ruby Gulch
5 Downstream to Confluence with Ruby Creek
6 Downstream to Monitoring Station Z-35.
7 Downstream to Study Area Boundary.
8 Downstream to Reservation Boundary.

NOTE: HELP Modeling Assumed An Average Annual Rainfall of 22-1/2 inches.

TABLE 4.2-2(b)

DRAINAGE AREA DISTURBANCE (acres) AND ESTIMATED VOLUMES OF WATER REQUIRING CAPTURE AND TREATMENT IN THE SHORT-TERM (20 years) AT THE LANDUSKY MINE

Drainage Area	Total Acres	Facility Type	Impacted Flow Currently Being Captured	Disturbed Acres[a]	% of Total Drainage Area[b]	ALTERNATIVE 1 Estimated Volume Requiring Capture & Treatment (gpm)[c,d]	ALTERNATIVE 2 Estimated Volume Requiring Capture & Treatment (gpm)[c,d]	ALTERNATIVE 3 Estimated Volume Requiring Capture & Treatment (gpm)[c,d]
Sullivan Creek[1]	212	Leach Pad	20	114.2	53.9	16-19	16-18	7-11
Mill Gulch[2]	580	Pits		10.0	1.7			
		Waste Rock		70.0	12.1			
		Leach Pad		125.3	21.6			
		TOTAL	40	205.3	35.4	31-34	31-34	19-22
Montana Gulch[3]	1,148	Waste Rock		108	9.4			
		Leach Pad		61.6	5.4			
		TOTAL	50-80	169.6	14.8	228-278	208-258	144-194
King Creek[4]	671	Pits		89	13.3			
		Waste Rock		5.9	0.9			
		TOTAL	0	94.9	14.2	0	0	0
Swift Gulch[5]	721	Pits	0	58.7	8.1	0	0	0
TOTALS			**110-150**			**275-331**	**255-310**	**170-227**

TABLE 4.2-2(b)
DRAINAGE AREA DISTURBANCE (acres) AND ESTIMATED VOLUMES OF WATER REQUIRING CAPTURE AND TREATMENT IN THE SHORT-TERM (20 years) AT THE LANDUSKY MINE

			ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	ALTERNATIVE 7
Drainage Area	Total Acres	Facility Type	Estimated Volume Requiring Capture & Treatment (gpm)[c,d]	Estimated Volume Requiring Capture & Treatment (gpm)[c,d]	Estimated Volume Requiring Capture & Treatment (gpm)[c,d]	Estimated Volume Requiring Capture & Treatment (gpm)[c,d]
Sullivan Creek[1]	212	Leach Pad	9-13	9-13	9-13	13-17
Mill Gulch[2]	580	Pits				
		Waste Rock				
		Leach Pad				
		TOTAL	18-21	18-21	18-21	24-17
Montana Gulch[3]	1,148	Waste Rock				
		Leach Pad				
		TOTAL	140-190	130-180	140-190	144-194
King Creek[4]	671	Pits				
		Waste Rock				
		TOTAL	0	0	0	0
Swift Gulch[5]	721	Pits	0	0	0	0
TOTALS			**167-224**	**157-214**	**167-224**	**181-228**

[a] "Disturbed Acres" is the sum of the acres of facilities active under each alternative (see Chapter 2).
[b] Drainage areas were defined as shown in points (1) through (8) below.
[c] Volumes from ZMI monitoring records.
[d] Volume based on HELP modeling of reclamation covers and reclamation of recharge areas (e.g. pits)

Drainage Areas Defined as Follows (see Exhibit 2 for stream locations):
1 Downstream to Confluence with Rock Creek
2 Downstream to Confluence with Rock Creek
3 Downstream to Confluence with Rock Creek
4 Downstream to Confluence with South Bighorn Creek
5 Downstream to Confluence with South Bighorn Creek

NOTE: No additional disturbance acreages are required at Landusky.

4.2.2 Impacts from Mining - 1979 to Present

As described in Section 3.2.5, water quality in the majority of the southern drainages within the Little Rocky Mountains has been adversely impacted to some degree by mining activity. Geologic materials and mine wastes derived from past and present mining operations have generated acid rock drainage and released these products to surface water and groundwater.

The rock removed from the high elevations during open pit mining at both mine sites has been redistributed to a number of heap leach pads and waste rock facilities. The excavation and redistribution of this rock has significantly increased the amount of potentially acid generating rock exposed to the atmosphere, thereby accelerating the rate of weathering and geochemical reactions that have a negative impact on surface and groundwater quality. Additionally, the mining operation has altered the water balance of some drainages in the Little Rocky Mountains, increasing infiltration in the open pit areas and reducing flows in the upper reaches of some drainages. While the impacts to water quality from ARD are significant and must be corrected, water quality degradation has been mostly contained to within the mine permit boundaries and off the Fort Belknap Indian Reservation.

Table 4.2-1 includes water quality data from a recent sampling event downgradient of waste rock dumps, leach pads, and buttresses at Zortman and Landusky. This illustrates the present day downstream surface water quality status after construction of the Ruby Gulch water and treatment system.

4.2.2.1 Zortman

With the exception of Lodgepole Creek, all the major drainages in the vicinity of the Zortman mine have been significantly impacted by mining activities (see Section 3.2.5.2). The upper reaches of Carter Draw, Alder Spur and Ruby Gulch presently have elevated concentrations of sulfate, TDS, metals, nitrates and occasional detections of cyanide. This water fails to meet aquatic life standards and human health criteria, and is currently being captured and treated before being discharged to Ruby Gulch. The lower reaches of Alder Gulch and Ruby Gulch show a record of being significantly impacted by acid rock drainage or process chemicals after specific release events or periods of extreme precipitation or snowmelt (see Section 3.2.5.2). Impacts to surface water and groundwater throughout the mid- and lower reaches of these drainages have been significantly reduced as a result of installation of capture systems (see Section 3.2.5.2).

Impacts to beneficial uses at the Zortman mining site since 1979 have included:

- A cyanide leak in November 1982, caused contamination of the once-utilized alluvial groundwater source for the town of Zortman in Alder Gulch. An alternative community water supply was developed (Z-8A).

- Ongoing degradation of wildlife drinking water and potential macroinvertebrate habitat in the upper reaches of Ruby Gulch, Alder Spur, and Carter Gulch.

- Diversion of recharge from approximately 26 acres of Lodgepole Creek catchment into the Zortman pits. This diversion of flow is not considered significant as it constitutes only a minor part of a large undisturbed drainage area.

4.2.2.2 Landusky

All the major drainages within the vicinity of the Landusky mine have been impacted to some degree by mine drainage and/or releases of process chemicals (see Section 3.2.5.2). Capture sumps or ponds have been installed within Sullivan Creek, Mill Gulch and Montana Gulch in order to protect the lower reaches of the drainages from any further impact. Water captured below leach piles and waste rock dumps at Sullivan Creek and Mill Gulch is currently recirculated into the process circuit rather than undergoing any direct treatment. Despite these actions some downstream surface water degradation persists at Mill Gulch and Montana Gulch. At Montana Gulch water discharging from the Gold Bug adit is captured and oxygenated to reduce iron concentrations. At monitoring station L-2 (downstream Montana Gulch), impacts from mining since about 1960 have been in the form of slightly elevated metal concentrations, derived primarily from drainage from the Gold Bug adit. King Creek, draining the north-western side of the mining operation has progressively incurred minor mining-related impacts in its upper reaches since 1979, including elevated concentrations of nitrates and moderate increases of TDS and sulfate.

Impacts to beneficial uses at the Landusky mining site since 1979 have included:

- Periodic events of surface water and alluvial groundwater degradation near the Montana Gulch campground limiting recreation use.

- Degradation of wildlife drinking water and potential macroinvertebrate habitat in Sullivan Creek, Mill Gulch, and Montana Gulch.

- Diversion of recharge from approximately 89 acres of King Creek catchment area into the Landusky pits. This ongoing impact is considered significant as it makes up approximately 13 percent of the King Creek drainage area above the confluence with South Bighorn Creek.

- Some minor surface water quality degradation in the Swift Gulch and King Creek areas indicating drainage from the open pits.

4.2.3 Impacts from Alternative 1

Closure and reclamation activities under Alternative 1 would be limited to actions required under the existing permit requirements combined with the requirements set out in the Water Quality Improvement Plan (Appendix A) for capture and treatment. In accordance with requirements set forth in the Improvement Plan, all seepage water capture systems would be resized to handle flow from the 6.33 inch 24-hour storm event. Other features that would be required to enhance the capture and treatment of mine drainage would include:

- Lined capture ponds
- Installation of monitoring and recovering wells
- Interceptor trenches and/or sumps
- An improved water quality monitoring program

Infiltration Modeling

Table 4.2-3(a) illustrates the HELP-modeled water budget at individual facilities, assuming application of 8 inches of cover soil and poorly established vegetative cover. A condition in which soil lies directly over potentially acid generating rock creates the potential for acidic fluids to rise into the soil by capillary action, and adversely impact plant growth. It is estimated that only 20 percent vegetative cover would be attained in the long-term and that vegetation would be of a poor quality. With the exception of the Mill Gulch waste rock repository and the 87/91 Pad, all other side slopes are modeled as having 2H:1V side slopes as the slope differences make a negligible difference to the water budget calculations. The amount of evapotranspiration expected under this alternative is approximately 65 percent of available precipitation; surface runoff is modeled at 12 percent and infiltration through the soil is estimated to be approximately 23 percent on both the gentle slopes and on the side slopes. HELP modeling of non-reclaimed conditions at waste rock piles (no soil cover) suggests that approximately 42 percent of available precipitation currently returns to the atmosphere through evapotranspiration, approximately 11 percent goes to surface runoff and approximately 47 percent infiltrates into the facility (Table 4.2-3(b)). Similar ratios of discharge would be expected for the leach pads if the liners were perforated without being reclaimed first (Table 4.2-3(b)). The difference between the estimates for non-reclaimed conditions and that of the 8 inches of soil cover under Alternative 1 is primarily due to the increased level of evapotranspiration (enhanced by the presence of some vegetative cover).

Post-Reclamation Surface Water Quality

Table 4.2-3(a) summarizes present day surface water quality conditions and estimated post-reclamation conditions for selected monitoring stations directly below heap leach pads and waste rock dumps under Alternative 1. Under all the alternatives, impacted water would be captured in ponds, sumps, and recovery wells below the facilities and treated or returned to the process circuit. The estimates of post reclamation water quality at the toe of facilities is based primarily on professional judgement after considering the current water quality conditions and the anticipated effectiveness of the proposed reclamation criteria to reduce infiltration through the leach pads, waste rock dumps and the pits. Although these estimates are based primarily on professional judgement it is considered likely that the post reclamation water quality draining from the facilities will fall within the specified ranges.

The heap detoxification process for this alternative would be as described in Sections 2.5.2.4 and 2.5.4.1. Rinsing would continue until 0.22 mg/l WAD cyanide has been maintained within the pile for a period of 6 months which must run over a winter period. The liner would not be perforated until monitoring of the effluent indicates that "water quality compliance" has been met and the risk of formation of acid rock drainage is established to be minimal. Given that under Alternative 1 a significant amount of precipitation would infiltrate into the spent ores following capping (approximately 23 percent), it is probable that ongoing acid rock drainage formation would occur. Although rinsate chemistry may indicate low cyanide and metal concentrations, the remaining spent ore may still have an appreciable sulfide content. Based on the kinetic testing performed, these materials are likely to form acid rock drainage in the longer-term (see Section 3.2.2.6) (Schafer and Assoc.

TABLE 4.2-3(a)
ALTERNATIVE 1: NO ACTION, PERMITTED RECLAMATION ONLY

1. At Zortman, reclamation covers will consist of 8" of cover soil to be placed on all disturbed (non-reclaimed) areas (no testing required.
2. At Landusky, reclamation covers for presently non-reclaimed waste rock dumps and leach pads will consist of 8" of cover soil. The Mill Gulch waste rock dump, the 87/91 leach pad, and the Gold Bug waste repository have covers B and C (see Chapter 2.0).

Help Model Results

	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	11.838	11.918
Evapotranspiration (as % of precipitation):	65.37	65.373
Lateral Drainage (as % of precipitation):	0.00000	0.00000
Infiltration (as % of precipitation):	22.792	22.709

Facility	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[2] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
ZORTMAN				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
- 85/86 Leach Pad & Dike	Ruby Gulch	8.9						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike	Ruby Gulch	4.9						***3.0-5.0***	***2,000-3,000***	***1,000-2,000***	***3.0-5.0***	*Z-37*
- Ruby Gulch Waste Rock Dump	Ruby Gulch	2.5										
- OK Pit Waste Dump	Ruby Gulch	2.1										
- 82 Leach Pad (free draining)	Ruby Gulch	4.3										
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	4.9						3	878	615	5.06	Z-1 (downstream)
	TOTAL RUBY GULCH:	*27.7*	*69*	*60*	*70*	*88*	*98*	***3.0-5.0***	***500-900***	***300-700***	***3.0-5.0***	***Estimated water quality at Ruby Gulch capture system***
- 84 Leach Pad & Dike	Alder Spur	4.7										
- 83 Leach Pad & Dike	Alder Spur	2.9						4.1	2310	1460	1.98	Z-14 (downstream)
	TOTAL ALDER SPUR:	*7.6*	*4.8*	*3*	*6*	*11*	*14*	***4.5-6.0***	***1,000-2,500***	***500-1,600***	***1.0-3.0***	***Estimated water quality at Alder Spur capture system***
- Alder Gulch Waste Rock Dump	Carter Gulch	4.2						3.4	5450	3480	10.4	Z-13
	TOTAL CARTER GULCH	*4.2*	*-0.3*	*0*	*3*	*4*	*7*	***3.0-5.0***	***3,000-6,000***	***2,500-4,000***	***4.0-9.0***	***Estimated water quality at Carter Gulch capture system***
LANDUSKY												
- 87/91 Leach Pad & Dike 1-3	Mill Gulch/Sullivan Cree	12.3										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.1						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	1.9										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	6.8										
	TOTAL MILL GULCH:	*26.0*	*7.2*	*5*	*8*	*31*	*34*	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Mill Gulch capture system***
- 87/91 Leach Pad & Dike 1-3	Sullivan Creek	12.3										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	*14.1*	*2.9*	*2*	*5*	*16*	*19*	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Sullivan Creek capture system***
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	7.3										
- 84 Leach Pad & Dike	Montana Gulch	3.6										
- 85/86 Leach Pad & Dike	Montana Gulch	6.9						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	5.8						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	*28.0*	*250*	*200*	*250*	*228*	*278*	***7.0-8.0***	***700-1,000***	***400-600***	***0.4-0.7***	***Estimated water quality at Montana Gulch capture system***
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						*378*	*450*					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

1994). This contaminated infiltration would add to current volumes requiring capture and treatment, since it would not be allowed to accumulate in the interior of the leach pads.

At Ruby Gulch it is estimated that approximately 13 percent of the water flowing in the headwaters of the drainage is currently derived from seepage through the waste rock dumps and or heap leach pad dikes (Table 4.2-3(b)). If the leach pads were perforated without surface reclamation, the drainage from the facilities would be on the order of 41 percent of the total drainage flow (Table 4.2-3(b)). The remainder is likely derived from precipitation infiltrating into the Zortman pit complex and discharging to the drainage under the 85/86 leach pad as baseflow (see Section 3.2.5.1). Under Alternative 1, no low permeability cover is proposed for the pits; thus, little decrease in the volume of baseflow to Ruby Gulch is expected. Estimated short-term (10 year) water quality within the upper reaches of Ruby Gulch are summarized on Table 4.2-3(a)). Average flows requiring treatment in the short-term at Ruby Gulch under this alternative are estimated at between 88 to 98 gpm, however peak flows of several thousand gpm have been observed in Ruby Gulch (Table 4.2-3(a)).

Approximately 30 percent of flow monitored in Alder Spur is estimated to be derived from seepage through the unlined portions of the facilities in that drainage (Table 4.2-3(b)). Estimated short-term water quality at the capture system in the headwaters of Alder Spur is summarized in Table 4.2-3(a). The average volume of this flow requiring capture and treatment is estimated at between 11 and 14 gpm (Table 4.2-3(a)).

Under Alternative 1, the Carter Gulch waste rock dump would remain in place and be covered with a minimum of 8 inches of soil. Modeling indicates that close to 100 percent of the seepage flowing at station Z-13 is derived from the dump (Table 4.2-3(b)). As the Carter Gulch waste rock dump is currently covered with 8 to 12 inches of topsoil, water quality and the volume of seepage from this facility is expected to stay similar to presently observed. Average volumes requiring capture and treatment are estimated at between 4 and 7 gpm (Table 4.2-3(a)).

At Landusky, it is estimated that 59 percent of the flow in Sullivan Creek's upper reaches comes from infiltration through the Sullivan Park leach pad dike. If the 91 leach pad were to be perforated, drainage from the facilities would make up approximately 92 percent of the total discharge flow. This is not surprising, as the facility takes up the entire recharge area (Exhibit 2 in EIS map pocket). Under Alternative 1, upstream post-reclamation water quality is expected to maintain similar concentrations as those presently observed (Table 4.2-3(a)). Average flows requiring capture and treatment under Alternative 1 at Sullivan Creek are estimated at between 16 and 19 gpm.

At Mill Gulch, the Mill Gulch waste rock dump and the 87 leach pad take up the majority of the upper catchment area (Exhibit 2 EIS map pocket), and as a result prior to reclamation of the waste rock dump contributed approximately 82 percent of the flow in the upper reaches of the creek (Table 4.2-3(b)). Under Alternative 1, water quality is expected to remain similar to what is observed today. The average volume requiring capture and treatment is estimated at between 31 and 34 gpm (Table 4.2-3(a)).

Finally, the waste rock dump and leach pad dikes located within Montana Gulch are estimated to contribute approximately 22 percent of the current total flow in the upper reaches of the drainage (Table 4.2-3(b)). The remainder is derived from the Gold Bug adit (up to 250 gpm), the August adit (20-30 gpm, Water Management Consultants, 1995), possibly the Niseka drain adit, and the large area of undisturbed catchment surrounding the facilities. Existing water quality draining from these facilities has a neutral pH and only moderate TDS and sulfate concentrations. Reclamation under Alternative 1 is expected to maintain this present water quality, as shown on Table 4.2-3(a). Estimated average volumes requiring capture and treatment are also expected to remain similar to present quantities at between 228 and 278 gpm (Table 4.2-3(a)).

The 1994 Decision Record for the Landusky Mine required that Landusky drainage and capture systems be expanded to be able to handle a 6- to 7-inch event. In addition, all remaining capture systems are to be expanded to handle a 6.33 inch 24-hour storm (Appendix A). Under these conditions, overtopping is extremely unlikely for the expanded ponds, but if such an event did occur it would result in a short-term slug of acidic, high metal content water discharging into surface drainages, followed by a period of degraded alluvial groundwater quality slowly improving thereafter. A period of poor quality recharge water would also enter the limestones beneath the alluvium or exposed in the stream beds. These waters would be neutralized, precipitating the majority of their metals.

The proposed land application area for all alternatives is located on gentle slopes on the southern side below the Little Rocky Mountains (See Exhibit 1). Surface water drainages in the area are intermittent to perennial

TABLE 4.2-3(b)
MODELING OF UNRECLAIMED SURFACES

Help Model Results

	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	10.60	10.75
Evapotranspiration (as % of precipitation):	42.14	42.07
Lateral Drainage (as % of precipitation):	n/a	n/a
Infiltration (as % of precipitation):	47.26	47.18

		LEACH PADS NOT PERFORATED				LEACH PADS PERFORATED			
Facility	Drainage	Modeled Seepage Through Facility Including from Dumps, Waste Rock	Estimated Current Groundwater Seepage (1) (gpm)	Measured Total Seepage Volume (gpm)	Percent of Total Seepage Volume that Drains Through Dumps, Waste Rock Piles, & Dikes	Modeled Seepage from all Facilities (gpm)	Estimated Current Groundwater Seepage (1) (gpm)	Calculated Total Seepage Volume (gpm)	Percent of Total Seepage Volume that comes from All Facilities
ZORTMAN									
- 85/86 Dike only	Ruby Gulch	1.7				19.0			
- 89 Dike only	Ruby Gulch	3.4				8.8			
- Ruby Gulch Waste Rock Dump	Ruby Gulch	1.4				1.4			
- OK Pit Waste Dump	Ruby Gulch	4.1				4.1			
- 82 Leach Pad (free draining)	Ruby Gulch	n/a				6.3			
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	n/a				8.1			
	TOTAL RUBY GULCH:	**10.7**	**69.3**	**80.0**	**13.4**	**47.7**	**69.3**	**117.0**	**40.8**
- 84 Dike only	Alder Spur	2.6				11.0			
- 83 Dike only	Alder Spur	2.6				9.9			
	ALDER SPUR:	**5.2**	**4.8**	**10.0**	**52.4**	**20.9**	**4.8**	**25.7**	**81.5**
- Alder Gulch Waste Rock Dump	Carter Gulch	10.3				10.3			
	TOTAL CARTER GULCH:	**10.3**	**-0.3**	**10.0**	**102.6**	**10.3**	**-0.3**	**10.0**	**102.6**
LANDUSKY									
- 87/91Leach Pad	Mill Gulch	n/a				50.8			
- Mill Gulch Waste Rock Dump	Mill Gulch	32.8				32.8			
- 79 Leach Pad (free draining)	Mill Gulch	n/a				2.1			
- 80/81/82 Leach Pad (free draining)	Mill Gulch	n/a				2.1			
	MILL GULCH	**32.8**	**7.2**	**40.0**	**82.0**	**87.8**	**7.2**	**95.0**	**92.3**
- 87/91Leach Pad	Sullivan Creek	n/a				50.8			
- Sullivan Park Waste Rock Dump	Sullivan Creek	11.7				11.7			
	SULLIVAN CREEK	11.7	**8.3**	**20.0**	**59.0**	**62.5**	**8.3**	**70.8**	**88.3**
- Gold Bug Pit Waste Rock Repository	Montana Gulch	41.1				41.1			
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	21.4				21.4			
- 84 Dike only	Montana Gulch	1.6				7.2			
- 85/86 Dike only	Montana Gulch	1.7				13.6			
- 1983 Dike only	Montana Gulch	3.0				9.2			
	MONTANA GULCH:	**68.8**	**250.2**	**319.0**	**21.6**	**92.5**	**250.2**	**342.8**	**27.0**
	TOTAL FLOW REQUIRING CAPTURE & TREATMENT (gpm):			*479.0*				*661.0*	

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Drainage Flow" less "Modeled Seepage Through Facilities" computed for Current Non Reclaimed Non Perforated Conditions.

and are used primarily for livestock watering. A shallow (perched) groundwater table exists in the area, but the soil and underlying permeable limestone aquifer are separated by low permeability shales. This reduces the potential for any vertical percolation of degraded groundwater. EPA standards for total loading of metals for land application of municipal sludge are significantly higher than barren solution concentrations (Trace Element Irrigation Standards, EPA 1981), although these standards may not be strictly applicable to mine solution disposal.

Soil in the Goslin Gulch area are relatively thick (18 to 36 inches) and moderately permeable (mean K of 1.25 x 10^{-3}cm/s) reducing the potential for ponding or significant runoff. Vegetation is well established and consists primarily of sagebrush and grass (see section 3.4). These factors combined with the Plan to not undertake any LAD within 100 feet of the Ruby Creek would limit the potential for any significant threat to vegetation or human health. However, some increased concentrations of LAD-associated constituents in Goslin Creek/Ruby Creek surface waters is anticipated following storm events causing a moderate short-term impact on a local scale. Impacts are considered moderate, primarily because of the general poor quality of the receiving waters and the lack of any fishery or significant macroinvertebrate population. As the same general LAD area and plan is proposed for all the extension and non-extension alternatives, impacts are anticipated to be similar for all alternatives.

Table 4.2-1 summarizes existing water quality at downstream monitoring stations close to identified areas of "beneficial use". These data are representative of conditions gathered after capture systems had been installed. Generally, downstream surface water constituent concentrations under Alternative 1 would be similar to those observed during 1995. The poor water quality observed at Ruby Gulch during July 1995 is understood to be due to construction activities at the Ruby Gulch capture system. Significant improvement from what has been recorded at Ruby Gulch during July 1995 is anticipated. Downstream surface water quality is expected to be maintained close to, if not within, freshwater and human health criteria (Table 4.2-1).

Estimated water quality upstream of capture points under Alternative 1 is expected to exceed aquatic life and human health criteria and would likely be in excess of the ranges estimated for baseline (pre-1979) surface water quality in the Little Rocky Mountains (Table 3.2-9). The total average volume of impacted water from both mines that would require capture and treatment in the short-term under Alternative 1 is estimated at between 378 and 450 gpm (Table 4.2-3(a)).

Beneficial uses of these upstream water resources are limited to wildlife drinking water and potential macroinvertebrate populations although the quality of water derived from upstream is critical to all downstream uses.

Overall, water quality conditions resulting from reclamation of facilities under this alternative are expected to remain similar in concentrations and loads to what is observed today. Long-term water quality trends expected under this alternative are shown schematically on the summary figure in Section 4.2.10.1. No improvement in upstream water quality is expected in the long-term, thus capture and treatment would likely be required indefinitely to avoid impacts to downstream users and meet water quality standards.

Pit Reclamation

Under the existing reclamation plan (Amendment 011, 1989) pit floors would be sloped/graded, then topsoiled and revegetated. Pit walls would be left at 1H:1V slopes with 30-foot-wide benches every 60 vertical feet. Infiltration of runoff into the pit floors would continue. The highwall runoff study carried out at the Zortman mine (Schafer 1993 and 1994) illustrates the acid generating potential of the exposed pit highwalls. Pit floors are likely to receive acidic (pH 2.0 - 5.0), metalliferous drainage from highwall-runoff that would negatively impact any vegetation contacted on the pit floors. Also, as demonstrated by the available groundwater level data within the Zortman pit complex (Figure 3.2-9) and the seep at the base of the 85/86 leach pads in Ruby Gulch, such degraded highwall drainage infiltrates into groundwater and preferentially discharges within the headwaters of Ruby Gulch. The flow to the south is preferential due to the physical/hydrogeologic connection of the ore body and Ruby Gulch. Despite these conditions, some of the pit disturbance appears to be on the northern side of the groundwater divide and likely contributes groundwater flow to the north. The direction of groundwater flow from the Zortman pits is further discussed in a report by Hydro-Geo Consultants, 1992 (Appendix 24 to Zortman Permit Application).

Under Alternative 1, the Zortman and Landusky pits would remain internally draining. As no further mining, moving facilities or significant reclamation is proposed, no significant changes to groundwater flow paths or spring discharge volumes are expected. However, some improvement in downstream alluvial and bedrock groundwater quality is expected as the capture and treatment systems are installed as described in Appendix A. This will significantly reduce the amount of potentially impacted recharge water reaching downstream portions of the drainages. Some impacted groundwater will still likely reach downstream groundwaters along longer flow paths recharged within the pit complexes and some by the inevitable bypass of the capture systems. Downstream groundwater includes the Madison Formation limestones that are currently receiving impacted water as recharge.

Reclamation Materials

Under Alternative 1, no additional sources of non-acid generating rock, clay or limestone would be required. Water quality impacts at the existing Williams clay pit would consist of periods of elevated suspended solids concentrations. Elevated suspended solids concentrations in stormwater runoff would not have any adverse impact on water resources as the quarry does not directly drain into any stream or pond.

4.2.3.1 Cumulative Impacts

Cumulative impacts associated with past, current and foreseeable activities at the Zortman and Landusky mine site under Alternative 1 would be essentially as described in Section 4.2.3, including:

- Continued degradation of the surface water and groundwaters in the upper reaches of the majority of the drainages surrounding the Zortman and Landusky mines.

- Little improvement in current water quality conditions draining from the base of mining related facilities and the likely need for long-term capture and treatment.

Cumulative impacts have been significantly negative for the past several years with some reduction in impacts due to recent water capture and treatment efforts.

Reclamation of existing exploration roads would cause short-term elevated total suspended solids. The cumulative effect of Alternative 1 would be continued degraded water quality conditions in the headwaters of the drainages surrounding the mining area. Cumulative impacts are ranked as high negative. This cumulative impact ranking reflects the high degree to which good water quality would depend upon successful upstream capture and treatment.

4.2.3.2 Unavoidable Adverse Impacts

Operation of a treatment plant results in significant volumes of surface water being removed from many drainages for treatment and/or recirculation through the process circuit. At the Zortman Mine, water is captured from Carter Gulch, Alder Spur and Ruby Gulch. Carter Gulch and Alder Spur seepage flow pumped to the treatment plant averages <10 gpm each, while approximately 80 gpm is captured and treated from Ruby Gulch. Once the water is treated it is all discharged to the Ruby Gulch drainage (see Section 3.2.5-2). On the Landusky side, capture facilities currently remove water from Sullivan Creek, Mill Gulch and Montana Gulch, and a capture facility is under development for King Creek. Seepage captured and recirculated to the 1987 leach pad averages 20 gpm at Sullivan Creek and 40 gpm at Mill Gulch. Oxygenated water from the Montana Gulch capture system overflows into Montana Gulch. After closure, seepage water would be piped to a treatment plant in Montana Gulch. This redistribution of flow to Ruby Gulch and Montana Gulch would result in continued low flow or intermittent flow conditions in drainages that could otherwise provide water supplies for wildlife or macroinvertebrate habitat. This reduction in flow is considered only moderate as these streams do not appear to have supported a fishery and only have limited macroinvertebrate populations. Perennial flow is expected at upper Ruby Gulch and Montana Gulch under all the alternatives.

Tables 4.2-3(a) and 4.2-3(b) summarize the estimated volumes that may require capture and treatment from each drainage under Alternative 1. These volumes have been estimated from HELP modeling results and present day field observations and should be regarded as estimates only.

As discussed in Section 4.2.3.1, rinsing of leach pads would be discontinued after the solution maintains a cyanide WAD concentration of <0.22 mg/l for a period of 6 months. After this time, the leach pad liners would be perforated. Chemical testing discussed in Section 3.2.2 suggests that perforating the rinsed and flushed leach pads as proposed under this alternative would result in a short period of alkaline drainage followed by an acidic, metalliferous seepage requiring capture and treatment in the long-term.

4.2.3.3 Short-term Use/Long-term Productivity

The long-term reclamation requirement expected under the no action alternative is for collection of impacted waters, treatment to acceptable standards, and discharge of the treated waters into surface drainages. Under this alternative the impacts to water resources caused by the relatively short-term mining use (approximately 25 years) is expected to have impacts on the quality and availability of the water resource to possible users for an indefinite period of time. Seepage to the upper reaches of presently impacted drainages above capture systems would render the habitat unsuitable for aquatic life and unsuitable as a water source for terrestrial wildlife. However, this impact is considered only moderately significant due to the limited area above the capture systems.

4.2.3.4 Irreversible or Irretrievable Resource Commitments

Continued infiltration of precipitation into the pit complexes results in an irretrievable loss of flow to the surrounding tributaries and a diversion of this flow to other tributaries. This occurs via fractured bedrock flow or adit discharges and by loss to the deep groundwater system. At Zortman this includes areas of the Lodgepole Creek catchment. A similar loss of catchment has also occurred since 1979 at Landusky within the King Creek drainage. Recharge to approximately 26 acres of the Lodgepole drainage area has been diverted into the pit complex as a result of mining. The exact percentage of this infiltration that flows to the north or south as groundwater is unclear due to the uncertainty regarding the exact location of the groundwater divide. Although no pre-1979 flow data exist for Lodgepole Creek, diversion of 26 acres of its drainage area represents only 0.6 percent of the total drainage area (Table 4.2-2(a)). Therefore, the potential impact due to loss of flow to Lodgepole Creek is not considered significant.

At King Creek approximately 89 acres of drainage area has been diverted primarily by excavation of the Queen Rose and Suprise pits. Some of the infiltration into these pit areas may in fact discharge to the north depending on the exact location of the groundwater divide. However, at a worst case this comprises approximately 13 percent of the King Creek total drainage area above its confluence with South Bighorn Creek and thus represents a significant impact to the potential volume of flow in King Creek (Table 4.2-2(b)).

Approximately 33 acres of the original Swift Gulch drainage area has been diverted by excavation of the Landusky Pit complex (Table 4.2-2(b)). This existing disturbance represents approximately 4.7 percent of the total drainage area, and subsequently is considered a moderate impact to downstream surface water flow above its confluence with South Bighorn Creek.

4.2.4 Impacts from Alternative 2

Under Alternative 2, reclamation plans would be revised to include company-proposed low permeability barriers for reclamation covers on spent heap leach ore, waste rock dumps and other disturbed areas. Existing facilities would be tested to ascertain if they have the potential to generate acid rock drainage (see Section 2.7.1.2). Areas shown to have acid generating potential would be capped with 6 inches of compacted clay overlain by 8 inches of topsoil. Areas shown to be non-acid-generating would be covered with 8 inches of topsoil only, as proposed in Alternative 1. Under Alternative 2, all facilities would be reclaimed with the same side slope angles as proposed for Alternative 1 (see Section 4.2.3).

Infiltration Modeling

HELP modeling of this alternative assumes that 50 percent of the tested facilities would be shown to be acid-generating and would thus be capped with the 6 inches of compacted clay overlain by 8 inches of soil. Under this scenario it is expected that revegetation would be more successful than under Alternative 1, although revegetation is only expected to attain 50 percent coverage of fair vegetation. This improvement in revegetation is expected as the 6-inch layer of compacted clay would reduce the potential for acidification of the overlying soil and plants roots entering the potentially acidic waste rock and spent ore. The 6 inches of compacted clay would also reduce the amount of water infiltrating into the facility. However, the long-term competence of the clay is expected to be poor. This poor competence is primarily due to the desiccation expected from freeze-thawing, which is reported to equal or exceed three feet below the surface in Montana (Splangler & Handy 1982) and secondly due to dehydration of the clay. It is also possible that burrowing animals may penetrate the clay barrier, significantly reducing its long-term usefulness. The lack of any stabilizing layer between the clay and the soil also increases the potential for erosional processes to expose or remove the clay cover (see Section 4.3.4). With the exception of the Mill Gulch waste rock repository and the 87/91 leach pad dike, all other side slopes are modeled as having 2H:1V side slopes as the remaining slope differences make a negligible difference to water budget calculations.

Breakdown of the 6-inch clay layer due to freeze-thawing, dehydration, burrowing animals, and erosion was considered in the HELP modeling. The hydraulic conductivity of the clay layer was increased by a factor of 30. Zimmie and La Plante (1990) found experimentally that the effect of freeze thaw cycles increased hydraulic conductivities by one and two orders of magnitude. Assuming an elevated average hydraulic conductivity (K) of 1.9 x 10^{-3} cm/s for the clay, HELP runs indicate that overall, approximately 65 percent of available precipitation would be lost to evapotranspiration, approximately 12 percent to surface runoff and 23 percent would infiltrate into the facility. Table 4.2-4 illustrates the results of HELP modeling assuming a degraded 6-inch clay layer.

Post-Reclamation Surface Water Quality

Impacts from leach pad detoxification and perforation under Alternative 2 would be as described for Alternative 1 in Section 4.2.3.

The slight reduction in infiltration due to the use of a low permeability clay layer is expected to slightly raise concentrations of acid rock drainage constituents at the toe of the heap leach and waste rock facilities. This is caused by a decrease in overall infiltration through the facilities; however, the overall load of acid rock drainage would likely decrease, along with the volume of contaminated discharge.

Estimated short-term water quality conditions draining reclaimed facilities under Alternative 2 are summarized on Table 4.2-4. In general, slight increases in TDS, sulfate, and metal concentrations are expected during the first few years at most facilities. At Montana Gulch slight increases may be seen in TDS, sulfate, and metal concentrations, but the water would maintain its near-neutral pH.

In the long-term it is likely that the integrity of the low permeability layer would be degraded, allowing greater infiltration of water and diffusion of oxygen into the facility. This situation would result in water quality concentrations and loads returning to similar levels as observed today. Long-term water quality trends expected for this alternative upstream of capture systems are shown on the schematic summary figure in Section 4.2.10.1.

Downstream, surface water quality is expected to be similar to that currently observed (Table 4.2-1). The quality in many drainages (e.g., Ruby Gulch), will improve due to the enlargement of capture systems and due to the added cutoff walls and recovery wells described in Appendix A, reducing the volume of water bypassing the capture systems.

Estimated concentrations for facility drainage above the capture systems exceed both aquatic life and human health criteria. These concentrations represent a significant detrimental impact on a local scale, but downstream concentrations should remain close to or less than relevant significance criteria (Table 4.2-1). Beneficial use of upstream water is limited to wildlife drinking water and potential macroinvertebrate habitat, although its quality has an impact on all downstream uses. Estimated volumes of drainage requiring capture and treatment in the short-term within each drainage are summarized on Tables 4.2-2(a) and 4.2-2(b). The total average volume of impacted water that would require capture and treatment in the short-term under Alternative 2 is estimated at between 348 and 419 gpm (Table 4.2-4).

Pit Reclamation

Reclamation of the Zortman and Landusky open pits would consist of leaving the pit wall slopes at 1H:1V (as for Alternative 1) and resloping and grading of the pit floor where possible. The pit floor would then be covered with 24 inches of non-acid generating (NAG) waste and topsoiled. The NAG material is expected to provide a stable base for revegetation and may effectively isolate the revegetation from any underlying sulfide-rich bedrock. As shown by the HELP modeling, a healthy vegetative cover would enhance evapotranspiration. However, the absence of an impermeable layer or substantial soil thickness (Alternatives 1 and 2) would limit the cover's ability to stop the remaining water from infiltrating into the bedrock. Infiltrating water would become acid and a significant proportion of the infiltration is expected to discharge to the surrounding tributaries by fracture flow paths or adit drainage, thereby providing a continuing source of water requiring long-term capture and treatment.

Other recharge will continue to infiltrate into the deeper groundwater system eventually recharging the sedimentary rocks surrounding the Little Rocky Mountains.

Impacts to groundwater resources under Alternative 2 would be the same as discussed for Alternative 1 (see Section 4.2.3) with improvement to downstream surface water and groundwater quality primarily due to the installation and operation of the capture and treatment facilities.

TABLE 4.2-4
ALTERNATIVE 2: MINE EXPANSION NOT APPROVED, COMPANY PROPOSED RECLAMATION

1. At Zortman, reclamation covers will consist of 8" of cover soil to be placed on all disturbed (non-reclaimed) areas (no testing required.
2. At Landusky, reclamation covers for presently non-reclaimed waste rock dumps and leach pads will consist of 8" of cover soil. The Mill Gulch waste rock dump, the 87/91 leach pad, and the Gold Bug waste repository have covers B and C (see Chapter 2.0).

Help Model Results

	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	11.532	11.567
Evapotranspiration (as % of precipitation):	65.069	65.079
Lateral Drainage (as % of precipitation):	0.00172	0.00687
Infiltration (as % of precipitation):	22.94554	22.89536

Facility	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[2] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
ZORTMAN				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
- 85/86 Leach Pad & Dike	Ruby Gulch	9.0						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike	Ruby Gulch	5.0										
- Ruby Gulch Waste Rock Dump	Ruby Gulch	2.5										
- OK Pit Waste Dump	Ruby Gulch	2.1										
- 82 Leach Pad (free draining)	Ruby Gulch	4.3										
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	5.0						3	878	615	5.06	Z-1 (downstream)
	TOTAL RUBY GULCH:	*27.9*	*69*	*50*	*60*	*78*	*88*	***4.0-6.0***	***3,000-4,000***	***1,500-2,500***	***3.0-6.0***	***Estimated water quality at Ruby Gulch capture system***
- 84 Leach Pad & Dike	Alder Spur	4.7										
- 83 Leach Pad & Dike	Alder Spur	2.9						4.1	2310	1460	1.98	Z-14 (downstream)
	TOTAL ALDER SPUR:	*7.6*	*4.8*	*3*	*6*	*11*	*14*	***3.0-4.0***	***2,000-3,500***	***1,000-2,000***	***1.5-3.0***	***Estimated water quality at Alder Spur capture system***
- Alder Gulch Waste Rock Dump	Carter Gulch	4.3						3.4	5450	3480	10.4	Z-13
	TOTAL CARTER GULCH:	*4.3*	*-0.3*	*0*	*3.0*	*4*	*7*	***3.0-5.0***	***4,000-7,000***	***3,000-5,000***	***7.0-12.0***	***Estimated water quality at Carter Gulch capture system***
LANDUSKY												
- 87/91 Leach Pad	Mill Gulch	12.4										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.1						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	1.9										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	6.8										
	TOTAL MILL GULCH:	*26.2*	*7.2*	*5*	*8.0*	*31*	*34*	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Mill Gulch capture system***
- 87/91 Leach Pad	Sullivan Creek	12.4										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	*14.2*	*2.9*	*2*	*4*	*16*	*18*	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Sullivan Creek capture system***
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	7.3										
- 84 Leach Pad & Dike	Montana Gulch	3.6										
- 85/86 Leach Pad & Dike	Montana Gulch	7.0						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	5.9						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	*28.0*	*250*	*180*	*230*	*208*	*258*	***7.0-8.0***	***700-1,200***	***500-800***	***0.4-1.0***	***Estimated water quality at Montana Gulch capture system***
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						*348*	*419*					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

Reclamation Materials
Under Alternative 2 an additional source of clay is required for the company proposed low permeability barrier. This clay would be mined by expanding the Seaford and Williams clay pits. Water quality impacts associated with further excavation of the Seaford and Williams clay pits would result in short-term periods of elevated suspended solids concentrations in stormwater runoff. However, no impact to water resources is anticipated as neither of the clay pits drain directly into a stream or pond.

4.2.4.1 Cumulative Impacts

Total impacts associated with past, current and foreseeable activities at the Zortman and Landusky mine sites under Alternative 2 would be essentially as described in Section 4.2.3 for Alternative 1, with the following exception:

- Moderately poor reclamation success is expected under Alternative 2, resulting in only a slight improvement to current water quality conditions by reducing the amount of flow requiring capture and treatment. However, this would be a moderately short-term benefit.

The cumulative affect of Alternative 2 would be continued degradation of water quality. Cumulative impacts are ranked as being high negative, reflecting the high degree to which good water quality would depend on upstream capture and treatment.

4.2.4.2 Unavoidable Adverse Impacts

As illustrated in Section 3.2.2, geochemical testing has shown that some waste rock having total sulfur concentrations less than 0.2 percent (especially some types of Tertiary igneous rock) may already be acid or may have the potential to, generate acid rock drainage. As such, some of the disturbed areas may generate acid rock drainage in the long-term, even when reclaimed according to Alternative 2.

As with Alternative 1, seepage, capture and treatment would occur below all waste rock and ore leaching facilities in the long-term. As discussed in Section 4.2.3.3 this results in water being diverted away from their respective drainages for treatment. Tables 4.2-3(a) and 4.2-3(b) summarize the estimated volumes that would be required to be captured and treated for each drainage under Alternative 2. As the majority of the streams in the Little Rocky Mountains are not perennial in their upper reaches, the impact of diverting acid rock drainage seepage to the Zortman and Landusky water treatment plants, would be minimal.

The lack of any water storage layer overlying the clay in Alternative 2 reclamation covers may result in the clay dehydrating during the summer months. Development of unsaturated conditions could lead to cracking of the clay, and diffusion of water and oxygen through the cap (see Section 4.3.4). As discussed in Section 4.2.4, freeze-thaw action would also diminish the effectiveness of this cover. This desiccation would ultimately result in the enhanced reclamation cover performing in a similar manner to that proposed for Alternative 1.

4.2.4.3 Short-term Use/Long-term Productivity

With or without the 6 inch clay barrier, it is expected that capture and treatment would be required indefinitely, reducing the long-term productivity of the watersheds above the capture systems. This reduction in productivity is considered only moderately significant due to the predominately ephemeral nature of the drainages above the capture system.

4.2.4.4 Irreversible or Irretrievable Resource Commitments

As for Alternative 1, continued infiltration of precipitation into the pit potentially results in an irretrievable loss of flow from the northern Lodgepole and King Creek tributaries. See Section 4.2.3.4 for discussion of the significance of this loss.

4.2.5 Impacts from Alternative 3

The emphasis of Alternative 3, as opposed to the previous "No Expansion" alternatives, is on source control. All existing reclaimed and unreclaimed facilities would be assumed to be potentially acid generating and all facilities would be reclaimed using improved reclamation covers (see Section 2.7.2 for detailed description of covers). Under Alternative 3, waste rock piles and leach pads would be reclaimed with side slopes of 3H:1V. This alternative uses “water balance reclamation covers” on the side slopes of facilities and reclaimed pit areas of 25 percent or greater (see Section 2.11.2.1), as opposed to the barrier type covers as described in Alternatives 2, 4, 5 and 6. Alternative 3 would use a Geosynthetic Clay Liner (GCL) barrier liner on the slopes less than 25 percent rather than compacted clay as would be used under Alternatives 2, and the PVC/clay composite liner proposed for Alternatives 4, 5 and 6 on slopes less than or equal to 5 percent.

Infiltration Modeling

The "water balance covers" on the slopes of 25 percent or greater use a 36 inch profile of soil and subsoil to increase the rooting depths of plants (Figure 2.7-1). This enhances the amount of evapotranspiration and provides a large volume of storage for when plant coverage is dormant. On the more gentle slopes (<25 percent), a GCL would be used rather than a compacted clay layer because the GCL is less susceptible to desiccation from freeze thawing, dehydration, etc. in the long-term. Use of the GCL material also avoids many of the impacts associated with hauling clay up to the mine for use as a low permeability barrier. On the slopes less than 25 percent approximately 60 percent vegetative cover with good quality vegetation is expected while 70 percent coverage of good vegetation is anticipated on the sideslopes of greater than 25 percent. The better vegetative coverage on the steeper slopes is due to there being 12 inches of topsoil and 24 inches of subsoil, whereas the less than 25 percent slopes will have between 12 and 24 inches of soil only.

HELP model simulation of the Alternative 3 water balance reclamation cover for slopes greater than or equal to 25 percent shows that approximately 82 percent of precipitation would be lost to evapotranspiration, 8 percent to runoff and approximately 10 percent would remain to infiltrate into the reclaimed facility (Table 4.2-5). On the slopes of less than or equal to 25 percent, the use of the GCL results in approximately 79 percent lost to evapotranspiration, approximately 9 percent to runoff, 4 percent to lateral drainage, and 8 percent to infiltration.

Post-Reclamation Surface Water Quality

Under this alternative, a number of facilities and materials currently contributing acid rock drainage and/or suspended solids to the Zortman drainages would be excavated and placed in the Zortman pit complex as backfill. These sources consist of the existing Alder Gulch waste rock dump, the O.K. waste rock dump and the 85/86 leach pad and dike. The historic tailings in Ruby Gulch would also be removed and used as reclamation materials where possible, any surplus tailings would be used as pit backfill. Removal of these materials is expected to lower dissolved solids concentrations in Ruby Gulch, and because these facilities are known sources of present-day acid rock drainage, their removal is expected to reduce the volume of water requiring capture and treatment and improve the general water quality downstream.

Leach pile detoxification criteria for Alternative 3 are discussed in Section 2.7.2.4. The main difference between this agency mitigated criterion and those of the other non-extension alternatives is that the liner would not be perforated until water quality management objectives have been met for a period of ten years.

Formation of significant volumes of ARD contaminated water from the spent ore pads is less likely under Alternative 3 than under Alternatives 1 and 2. This is because of the lengthy duration of sampling required to establish acceptable cyanide and metal concentrations and because of the minimal amount of infiltration expected from the enhanced reclamation. However, the likely remnant sulfide content does have the potential to form acid rock drainage.

Estimated short-term water quality draining from facilities under Alternative 3 is summarized on Table 4.2-5. In general increases in TDS, sulfate and metal concentrations are expected in the short term. Reduced constituent loads are expected at Ruby Gulch and Carter Gulch due to removal of the Alder Gulch waste rock dump, the Ruby Gulch tailing, and effective reclamation of the Zortman pit complex . Despite the use of best management practices during removal of the Ruby Gulch tailing and subsequent reconstruction of the Ruby Gulch channel, the excavation and construction activities would undoubtedly result in limited amounts of sediment runoff into lower Ruby Gulch and potentially Ruby Creek. The impacts associated with such releases are expected to be relatively minor as similar sediments as those being disturbed have been present and have been moving within the drainage channel for many years. Impacts from sediment erosion in the channel reclamation areas should be minimal upon project completion and would diminish within a few years if the reconstruction plan is completed in a quality manner and if revegetation is successful. A reduction in the volumes requiring capture and treatment is also expected if precipitation falling on these reclaimed areas can be diverted around the capture ponds. Seepage from the remaining facilities is expected to develop increased TDS, sulfate and metals concentrations in the short-term. At Landusky, short-term increases in TDS, sulfate and metals concentrations may occur at Sullivan Creek, Mill Gulch, and Montana Gulch. While these concentrations are expected to rise due to the lack of diluting water, loads are expected to be reduced rapidly. Table 4.2-5 summarizes the estimated volumes that may require capture and treatment from each drainage under Alternative 3. Significant reduction in the volume of baseflow is expected for most drainages due to the effective capping and contouring of the open pit complexes. Long-term water quality trends expected under Alternative 3 are shown schematically on the summary figure in Section 4.2.10.1, with drainage from the facilities potentially reaching conditions that would not require active treatment.

As all surface water control systems would be upgraded, ultimate downstream surface water quality is expected to be similar to that projected for Alternatives 1 and 2.

Under Alternative 3, estimated concentrations for facility drainage above the capture system would exceed both aquatic life and human health criteria in the short- and long-term. These concentrations, as in Alternatives 1 and 2, make the negative impact moderately significant on a local scale, although downstream surface water concentrations should remain close to or less than relevant water quality criteria. Beneficial use upstream is limited to wildlife drinking water. The total volume of impacted water that would require capture and treatment in short-term under Alternative 3 is estimated at between 211 and 284 gpm (Table 4.2-5).

Pit Reclamation

Reclamation of the existing open pits using the combined water balance and GCL barrier covers and establishment of a free draining surface from the pits at both Zortman and Landusky will significantly reduce the amount of recharge to the groundwater system below the pits and would likely reduce the volume of water discharging from springs and seeps throughout the upper reaches of the surrounding drainages. The flux of poor quality water into the underlying intrusive rocks would also be significantly reduced. As all treated and diverted water would be returned to Ruby or Montana Gulch, little change in the net volume of downstream recharge to the limestones is expected. Furthermore, due to the upstream capture and treatment systems, downstream recharge water is expected to be of good quality and volume of discharge from the springs surrounding the Little Rocky Mountains is expected to remain unchanged.

The Zortman pit complex would be backfilled to approximately 4,900 feet above mean sea level (msl). This allows runoff to drain freely into Ruby Gulch and Alder Spur, where the capture systems would collect runoff/drainage, and if necessary, route it to the Zortman water treatment plant prior to discharge. The final pit floor would be covered with either the water balance cover or the GCL barrier cover depending on the slope of the reclaimed surface, limiting surface water infiltration and minimizing further impact to groundwater resources. Poor quality runoff from the highwall would be captured in lined drains and routed directly to the capture pond or treatment plant to avoid any impact to the pit floor vegetation or to good quality runoff water.

The Landusky pit complex would be backfilled to an elevation of at least 4,740 feet above msl in order to create a surface which would freely drain into Montana Gulch. The drainage ditch that would be required would be up to 120 feet deep. Capping of the Landusky pit floors with the water balance and GCL barrier covers is expected to significantly reduce recharge to the underlying adits, thereby decreasing the volume of base flow under the 85/86 leach pad and the Montana Gulch waste dump in Montana Gulch. Runoff from the reclaimed pit surface would be routed to Montana Gulch and is expected to be of good quality. The remaining flow discharging below the facilities would be captured and routed to the Landusky water treatment plant and then returned to Montana Gulch. Overall as treated and diverted waters are to be returned to Montana Gulch, no significant net loss of flow is expected.

Current water level conditions suggest that water in the Suprise shear zone is draining northeast from the Landusky mine area towards Swift Gulch with spring L-20 possibly representing a discharge point for this groundwater. Therefore, some potential does exist for groundwater from the reclaimed Landusky pit complex to discharge to the north. This water would likely be of poor quality and would require capture and treatment.

Reclamation Materials

In order to obtain materials for the water balance and GCL barrier cover, NAG gravels, soils and subsoils are proposed to be mined from the Goslin Flats soil borrow area with additional soils taken from the existing soil stockpiles at Landusky. Potential impacts to water resources associated with the salvaging of these materials would be limited to elevated concentrations of suspended solids entering Goslin Creek and/or Ruby Creek during salvage operations. Although BMPs would be used to control such runoff, the large surface area (250 acres) increases the potential for some sediment runoff during extreme precipitation events. Such runoff would result in short-term elevated concentrations of suspended solids and some longer term accumulation of sediments in the streambeds. This impact is not considered significant due to the relatively poor quality of the receiving waters and the lack of any fishery or significant macroinvertebrate population.

Additional non-acid generating material for reclamation covers and drains would also be available from the proposed LS-2 quarry location just north of the town of Zortman in the Alder Spur drainage (Exhibit 1). A haul

TABLE 4.2-5
ALTERNATIVE 3: MINE EXPANSION NOT APPROVED WITH AGENCY MITIGATION

1. At Zortman, slopes ≥25% have the water balance cover, slopes <25% have the barrier cover, no testing required as all facilities are assumed to have acid generating potential.
2. At Landusky, slopes ≥25% would have the water balance cover, slopes <25% would have the barrier cover. The Mill Gulch waste rock dump, 91/87 leach pad and the Gold Bug waste repository have covers B and C (see Chapter 2.0).

Help Model Results

	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	8.555	7.676
Evapotranspiration (as % of precipitation):	78.775	81.821
Lateral Drainage (as % of precipitation):	4.35854	0.00001
Infiltration (as % of precipitation):	8.04063	10.50299

Facility	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[2] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
ZORTMAN												
- 85/86 Leach Pad & Dike (removed)	Ruby Gulch	0.0						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike	Ruby Gulch	2.2										
- Ruby Gulch Waste Rock Dump (removed)	Ruby Gulch	0.0										
- OK Pit Waste Dump (removed)	Ruby Gulch	0.0										
- 82 Leach Pad (free draining)	Ruby Gulch	1.8										
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	2.2						3	878	615	5.06	Z-1 (downstream)
	TOTAL RUBY GULCH:	*6.2*	*69*	*30*	*40*	*36*	*46*	***4.0-6.0***	***2,000-4,000***	***500-1,000***	***3.0-6.0***	***Estimated water quality at Ruby Gulch capture system***
- 84 Leach Pad & Dike	Alder Spur	2.0										
- 83 Leach Pad & Dike	Alder Spur	1.3						4.1	2310	1460	1.98	Z-14 (downstream)
	TOTAL ALDER SPUR:	*3.3*	*4.8*	*2*	*4*	*5*	*7*	***4.5-6.0***	***1,000-2,500***	***1,500-2,000***	***1.0-3.0***	***Estimated water quality at Alder Spur capture system***
- Alder Gulch Waste Rock Dump (removed)	Carter Gulch	0.0						3.4	5450	3480	10.4	Z-13
	TOTAL CARTER GULCH:	*0.0*	*-0.3*	*0*	*4*	*0*	*4*	***5.0-7.0***	***1,000-2,000***	***3,000-4,000***	***1.0-3.0***	***Estimated water quality at Carter Gulch capture system***
LANDUSKY												
- 87/91 Leach Pad	Mill Gulch	5.4										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.1						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	0.7										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	2.7										
	TOTAL MILL GULCH:	*14.0*	*7.2*	*5*	*8*	*19*	*22*	***4.0-5.0***	***2,000-3,000***	***2,000-2,500***	***5.0-9.0***	***Estimated water quality at Mill Gulch capture system***
- 87/91 Leach Pad	Sullivan Creek	5.4										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	*7.3*	*2.9*	*0*	*4*	*7*	*11*	***4.0-5.0***	***2,000-3,000***	***900-1,200***	***5.0-9.0***	***Estimated water quality at Sullivan Creek capture system***
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	2.9										
- 84 Leach Pad & Dike	Montana Gulch	1.6										
- 85/86 Leach Pad & Dike	Montana Gulch	3.1						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	2.4						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	*14.3*	*250*	*130*	*180*	*144*	*194*	***7.0-8.0***	***700-1,200***	***500-800***	***0.4-1.0***	***Estimated water quality at Montana Gulch capture system***
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						*211*	*284*					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

road exists to this site, but it would likely require upgrading and widening. At Landusky additional non-acid generating materials would be obtained from the Montana Gulch quarry north of Landusky (Exhibit 2). Impacts associated with the development, operation, and reclamation of these facilities are anticipated to be limited to some minor elevation of suspended solids concentrations in Montana Gulch and potentially Alder Spur if construction activities were to coincide with extreme periods of precipitation. These impacts are not anticipated to be significant due to their short-term nature and lack of any fishery or significant macroinvertebrate population in the immediate receiving waters.

4.2.5.1 Cumulative Impacts

Cumulative impacts associated with past, current, and foreseeable activities at the Zortman and Landusky mine sites under Alternative 3 would include:

- A reduction in the volume of water requiring capture and treatment due to the use of enhanced reclamation covers on leach pads, waste rock dumps and the backfilled pits.
- Use of the LS-1 and King Creek limestone quarries only if more NAG materials were required to complete the reclamation of the site (reasonably foreseeable). See Section 4.2.6 for a discussion of the potential impacts to surface water associated with the development of these facilities.

This improvement on current conditions, coupled with the possibility that capture and treatment may not be required in the long-term, results in cumulative impacts being ranked as low negative to neutral, as implementation of Alternative 3 would establish a trend moving toward pre-1979 conditions.

4.2.5.2 Unavoidable Adverse Impacts

As discussed in Section 4.2.3.2, capture and treatment would reduce flows in several streams of the Little Rocky Mountains. Estimated volumes of drainage requiring capture and treatment under Alternative 3 are summarized on Table 4.2-5. As the majority of the streams in the Little Rocky Mountains are not perennial in their upper reaches, the impact of diverting acid rock drainage seepage to a treatment plant would be negligible in most cases.

Water treatment and generation of waste sludge is unavoidable in the short-term and has not been ruled out in the long-term.

4.2.5.3 Short-term Use/Long-term Productivity

The enhanced reclamation covers are expected to reduce volumes of acid rock drainage such that in the long-term passive treatment techniques may be able to maintain acceptable water quality below the reclaimed facilities. Therefore the volumes of water adversely impacted in the long-term would be considerably less than under Alternatives 1 and 2. Although it is possible that water treatment would still be required continuously, the long-term productivity of the water resources of the Little Rocky Mountains is expected to be higher under Alternative 3 than for Alternatives 1 or 2, although it will not reach pre-mining conditions.

4.2.5.4 Irreversible or Irretrievable Resource Commitments

Drainages such as Lodgepole Creek and King Creek have had some catchment area removed as a result of mining. This catchment area would not be returned to its original flow status, constituting an irretrievable loss of flow from the north of the Little Rocky Mountains. See Section 4.2.3.4 for discussion of the significance of this loss.

4.2.6 Impacts from Alternative 4

Alternative 4 is the Company Proposed Action (CPA) by ZMI for additional mining beyond that currently permitted at the Zortman and Landusky mines, together with proposed modifications to reclamation plans at each mine (described in detail in Section 2.8).

Infiltration Modeling

Table 4.2-6 summarizes the HELP modeled water budget conditions at each facility assuming all slopes greater than or equal to 5 percent are covered with Reclamation Cover B and all slopes less than 5 percent are covered with Reclamation Cover C (Figure 2.2-1). Both these covers appear efficient at limiting infiltration and providing a stable substrate for vegetation. Reclamation cover C (Figure 2.2-1) has 3 inches of clay overlain by a geomembrane (PVC) liner. It is anticipated that the hydraulic conductivity of the clay layer would be significantly increased due to the high potential for puncture during compaction of such a thin layer over coarse material. The leakage factor of the geomembrane is also expected to be higher due to the increased likelihood of puncturing from below.

HELP model simulations of the CPA reclamation cover assume that the clay is uncompacted and thus has and a hydraulic conductivity of 6.4 x 10^{-5} cm/s for the 3 inches of underlying clay. Modeling of all alternatives using a PVC/clay composite cover (Alternatives 4, 5, and 6) assume that puncturing during installation would be minimal due to a high level of QA/QC.

HELP modeling also assumed that all facilities would be found to be potentially acid-generating and thus capped with reclamation covers B and C. Under the Company Proposed Action, all dikes would be reclaimed with side slopes at 2.5H:1V as proposed for Alternative 3. Alternative 4 also states that final post reclamation surfaces on waste rock piles and leach pads would be 3H:1V where possible and no steeper than 2H:1V, HELP modeling of this alternative assumes that 70 percent of the side slopes would be completed at 3H:1V, the remaining 30 percent at 2H:1V. Table 4.2-6 summarizes the estimated water budgets for new facilities proposed under Alternative 4.

HELP model simulations of reclamation covers B and C estimates that approximately 79 percent of available precipitation would go to evapotranspiration and 9 percent to surface runoff. The flat areas reclaimed with the composite PVC/clay liner lose approximately 12 percent of precipitation to lateral drainage and approximately 0.03 percent to infiltration. On the 3H:1V and 2H:1V slopes approximately 4 percent of precipitation goes to lateral drainage and approximately 8 percent infiltrates (Table 4.2-6).

Volumes of drainage requiring capture and treatment under Alternative 4 are shown on Table 4.2-6. Notable differences occur at Goslin Gulch, Alder Gulch, and Montana Gulch due to the construction of the new waste rock and leach pad facilities and the deepening and then backfilling of the Landusky pit.

Haul road areas shown to have significant acid generating potential would be capped with 6 inches of clay overlain by 8 inches of topsoil. As discussed in Section 4.2.4, the competence of a clay layer underlying only 8 inches of soil is expected to be poor due to desiccation from freeze-thawing and dehydration. This desiccation is expected to considerably reduce the success of revegetation overlying rock with acid generating potential. The poor vegetative coverage would also increase the amount of soil loss and general erosion on the reclaimed haul roads. Impacts from this potentially acidic water with a high suspended solids content could be significant if it were allowed to communicate with the surface water system directly. Under Alternative 4, roads would thus further contribute to short-term periods of downstream water quality degradation during storm events.

Post-Reclamation Surface Water Quality

The proposed Carter Gulch waste rock repository would be a valley fill facility, built on steep terrain. The scree covering these slopes would allow natural drainage beneath the waste rock. In areas where scree depths are insufficient (mainly in the valley bottom), rock finger drains would be constructed. The quality of water discharged from the Carter Gulch waste repository underdrains has the potential to be similar to that presently at monitoring station Z-13 below the Alder Gulch waste dump, which has a pH of 3.4, and TDS and sulfate concentrations around 5,400 and 3,500 mg/l respectively.

Effective water quality management is made problematic in this steep terrain due to the high degree of interaction between surface water and groundwater (Section 3.2). This relationship makes it difficult to capture all the drainage by use of a surface impoundment, even with cutoff walls and recovery wells. As a result, the ability to avoid impacts from acid rock drainage in the drainage area below the proposed repository would rely heavily on the success of the proposed source control measures (see Section 2.9.1.6).

Estimated total seepage from the proposed Carter Gulch waste rock repository are between 63 and 76 gpm. This water would require capture and treatment for an indefinite period of time.

Downstream water quality for Alder Gulch under Alternative 4 is summarized on Table 4.2-1. Concentrations are expected to be similar to those observed today, although slight increases in TDS and sulfate concentrations are likely due to the increased area of disturbed rock and the increased volumes of impacted water bypassing the capture system. This projected increase in concentrations within surface water and alluvial groundwater is due primarily to the construction of the proposed Carter Gulch waste rock repository and would likely exceed the relevant significance criteria, making a significant impact on a local scale.

In order to construct Reclamation Cover B and C at the Zortman and Landusky mines, limestone would be obtained from the proposed LS-1 and King Creek quarries (see Exhibit 1 and 2). The haul road to the

TABLE 4.2-6
ALTERNATIVE 4: COMPANY PROPOSED PLAN
(3 in. of clay underlying PVC liner)

1. At Zortman and Landusky, slopes ≥5% have Reclamation Cover C, slopes <5% have Reclamation Cover B; if testing indicates not potentially acid draining, cover A used; reclamation slopes constructed at 3H: 1V where possible.

Help Model Results

	Flat Surfaces	33% Sloped Surfaces	50% Sloped Surfaces
Surface Runoff (as % of precipitation):	8.555	8.594	8.602
Evapotranspiration (as % of precipitation):	78.775	79.035	79.128
Lateral Drainage (as % of precipitation):	12.11061	4.04973	3.76665
Infiltration (as % of precipitation):	0.0279	7.7882	7.96771

Facility	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[2] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
ZORTMAN												
- 85/86 Leach Pad & Dike	Ruby Gulch	13.3						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike	Ruby Gulch	1.4						***3.0-5.0***	***2,000-3,000***	***1,000-2,000***	***3.0-5.0***	***Z-37***
- Ruby Gulch Waste Rock Dump (removed)	Ruby Gulch	0.0										
- OK Pit Waste Dump	Ruby Gulch	0.5										
- 82 Leach Pad (free draining)	Ruby Gulch	1.0										
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	1.6						3	878	615	5.06	Z-1 (downstream)
	TOTAL RUBY GULCH:	*17.7*	*69*	*40*	*50*	*58*	*68*	***3.0-5.0***	***500-900***	***300-700***	***3.0-5.0***	***Estimated water quality at Ruby Gulch capture system***
- 84 Leach Pad & Dike	Alder Spur	1.2										
- 83 Leach Pad & Dike	Alder Spur	0.8						4.1	2310	1460	1.98	Z-14 (downstream)
	TOTAL ALDER SPUR:	*2.0*	*4.8*	*2*	*4*	*4*	*6*	***4.5-6.0***	***1,000-2,500***	***500-1,600***	***1.0-3.0***	***Estimated water quality at Alder Spur capture system***
- Adler Gulch Waste Rock Dump (removed)	Carter Gulch	0.0						3.4	5450	3480	10.4	Z-13
- Carter Gulch Waste Rock Repository	Carter Gulch	13.4										
	TOTAL CARTER GULCH:	*13.4*	*108.0*	*NA*	*NA*	*63*	*76*	***3.0-5.0***	***3,000-6,000***	***2,500-4,000***	***4.0-9.0***	***Estimated water quality at Carter Gulch capture system***
- Goslin Flat Leach Pad	Goslin Gulch	15.0						7.5-8.0	851-1,030	414-506	0.005-0.0	Z-35
	TOTAL GOSLIN GULCH:	*15.0*	*0.0*	*0*	*0*	*15*	*15*	***6.5-7.0***	***800-1,500***	***400-800***	***.005-0.0***	***Estimated water quality at Goslin Gulch***
LANDUSKY												
- 87/91 Leach Pad	Mill Gulch	6.7										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.2						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	0.2										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	1.1										
	TOTAL MILL GULCH:	*13.2*	*7.2*	*5*	*8*	*18*	*21*	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Mill Gulch capture system***
- 87/91 Leach Pad	Sullivan Creek	6.7										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	*8.6*	*2.9*	*0*	*4*	*9*	*13*	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Sullivan Creek capture system***
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	1.2										
- 84 Leach Pad & Dike	Montana Gulch	1.2										
- 85/86 Leach Pad & Dike	Montana Gulch	2.1						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	1.0						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	*9.7*	*250*	*130*	*180*	*140*	*190*	***7.0-8.0***	***700-1,000***	***400-600***	***0.4-0.7***	***Estimated water quality at Montana Gulch capture system***
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						*307*	*389*					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

LS-1 quarry traverses around the headwaters of Lodgepole Creek and then along the ridge or drainage divide between the Lodgepole and Beaver Creek drainages. The potential impacts associated with the construction and operation of the haul road and quarry include some short-term elevated suspended solids concentrations in the surface water of both drainages. This would most likely occur during the construction of the roads while BMPs are still being installed to control sediment runoff. Some elevated dissolved solids concentrations may also occur in the surface water if any sulfide bearing bedrock is exposed during construction of the road. This would be a significant impact considering the existing high quality of these drainages.

At Landusky, impacts associated with construction and operation of the quarry would be primarily in the King Creek drainage; however some of the quarry would fall within the Swift Gulch drainage area. As the facility would drain out towards King Creek, no adverse impacts to Swift Gulch are anticipated. At King Creek some short-term periods of elevated suspended solids concentrations are expected during construction of the haul road and while BMPs are being constructed to control sediment runoff.

Goslin Flats consists of a flat prairie mantled with alluvium and underlain by over 200 feet of low permeability Thermopolis Shale. Below the shale lies the regionally extensive Madison Limestone. The flat nature of the terrain and resultant gentle hydraulic gradient, combined with the low permeability of the shales underlying the proposed facilities, would significantly aid monitoring for and recovery of any released contaminant. Some minor water quality degradation in the form of increases in TDS, sulfate, etc. is expected to occur in surface water and alluvial groundwater surrounding the leach pad. These impacts would be primarily due to exposing a large area of bedrock to oxidation during construction and are considered only moderately significant due to the poor quality of the water in the receiving drainages .

The salvaging of the soil from the footprint of the proposed Goslin Flats leach pad (approximately 250 acres and the clearance of a corridor for the associated conveyor (12,000 feet long by 200 feet wide) is expected to result in short-term elevated concentrations of suspended solids entering the upper and lower reaches of Goslin Creek and in the lower reaches of Alder Gulch. Although the solids would likely be only held in suspension for a short time the longer-term impact may be some build up of fines in the Goslin Gulch, Alder Gulch and potentially Ruby Creek drainages. Although ZMI proposes to use BMPs to control sediment runoff, there is the potential for a significant short-term local impact.

HELP model simulation of the proposed Goslin Flats leach pad is summarized on Table 4.2-6. Short-term drainage from the facility after perforation is estimated at an average seepage rate of 15 gpm.

Expansion proposed under Alternative 4 poses no additional potential for impacts to domestic water supplies at Zortman, Landusky, Hays, or Lodgepole.

The 7.6 million tons of ore proposed to be mined at Landusky would be placed on the existing 87/91 leach pad. No adverse impact to water resources is expected from expansion of the 87/91 leach pad, as all ore would be placed on top of existing liners and there would be no increase in disturbance area.

Expected long-term water quality trends at capture systems are shown on the schematic summary figure in Section 4.2.10.2. Due to the effective water quality management attainable at the Goslin Flats leach pad, short and long-term water quality is expected to be better than that for the Carter Gulch waste repository. As discussed, the Carter Gulch waste repository is in steep terrain which makes effective monitoring and capture of effluent much more problematic.

Overall, the effectiveness of the reclamation covers proposed for this alternative is expected to reduce in the long-term due to dehydration and potential freeze thawing reducing the integrity of the compacted clay. This will likely result in some proportional increase in infiltration, reaction rates, concentrations and loads in the longer-term.

Estimated volumes of drainage requiring capture and treatment for each drainage are shown on Tables 4.2-2(a) and 4.2-2(b). The total average volume of impacted water that would require capture and treatment in the short-term under Alternative 4 is estimated at between 307 and 389 gpm (Table 4.2-6).

Pit Reclamation

Mine expansion would involve lateral and vertical extension of the Zortman pit complex. This would result in an additional surface disturbance of 103 acres. Pit expansion would also lower the pit floor to an elevation of about 4,500 feet. A pit water inflow study carried out by Hydro-Geo Consultants (1992) simulated inflow into the O.K. and Independent pits. The modeling showed that after excavation reached approximately the 4,700 foot elevation, groundwater would start to flow into the O.K. Pit. This calculated water level is below the proposed breach between the O.K. Pit and Ruby Gulch and thus would result in inflow into the pit, rather than drainage into Ruby Gulch.

The inflow of water into the Zortman pit complex may cause a reduction in the discharge of some springs and seeps in the headwaters of surrounding drainages during pit operation. However after backfilling, spring discharge in the upper reaches of the streams should resume although discharge volumes are expected to be significantly less than those observed today due to reclamation of the pit floor reducing direct recharge to the groundwater system. After reclamation is complete and steady state conditions are established, the lower 140 feet of the backfill would be saturated. This saturated fill would receive recharge of oxygenated water from the buried pit walls and likely become a source of continued discharge. Backfilling consolidates the rock and may slow the oxidation (rates) of sulfides. Nevertheless, backfilling the open pits with mined material -- either waste rock or spent ore -- is likely to degrade the water quality relative to pre-1979 conditions even if the waters do not become acidic. Chemical constituent concentrations would increase in the pit backfill, primarily because the mining process has increased the reactive surface area of the geological materials (see Section 3.2.2.1). Also, as fill materials react with the originally oxygenated waters, the oxidation potential of the deeper backfill would eventually drop making some metal forms more soluble (e.g., Fe, Mn, As, Zn) (Ribet, et al. 1995).

The position of the current groundwater divide, low water levels in the vicinity of Ruby Gulch, and the observed groundwater discharge at the head of Ruby Gulch all suggest that a preferred flow path for groundwater exists from the Zortman pit complex to the south through Ruby Gulch . This flow path is thought to be associated with the northwest - southeast oriented structures along which the ore body has developed. However, due to the expansion of the Zortman pit complex to the north there is an increased potential for some groundwater flow to the north. This groundwater flow would likely discharge to alluvium or surface water in the headwaters of the northern drainages. The nature of groundwater flow on the northern side of the Little Rocky Mountains is not as well understood as that to the south due to the majority of monitoring wells being located south of the drainage divide so as to monitor likely contaminant pathways.

Mining of the Zortman pits would remove the majority of the historic underground openings and workings. These adits and workings are above the static groundwater table and convey only transient flow (Golder 1995). To minimize oxygen flow and discharge of transient water collected in the workings, the adits would be sealed using concrete bulkheads where exposed in the pits. Additionally, the adit which daylights in the Lodgepole Creek drainage would also be sealed. No impact to surface or groundwaters of Lodgepole Creek is anticipated from the adit drainage as it would be above the final potentiometric surface, would transport transient groundwater flow only, and would be controlled by the construction of the bulkheads.

Alternative 4 also proposes mining of an additional 7.6 million tons of ore and 7 million tons of waste rock from the Landusky Mine. This material would come primarily from the August pit. The final Queen Rose pit floor elevation prior to backfilling was 4,700 feet and the August pit final elevation would be 4,400 feet. The Gold Bug adit is at an elevation of 4,580 feet and the August adit elevation is 4,604 feet.

An investigation has been completed by Water Management Consultants into the groundwater conditions of the August Pit and the likely conditions during mining and after reclamation of the pit. Collectively, the adits and the natural groundwater discharge have caused the water table in the vicinity of the August pit to be at an elevation of 4,630 to 4,635 feet. The final pit floor would, as a result, be 230 to 235 feet below the current water table although mining below the water table is expected to last only one year (Water Management Consultants 1995). After mining reaches 4,630 feet, groundwater would start to flow from the intrusive rocks.

Under the proposed backfill plan groundwater would drain from the backfill material into the existing August Drain adit at an elevation of 4,604 ft. Groundwater heads in the wall rock surrounding the reclaimed pit will always be higher than the groundwater heads within the backfilled material, so the majority of flow would be from the wall rock into the backfill and then out through the August Drain adit and associated structures. After mining is complete, groundwater would flood the backfill material until it reaches the elevation of the August Drain Adit (4,604 feet) and discharges at 30 to 40 gpm (Water Management Consultants 1995). Highwall runoff would be captured prior to running onto the reclaimed pit surface. This water and runoff from the reclaimed pit floor would also be drained through the August Adit.

The water draining through the August Adit would continue to "daylight" beneath the Montana Gulch waste rock dump. This water combined with the highwall runoff and any reclaimed surface runoff will need to flow through the Montana Gulch waste rock pile underdrains before discharging at the base of the facility and being captured by the proposed surface water capture system. The adequacy of the underdrains to contain this flow is uncertain and increasing the flow beneath the facility increases the potential for further water rock interaction and/or loss of water to the groundwater system. If the adit drainage water is able to recharge the groundwater system, it could potentially bypass the capture system at the base of the waste rock dump and daylight downstream and/or recharge the downgradient limestones.

Current water level conditions suggest that water in the Suprise shear zone is draining northeast towards Swift Gulch with spring L-20 possibly representing a discharge point for this groundwater. Therefore, some potential does exist for groundwater within the pit backfill to discharge to the north. This water would likely be of poor quality and would require capture and treatment.

A higher, perched water table has also been discovered in blast holes in a fault zone area of the August/Little Ben/Queen Rose Pits (Water Management Consultants 1995). The elevation of this water table coincides with the level of spring L-5 in King Creek. For this reason it is expected that discharges from spring L-5 would decrease or cease as a result of deepening the pit. This is not expected to noticeably change the current flow conditions in King Creek as the spring is typically dry.

Water Use

An average water appropriation of 190 gpm would be required for the expanded Zortman operation and an average of 260 gpm at Landusky. These figures include makeup water for the new process circuit, dust control, and ore wetting losses. The 190 gpm required at the Zortman Mine is already available from a permitted water supply well. At Landusky the current appropriation would be sufficient for the proposed operation. However, approximately 170 gpm is currently captured from the Gold Bug adit discharge. Complete backfilling and capping of the Gold Bug pit is expected to decrease flow from the Gold Bug adit. Therefore, an additional groundwater source may be required. The additional 170 gpm is a worst case, and is considered to be attainable with no significant impact to groundwater resources available in the Little Rocky Mountains.

4.2.6.1 Cumulative Impacts

Cumulative impacts associated with past, current and foreseeable activities at the Zortman and Landusky mine sites under Alternative 4 include impacts to two currently undisturbed drainage areas and the potential for degradation of other currently unimpacted drainages due to reasonably foreseeable exploration and mining activities. More specifically, the cumulative impacts include:

- Construction of the Carter Gulch waste rock repository would likely result in additional degradation of downstream water quality at Alder Gulch in the short- and long-term and the loss of currently undisturbed drainage areas. This is considered significant due to the current high quality of the water, near perennial flow conditions and the high acid generating potential of the bedrock in the headwaters of Alder Gulch.

- Construction of the Goslin Flats leach pad would degrade water quality in the vicinity of the leach pad in the short-term primarily due to disturbing the mineral rich shales.

- Enhanced reclamation covers are expected to be moderately successful in controlling infiltration although occasional 2H:1V slopes may be susceptible to erosion.

- Pit backfill and reclamation with a low permeability barrier would reduce the amount of base flow under facilities, and the overall volume of water requiring capture and treatment.

- Approval of the mine expansion and construction of the conveyor to Goslin Flats, would likely result in future exploration activities. Water resource impacts associated with reasonably foreseeable activities would involve short-term increases in suspended solids and TDS concentrations. Road building would increase TSS and metal concentrations in drainage areas potentially unimpacted at present.

- It is reasonably foreseeable that the Big Flat Electric Cooperative would construct a 53-mile, 69-K-V transmission line from the Malta Western Area Power Administration Tie Substation to Goslin Flats (see Section 2.8.4.1). As the line would consist of single wood poles structures and would parallel Highway 191 along existing right-of-way for the majority of its route, no significant impact to water resources of the area is anticipated.

- The reasonably foreseeable development of the Pony Gulch ore body is less likely to generate acid rock drainage due to the buffering capacity of the limestone host rock. However excavation, road building, etc. would have an adverse impact on the present water quality in Pony Gulch. It is likely that these actions would cause adverse impacts including elevating TDS, TSS and sulfate concentrations, in the short- to mid-term.

Reclamation success is expected to be similar to that under Alternative 3 in the short- to mid-term, although in the long-term the effectiveness of these covers is expected to reduce due to desiccation of the clays and/or puncturing of liners. Cumulative impacts under Alternative 4 are rated as being moderately negative.

4.2.6.2 Unavoidable Adverse Impacts

ZMI defines NAG rock as having less than 0.2 percent sulfur. Geochemical testing shows that some of this waste with less than 0.2 percent sulfur has negative NNP values (see Section 3.2.2). Thus, some of this waste is expected to be acid generating. As such, use of low sulfur (<0.2 percent), negative NNP waste has the potential to degrade water quality relative to a situation where truly NAG waste was used. Water quality degradation may result in further depressed pHs, and increased TSS, TDS, sulfate and metals concentrations. The magnitude and duration of such water quality degradation cannot be predicted with any acceptable accuracy and precision given the state of the art. It is likely, that a cap composed of NAG material selected according to the modified criteria presented in Section 2.7.2 would result in better water quality than what would result from simply using the less than 0.2 percent total sulfur criteria in Alternative 4.

4.2.6.3 Short-term Use/Long-term Productivity

The Goslin Flats leach pad and Alder Gulch waste rock repository would be permanent features. Existing stream beds and ponds within the footprint of these facilities would be covered during operations. Although drainage areas would be regained after reclamation, the long-term productivity of the covered streambeds would be lost. Other construction-related disturbances would be short-term (road construction, conveyor construction, land application, and similar activities) and the water resources associated with these areas should return to baseline conditions in the long-term.

4.2.6.4 Irreversible or Irretrievable Resource Commitments

A large waste rock repository would be constructed in Carter Gulch which is currently only partially disturbed. The Goslin Flats leach pad would be constructed in an area where the water resources are currently not impacted by past mining activity, but presently contain naturally high concentrations of TDS and sulfate (Section 3.2.5). Despite the best available source control and capture and treatment technology, some irreversible impacts to the present surface water quality are expected in the immediate vicinity of the Goslin Flats leach pad. These impacts are not expected to be significant on a regional scale due to the existing poor water quality in the receiving drainage.

As part of the Zortman pit expansion, an additional 41 acres of watershed would be lost from the Lodgepole Creek drainage and diverted to the south (Table 4.2-2(a)). The total 67 acres of disturbance represent only approximately 1.5 percent of the total Lodgepole Creek drainage area, thus it is expected that impacts to flow within the Lodgepole Creek drainage from expansion of the Zortman Pits would be minimal.

4.2.7 Impacts from Alternative 5

The major modification to the CPA (see Alternative 4, Section 2.9) would be relocation of the ore heap leach facility to Upper Alder Gulch, instead of Goslin Flats (see Alternative 5, Section 2.10). This alternative was developed as a means of limiting the distribution of disturbance. Reclamation under this alternative would use a Modified Reclamation Cover C on the slopes of less than 5 percent. Modified Reclamation Cover C has 6 inches of compacted clay, overlain by a geomembrane (PVC) liner. Slopes of 5 percent or more would be reclaimed using reclamation cover B as is proposed for Alternative 4.

Modified reclamation requirements for the Landusky Mine would also require backfill of the pits so that surface water would drain freely to the northwest into King Creek rather than to Montana Gulch via the August drain adit (see Section 4.2-6). The fill removal and pit backfilling would re-establish the approximate pre-mining King Creek catchment area by reconnecting surface runoff from the August/Queen Rose pit areas with King Creek.

Infiltration Modeling

HELP modeling of slopes less than 5 percent suggest that approximately 79 percent of precipitation would evaporate, 9 percent would runoff the surface, 12 percent would drain laterally through the capillary break and only 0.005 percent would infiltrate (Table 4.2-7). The water budget for the slopes of 5 percent or greater would be as calculated for Alternative 4 (see Section 4.2.6).

Post-Reclamation Surface Water Quality

Development of the 80-million-ton leach facility in Upper Alder Gulch would create an additional 160 acres of disturbance. Disturbance to the soil, scree and bedrock during construction of the leach pad is likely to result in the generation of water quality similar to that observed at monitoring station Z-13 or L-28, exceeding aquatic life and human health criteria and therefore requiring capture and treatment.

Seepage from the reclaimed facility after perforation combined with baseflow is estimated at between 54 and 73 gpm, combined with the Carter Gulch waste rock repository seepage of 63 to 76 gpm, makes a total of between 117 and 149 gpm that would require capture and treatment.

As discussed in Section 4.2.6, effective water quality management is made difficult in this steep terrain due to the high degree of interaction between surface water and groundwater (see Section 3.2.6). This relationship makes it difficult to capture all the drainage from such a facility by use of a surface impoundment, thus increasing the risk of impacting surface and groundwater resources downstream. Conversely, the benefit of constructing two large facilities within the same already moderately-impacted drainage restricts the risk of future uncaptured acid rock drainage or process fluid spills to one drainage.

Downstream water quality in Alder Gulch is expected to be similar to that observed today (Table 4.2-1). However, due to the magnitude of earth moving associated with the Carter Gulch waste rock repository and the Alder Gulch leach pad and the high acid generating potential of the bedrock in these drainages, some longer-term minor increases in TDS and sulfate concentrations and loads are expected downstream due to some impacted water bypassing the capture systems (Table 4.2-1). The total average volume of water that would require capture and treatment in the short-term is estimated at between 322 and 423 gpm (Table 4.2-7).

The pit runoff to the north from the Landusky complex into King Creek would be restricted to precipitation that falls directly onto the pit floor. Estimated downstream surface water quality for King Creek under Alternative 5 is summarized on Table 4.2-1. Water quality is expected to remain similar to that observed in King Creek and South Bighorn Creek today with slightly elevated nitrates due to fertilization of revegetated areas. Some short-term elevated suspended solids concentrations are also expected during earthwork to construct the breach between the pits and King Creek and subsequent reclamation of the pit floor. As a result of the installation of a capture system at King Creek no adverse impacts would be expected to the beneficial uses downstream in Little Peoples Creek.

Impacts associated with the construction and operation of the LS-1 limestone quarry at Zortman and the King Creek quarry at Landusky will be the same as discussed for Alternative 4 in Section 4.2.6.

Long-term water quality trends expected under this alternative are shown schematically on the summary figure in Section 4.2.10.2. Although the potential for stopping active treatment does exist under this alternative, some long-term reduction in the efficiency of the reclamation covers proposed is expected (see Section 4.2.6).

Pit Reclamation

Agency mitigated reclamation for the Zortman pit complex includes the relocation of Alder Gulch waste rock dump, Ruby Gulch sulfide storage and the waste rock dump into the pit complex as backfill. This would concentrate the potentially acid generating materials in a more controlled environment and would significantly reduce the impacts at the materials existing location. Furthermore, for Alternatives 5, 6, and 7 at the Zortman mine, only materials with less than 0.5 percent sulfur would be placed below the water table and only NAG waste (less than 0.2 percent sulfur) would be placed in the zone where the backfill is expected to be saturated only some of the time due to seasonal fluctuations. These additional reclamation measures are expected to significantly reduce the amount of ARD generated within the backfill compared to the company proposed backfill plan. The use of the Modified Reclamation Cover C and the construction of a free draining pit surface would further reduce the amount of infiltration on the pit floor. However, as the majority of the reclaimed pit surface would be of slopes greater than 5 percent, the groundwater quality and quantity discharging from the backfilled and reclaimed open pit areas is expected to be similar to what has been discussed for Alternative 4. Reclamation of the

TABLE 4.2-7

ALTERNATIVE 5: AGENCY MITIGATED EXPANSION WITH ALDER GULCH LEACH PAD AND CARTER GULCH WASTE ROCK REPOSITORY

1. At Zortman and Landusky, slopes ≥5% have Reclamation Cover C, slopes <5% have modified reclamation cover B.
No testing required, all slopes at 3H:IV

Help Model Results	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	8.555	9.594
Evapotranspiration (as % of precipitation):	78.775	79.035
Lateral Drainage (as % of precipitation):	12.13374	4.04973
Infiltration (as % of precipitation):	0.00477	7.7882

Facility	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[2] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
ZORTMAN												
- 85/86 Leach Pad & Dike (removed)	Ruby Gulch	0.0						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike	Ruby Gulch	1.4						***3.0-5.0***	***2,000-3,000***	***1,000-2,000***	***3.0-5.0***	*Z-37*
- Ruby Gulch Waste Rock Dump (removed)	Ruby Gulch	0.0										
- OK Pit Waste Dump (removed)	Ruby Gulch	0.0										
- 82 Leach Pad (free draining)	Ruby Gulch	1.0										
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	1.5						3	878	615	5.06	Z-1 (downstream)
	TOTAL RUBY GULCH:	***3.9***	***69***	***40***	***50***	***44***	***54***	***3.0-5.0***	***500-900***	***300-700***	***3.0-5.0***	***Estimated water quality at Ruby Gulch capture system***
- 84 Leach Pad & Dike	Alder Spur	1.2										
- 83 Leach Pad & Dike	Alder Spur	0.8						4.1	2310	1460	1.98	Z-14 (downstream)
	TOTAL ALDER SPUR:	***1.9***	***4.8***	***2.0***	***4.0***	***4***	***6***	***4.5-6.0***	***1,000-2,500***	***500-1,600***	***1.0-3.0***	***Estimated water quality at Alder Spur capture system***
- Adler Gulch Waste Rock Dump (removed)	Carter Gulch	0.0						3.4	5450	3480	10.4	Z-13
- Carter Gulch Waste Rock Repository	Carter Gulch	13.2										
	TOTAL CARTER GULCH:	***13.2***	***108.0***	***NA***	***NA***	***63***	***76***	***3.0-5.0***	***3,000-6,000***	***2,500-4,000***	***4.0-9.0***	***Estimated water quality at Carter Gulch capture system***
- Upper Alder Gulch Leach Pad	Alder Gulch	11.0						6.4	448	249	0.03	Z-2
	TOTAL ALDER GULCH:	***11.0***	***126.0***	***NA***	***NA***	***54***	***73***	***4.0-7.0***	***1,000-2,000***	***1,000-2,000***	***1.0-5.0***	***Estimated water quality at Alder Gulch capture system***
LANDUSKY												
- 87/91 Leach Pad	Mill Gulch	6.6										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.3						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	0.2										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	1.1										
	TOTAL MILL GULCH:	***13.2***	***7.2***	***5.0***	***8.0***	***18***	***21***	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Mill Gulch capture system***
- 87/91 Leach Pad	Sullivan Creek	6.6										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	***8.5***	***2.9***	***0.0***	***4.0***	***9***	***13***	***4.0-5.0***	***2,000-3,000***	***1,500-2,000***	***5.0-9.0***	***Estimated water quality at Sullivan Creek capture system***
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	1.2										
- 84 Leach Pad & Dike	Montana Gulch	1.1										
- 85/86 Leach Pad & Dike	Montana Gulch	2.0						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	1.0						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	***9.5***	***250***	***120***	***170***	***130***	***180***	***7.0-8.0***	***700-1,000***	***400-600***	***0.4-0.7***	***Estimated water quality at Montana Gulch capture system***
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						*322*	*423*					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

Zortman pit complex so that it free drains to Ruby Gulch further reduces the potential for groundwater discharge to the north. This is due to the fact that in the absence of any preferred flow path such as a permeable structure or drainage adit; groundwater divides tend to mimic surface drainage divides. However, due to the structural complexity of the Little Rocky Mountains the potential for groundwater discharge to the north after backfilling the pits remains a concern.

Diverting the Landusky pit runoff north towards King Creek would have the positive impact of augmenting surface water flows onto the Fort Belknap Reservation. However, the runoff from the reclaimed pit surface is not expected to provide perennial flow to the headwaters of King Creek. The lack of any pre-1979 King Creek flow data makes it unclear what, if any, flow reductions have occurred in King Creek as a result of post-1979 mining activities. However, approximately 89 acres of potential drainage area have been disturbed, diverting flow into the Landusky Pit complex.

The reclamation plan for the Landusky pits under Alternative 5 also proposes a diversion drain at approximately 4,900 feet elevation to divert highwall runoff to the south before it comes into contact with the pit floor. This highwall runoff water may have a pH between 2 and 5, and elevated nitrate, sulfate, TDS, and metal concentrations (Schafer and Associates 1993 and 1994). As a result, this water would have to be captured and treated before being discharged.

The August Adit drainage would be at between 4,600 and 4,650 feet elevation (approximately 200 feet below King Creek) so the potentially acidic and elevated metal drainage from within the backfill would drain preferentially through the August Adit rather than towards King Creek and be captured and treated in Montana Gulch as discussed in Section 4.2.6. However, present day water levels suggest the potential does exist for some impacted groundwaters to migrate from the pits towards King Creek and/or Swift Gulch, although current water quality data suggests such flow is minimal.

As a result of deepening the pits at Landusky and diverting surface drainage from the pits to the north, it is expected that post-reclamation flow from the August and Gold Bug adits could potentially decrease. However as under all alternatives, treated waters from Sullivan Creek, Mill Gulch, and King Creek would be discharged to Montana Gulch. Flow in Montana Gulch is expected to remain perennial. Decreased flow volumes are not expected to have a significant effect below the confluence of Montana Gulch and Rock Creek.

Water Use

Water Appropriations required under Alternative 5 would be the same as Alternative 4, see discussion in Section 4.2.6.

4.2.7.1 Cumulative Impacts

Cumulative impacts associated with past, current and foreseeable activities at the Zortman and Landusky mine sites under Alternative 5 include construction of two large facilities in mountain valleys where water management is difficult. However, impacts are restricted to already disturbed drainages and treated and diverted runoff is proposed to be returned to its original drainage area at the Landusky mine.

Cumulative impacts associated with Alternative 5 would be as described for Alternative 4 in Section 4.2.6.1, with the following exceptions:

- Construction of the Alder Gulch leach pad and the Carter Gulch waste rock repository would result in compounded degradation of downstream water quality and further loss of currently undisturbed drainage areas. The impact to these drainage areas is considered very significant due to the current high quality of the water and near perennial flow conditions. Water quality degradation is anticipated despite source control actions due to the acid generating potential of the bedrock on which the facilities would be constructed.

- Mining would no longer be foreseeable in Pony Gulch due to there being no conveyor; however, prospects close to the Alder Gulch leach pad may be developed. Impacts would be similar to those described in Section 4.2.6.1 with the exception that they may be restricted to an already impacted drainage area.

- A positive impact would result from the diversion of pit floor runoff flow into King Creek supplementing current flow conditions.

Cumulative impacts under Alternative 5 are ranked as being highly negative.

4.2.7.2 Unavoidable Adverse Impacts

The diversion of surface water runoff from the Landusky pits into King Creek would likely reduce the amount of water discharging to Montana Gulch. However, flow in Montana Gulch is expected to remain perennial due to the discharge of treated waters from the neighboring drainages. The loss of flow from drainages from which captured water is withdrawn for treatment without being replenished also constitutes an unavoidable adverse impact.

4.2.7.3 Short-term Use/Long-term Productivity

Construction of the proposed Carter Gulch waste rock repository and the Alder Gulch leach pad represents a loss of approximately 343 acres of natural watershed. On the local scale this means the loss of a significant area of high quality perennial flow and the loss of a water supply for wildlife. Although the facility has a short operating life it would inhibit the long-term productivity of this watershed.

4.2.7.4 Irreversible or Irretrievable Resource Commitments

Diversion of flow from the Zortman pits into Ruby Creek would alter the drainage that once flowed northward into Lodgepole Creek. As discussed under Alternative 4 (Section 4.2.6.4), this diversion of flow represents a negligible impact on flow within Lodgepole Creek drainage.

4.2.8 Impacts from Alternative 6

Alternative 6 would approve expansion of both the Zortman and Landusky mines, but impose agency-developed mitigations on the expansion and reclamation activities. The major modification to the CPA (see Alternative 4, Section 2.8) would be the construction of a 60-million-ton waste rock repository on Ruby Flats just east of the Goslin Flats leach pad rather than in Carter Gulch as proposed for Alternatives 4 and 5. This alternative was developed primarily because a repository on Ruby Flats would be easier to construct and maintain than would a facility in the steep Carter Gulch drainage. The alternative would route the Landusky mine pit drainage and surface water runoff to Montana Gulch, rather than to the north into King Creek as in Alternative 5. Surface water runoff would be obtained by the construction of a drainage notch rather than draining it through the August adit as in Alternative 4.

Infiltration Modeling

Reclamation covers for pits, and sideslope angles for the existing pits, leach pads and waste rock piles would be as described for Alternative 5. The proposed Goslin Flats leach pad would be reclaimed with side slopes no greater than 2.5H:1V and 3H:1V where topography allows. At the proposed Ruby Flats waste rock repository, post reclamation side slopes would be at 3H:1V. HELP modeling for this alternative uses a 3H:1V overall sideslope as the slight differences on the dikes and possibly at Goslin Flats have a negligible effect on the water budget calculations. HELP model simulation of the Ruby Flats waste rock repository estimates that 79 percent of available precipitation would be lost to evapotranspiration, 8.5 percent to surface runoff. Lateral drainage would be approximately 12 percent on gentle slopes and 4 percent on steep slopes. On the gentle slopes it is estimated that infiltration would be approximately 0.005 percent and 8 percent on the side slopes. Any uncontrolled drainage from the facility has the potential to flow towards Ruby or Camp Creek.

Post-Reclamation Surface Water Quality

Some increases in concentrations of TDS and sulfate are expected in the surface water surrounding the waste rock repository and leach pad, primarily due to the exposure of more bedrock area during construction. These impacts are not considered significant on a regional scale due to the low quality of the receiving waters at these locations and the lack of any fishery or significant macroinvertebrate populations. Although no waste rock sorting is proposed for this alternative, the placement of a liner under the waste rock repository and the leach pad (see Section 2.9.1.1) would control the acid-generating potential of these facilities. In the long-term, acid rock drainage is expected, but it is possible that only passive treatment techniques such as wetlands and anoxic limestone drains may be needed to maintain a level of acceptable water quality. Excess water is expected to drain from the facilities leaving them "high and dry," with little infiltration available to transport the sulfide oxidation products.

The impacts associated with the construction and operation of the LS-1 and King Creek limestone quarries for reclamation materials would be as for Alternatives 4 and 5 (see Section 4.2.6).

The proposed location of the Ruby Flats waste rock repository is within 300 feet of the well head of the Zortman community water supply well Z-8A. Little potential exists for any vertical infiltration of ARD contaminated waters to the production zone of the well as it is completed 728 feet below ground level and the permeable limestones are overlain by a significant thickness of lower permeability shales. However, monitoring wells would have to be placed in the surrounding alluvium and underlying shale to ensure that any seepage did not have the opportunity to pond around the well casing. In the unlikely event of this occurring an alternative water supply well could be developed to avoid the risk of any contaminant entering the well by flowing down around the well casing. Therefore, the impact to the Zortman water supply well is not considered to be significant.

The salvaging of the soil from the footprint of the proposed Ruby Flats waste rock repository (203 acres) and the Goslin Flats leach pad (approximately 250 acres), combined with the clearance of a corridor for the associated conveyor is expected to result in significant amounts of suspended solids entering the upper and lower reaches of Goslin Creek, Alder Gulch and the lower reaches of Ruby Creek and Camp Creek. Although the solids would likely be held in suspension for a relatively short-time, the longer term impact would be a buildup of fines in the stream bottoms. If not controlled by efficient sediment traps this has the potential to be a local impact, degrading potential macroinvertebrate habitat in the short- to mid-term. Long-term water quality trends expected for the Goslin Flats leach pad and Ruby Flats waste rock repository are shown schematically on the summary figure in Section 4.2.10.2. Although the potential for stopping active treatment does exist under this alternative, some long-term reduction in the efficiency of the reclamation covers proposed is expected (see Section 4.2.6). The total volume of water that will require capture and treatment from both mines in the short-term under Alternative 6 is estimated at between 244 and 313 gpm (Table 4.2-8).

Post-reclamation surface water quality impacts associated with the removal of the Alder Gulch waste rock dump and Ruby Gulch tailing would be as discussed for Alternative 3 in Section 3.2.5.

Pit Reclamation

As a result of deepening the pits at Landusky to levels below the August and Gold Bug adits, discharge volumes are expected to decrease during the period of mining. Once the pits are backfilled, water discharges are expected to recover to some degree, but adit discharges are expected to remain depressed due to the decreased volume of recharge through the impermeable cover on the pit backfill. Under this alternative, pit runoff would be drained to the stream through a drainage notch across the drainage divide between the August Pit and Montana Gulch. A slight improvement in downstream water quality is expected due to the reduction of flow from a known source of metals (Gold Bug Adit) and the return of good quality runoff water (Table 4.2-1). Other impacts to water resource associated with the expansion and subsequent reclamation of the Zortman and Landusky pits would be as discussed for Alternative 5 in Section 4.2.7.

Water Use

Water appropriations required under Alternative 6 would be the same as Alternative 4, see discussion in Section 4.2.6.

4.2.8.1 Cumulative Impacts

Cumulative impacts associated with past, current and foreseeable activities at the Zortman and Landusky mine sites under Alternative 6 include the construction of two large facilities on the flats to the south of the Little Rocky Mountains and the foreseeable development of a mine in Pony Gulch.

Cumulative impacts from Alternative 6 would be as described for Alternative 4 in Section 4.2.6.1, with the following exceptions:

- Construction of the Ruby Flats waste rock repository rather than the Carter Gulch waste rock repository puts both the new leach pad and waste rock facilities in an environment where water quality can be much more successfully managed, resulting in minimal impacts to water quality on the flats.

Cumulative Impacts under Alternative 6 are ranked as moderately negative.

4.2.8.2 Unavoidable Adverse Impacts

The diversion of the Zortman and Landusky Pit floor runoff to the south into Ruby and Montana Gulches leaves the adverse impact of decreased flow to the north unaddressed. However, it does provide assurance against any water degradation from poor quality runoff. Other unavoidable adverse impacts would be as described in Section 4.2.7.2.

TABLE 4.2-8
ALTERNATIVE 6: AGENCY MITIGATED EXPANSION WITH GOSLIN FLATS LEACH PAD AND RUBY FLATS WASTE REPOSITORY

1. At Zortman and Landusky, slopes ≥5% have Reclamation Cover C, slopes <5% have modified reclamation cover B.
   No testing required, all slopes at 3H:1V

Help Model Results

	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	8.555	8.594
Evapotranspiration (as % of precipitation):	78.775	79.035
Lateral Drainage (as % of precipitation):	12.13374	4.04973
Infiltration (as % of precipitation):	0.00477	7.7882

Facility	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[1] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
ZORTMAN												
- 85/86 Leach Pad & Dike (removed)	Ruby Gulch	0.0						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike	Ruby Gulch	1.4						3.0-5.0	2,000-3,000	1,000-2,000	3.0-5.0	Z-37
- Ruby Gulch Waste Rock Dump (removed)	Ruby Gulch	0.0										
- OK Pit Waste Dump (removed)	Ruby Gulch	0.0										
- 82 Leach Pad (free draining)	Ruby Gulch	1.0										
- 79/80/81 Leach Pad (free draining)	Ruby Gulch	1.5						3	878	615	5.06	Z-1 (downstream)
	TOTAL RUBY GULCH:	3.9	69	40	50	44	54	3.0-5.0	500-900	300-700	3.0-5.0	Estimated water quality at Ruby Gulch capture system
- 84 Leach Pad & Dike	Alder Spur	1.18										
- 83 Leach Pad & Dike	Alder Spur	0.75						4.1	2310	1460	1.98	Z-14 (downstream)
	TOTAL ALDER SPUR:	1.9	4.8	2.0	4.0	4	6	4.5-6.0	1,000-2,500	500-1,600	1.0-3.0	Estimated water quality at Alder Spur capture system
- Adler Gulch Waste Rock Dump (removed)	Carter Gulch	0.0						3.4	5450	3480	10.4	Z-13
	TOTAL CARTER GULCH:	0.0	-0.3	0.0	4.0	0	0	3.0-5.0	3,000-6,000	2,500-4,000	4.0-9.0	Estimated water quality at Carter Gulch capture system
- Ruby Flats Waste Repository	Ruby Flats/Camp Creek	14.0										
	TOTAL RUBY FLATS/CAMP CREEK	14.0		0.0	0.0	14	14	6.5-7.0	800-1,500	400-800	0.02-0.05	Estimated water quality at Ruby Flats/Camp Creek capture system
- Goslin Flat Leach Pad	Goslin Gulch	14.7						7.4-8.0	851-1,030	414-506	0.005-0.02	Z-35
	TOTAL GOSLIN GULCH:	14.7		0.0	0.0	15	15	6.5-7.0	800-1,500	400-800	0.005-0.02	Estimated water quality surrounding heap leach
LANDUSKY												
- 87/91 Leach Pad	Mill Gulch	6.6										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.3						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	0.2										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	1.1										
	TOTAL MILL GULCH:	13.2	7.2	5.0	8.0	18	21	4.0-5.0	2,000-3,000	1,500-2,000	5.0-9.0	Estimated water quality at Mill Gulch capture system
- 87/91 Leach Pad	Sullivan Creek	6.6										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	8.5	2.9	0.0	4.0	9	13	4.0-5.0	2,000-3,000	1,500-2,000	5.0-9.0	Estimated water quality at Sullivan Creek capture system
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	1.2										
- 84 Leach Pad & Dike	Montana Gulch	1.1										
- 85/86 Leach Pad & Dike	Montana Gulch	2.0						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	1.0						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	9.5	250	130	180	140	190	7.0-8.0	700-1,000	400-600	0.4-0.7	Estimated water quality at Montana Gulch capture system
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						244	313					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

4.2.8.3 Short-term Use/Long-term Productivity

The presently undisturbed prairie at Goslin Flats and Ruby Flats acts primarily as a water catchment area. The short-term productivity of this area would be lost due to the construction of the Goslin Flats leach pad and the Ruby Flats waste rock repository. The catchment area would be regained in the long-term following reclamation and resumption of modified runoff patterns.

4.2.8.4 Irreversible or Irretrievable Resource Commitments

Irretrievable resource commitments under this alternative would be limited when compared to alternatives 4 and 5, as the long-term productivity of the drainage areas covered by the Goslin Flats leach pad and the Ruby Flats waste rock repository would not be lost.

4.2.9 Impacts from Alternative 7

The major modification to the CPA would be at the Zortman Mine, where the proposed waste rock repository would be constructed on top of the existing facilities at the mine. Use of this area for waste rock storage confines disturbance predominantly to areas and facilities already disturbed by mining activity while providing the cap on top of the existing facilities that currently require reclamation. This alternative also uses a combination of "water barrier" and "water balance reclamation covers" (see Section 2.11.2.1), as opposed to the barrier-type covers described for Alternatives 2, 4, 5, and 6. At the Landusky Mine reclamation would include routing surface runoff from the pit complex into Montana Gulch as described for Alternative 6.

Infiltration Modeling

For Alternative 7, the same side slopes are proposed as would be used in Alternative 6, with between 2.5H:1V and 3H:1V on the Goslin Flats leach pad.

HELP model simulation of the Alternative 7 water balance reclamation cover for slopes greater than or equal to 25 percent shows that approximately 82 percent of precipitation would be lost to evapotranspiration, 8 percent to runoff and approximately 10.5 percent would remain to infiltrate into the facility (Table 4.2-9). On the slopes of less than 25 percent the use of the GCL results in approximately 79 percent of precipitation being lost to evapotranspiration, 9 percent to runoff 4 percent to lateral drainage and 8 percent to infiltration.

Overall, modeling shows the water balance covers to intercept a comparable amount of precipitation when compared to the barrier types covers proposed for Alternatives 4, 5, and 6. This is due to GCL covers being used on slopes less than 25 percent whereas the composite clay/PVC liners would be limited to slopes of less than 5 percent. Although infiltration estimates are higher for the water balance covers and the GCL barrier covers, the long-term effectiveness of the water balance covers is expected to be better due to the significant thickness of soil available for establishing and maintaining a good vegetative cover and the lack of any impermeable compacted clay or synthetic barrier that could desiccate or be damaged in the future.

Post Reclamation Surface Water Quality

Only a small additional area of disturbance would be required for the Alternative 7 waste rock repository, as a result water quality degradation due to exposing more potentially acid generating bedrock below the facility would be minimized. Additionally, the use of the GCL in the reclamation cover on slopes of less than 25 percent would result in the majority of the pit backfill being covered with an effective long-term barrier to infiltration, thereby reducing the volume of drainage requiring capture and treatment. Expected short-term water quality at the capture points is shown on Table 4.2-9.

Surface water quality impacts associated with the salvaging of soils, subsoil, and gravels from the Ruby Flats area for the water balance covers would essentially be the same as those discussed for Alternative 3. Potential impacts to water resources associated with the salvaging of these materials would be limited to elevated concentrations of suspended solids entering Goslin Creek and/or Ruby Creek during salvage operations. Although BMP's would be used to control such runoff, the large surface area (250 acres) increases the potential for some sediment runoff during extreme precipitation events. Such runoff would result in short-term concentrations of suspended solids and some longer-term elevated accumulation of sediments in the streambed. These impacts are considered only moderate as no known fisheries exist in the receiving water and macroinvertebrate populations are limited. Additional soil salvaging would also be required in the footprint of the Goslin Flats leach pad. The flat nature of the terrain and the resultant gentle hydraulic gradient combined with the low permeability of the shales underlying the proposed Goslin Flats leach pad, would significantly aid monitoring and recovery of any released

TABLE 4.2-9
ALTERNATIVE 7: MINE EXPANSION AND RECLAMATION WITH WASTE ROCK REPOSITORY LOCATED ON EXISTING MINE FACILITIES AT ZORTMAN

Help Model Results

	Flat Surfaces	Side Slopes
Surface Runoff (as % of precipitation):	8.555	7.676
Evapotranspiration (as % of precipitation):	78.775	81.821
Lateral Drainage (as % of precipitation):	4.35854	0.00001
Infiltration (as % of precipitation):	8.04063	10.50299

1. At Zortman and Landusky, slopes ≥25% have water balance cover, slopes <25% have modified reclamation cover B. No testing required, all slopes at 3H:IV.

	Drainage	Modeled Seepage through Facility (gpm)	Estimated Current Groundwater Seepage[1] (gpm)	Modified Groundwater Seepage[2] (gpm)		Estimated Combined Seepage Volumes Requiring Capture & Treatment (gpm)		1994 Existing Water Quality (plain text); Estimated 5-yr. Water Quality (bold italics)				Comments
				Low	High	Low	High	pH (su)	TDS (mg/L)	Sulfate (mg/L)	Zinc (mg/L)	
ZORTMAN												
- 85/86 Leach Pad & Dike (100% covered)	Ruby Gulch	0.0						2.9	2760	1920	5.4	Z-37
- 89 Leach Pad & Dike (32% covered)	Ruby Gulch	0.8						*3.0-5.0*	*2,000-3,000*	*1,000-2,000*	*3.0-5.0*	*Z-37*
- Ruby Gulch Waste Rock Rock Dump (removed)	Ruby Gulch	0.0										
- OK Pit Waste Dump	Ruby Gulch	0.9										
- 82 Leach Pad (free draining)	Ruby Gulch	1.8										
- 79/80/81 Leach Pad (free draining) (72% covered)	Ruby Gulch	0.4						3	878	615	5.06	Z-1 (downstream)
- *Alt. 7 Waste Rock Repository*	*Ruby Gulch*	*10.5*										
	TOTAL RUBY GULCH:	*14.4*	*69.3*	*25.0*	*35.0*	*39*	*49*	*3.0-5.0*	*500-900*	*300-700*	*3.0-5.0*	*Estimated water quality at Ruby Gulch caputre system*
- 84 Leach Pad & Dike (92% covered)	Alder Spur	0.2										
- 83 Leach Pad & Dike (93% covered)	Alder Spur	0.1						4.1	2310	1460	1.98	Z-14 (downstream)
- *Alt. 7 Waste Rock Repository*	*Alder Spur*	*6.0*										
	TOTAL ALDER SPUR:	*6.3*	*4.8*	*2.0*	*4.0*	*8*	*10*	*4.5-6.0*	*1,000-2,500*	*500-1,600*	*1.0-3.0*	*Estimated water quality at Alder Spur capture system*
- Adler Gulch Waste Rock Dump	Carter Gulch	1.8						3.4	5450	3480	10.4	Z-13
	TOTAL CARTER GULCH:	*1.8*	*-0.3*	*0.0*	*4.0*	*2*	*6*	*3.0-5.0*	*3,000-6,000*	*2,500-4,000*	*4.0-9.0*	*Estimated water quality at Carter Gulch capture system*
- *Goslin Flat Leach Pad*	*Goslin Gulch*	*28.1*						*6.5-7.5*	*800-1,500*	*400-800*	*0.005-0.05*	*Z-35*
	TOTAL GOSLIN GULCH:	*28.1*	*0.0*	*0.0*	*0.0*	*28*	*28*	*6.5-7.5*	*800-1,500*	*400-800*	*0.005-0.05*	*Estimated water quality surrounding heap leach*
LANDUSKY												
- 87/91 Leach Pad	Mill Gulch	10.8										
- Mill Gulch Waste Rock Dump	Mill Gulch	5.1						4	2460	1620	8.43	
- 79 Leach Pad (free draining)	Mill Gulch	0.7										
- 80/81/82 Leach Pad (free draining)	Mill Gulch	2.7										
	TOTAL MILL GULCH:	*19.4*	*7.2*	*5.0*	*8.0*	*24*	*17*	*4.0-5.0*	*2,000-3,000*	*1,500-2,000*	*5.0-9.0*	*Estimated water quality at Mill Gulch capture system*
- 87/91 Leach Pad	Sullivan Creek	10.8										
- 87/91 Dike	Sullivan Creek	1.9						2.8	14700	9960	25.4	L-28 (downstream; 1992)
	TOTAL SULLIVAN CREEK:	*12.6*	*2.9*	*0.0*	*4.0*	*13*	*17*	*4.0-5.0*	*2,000-3,000*	*1,500-2,000*	*5.0-9.0*	*Estimated water quality at Sullivan Creek capture system*
- Gold Bug Pit Waste Rock Repository	Montana Gulch	4.2										
- Montana Gulch Waste Rock Dump	Mont Gulch/King Creek	2.9										
- 84 Leach Pad & Dike	Montana Gulch	1.6										
- 85/86 Leach Pad & Dike	Montana Gulch	3.1						7.7	806	489	0.52	L-16
- 1983 Leach Pad & Dike	Montana Gulch	2.4						6.6	4670	2920	1.56	ZL-114R data used because surface stations are generally dry
	TOTAL MONTANA GULCH:	*14.3*	*250.0*	*130.0*	*180.0*	*144*	*194*	*7.0-8.0*	*700-1,000*	*400-600*	*0.4-0.7*	*Estimated water quality at Montana Gulch capture system*
TOTAL ESTIMATED FLOW REQUIRING CAPTURE & TREATMENT (gpm):						*258*	*321*					

Notes:
1. "Estimated Current Groundwater Seepage" is equal to "Measured Total Seepage Volume" less "Modeled Seepage Through Facility" computed for Current Unreclaimed Non-Perforated Conditions.
2. "Modified Groundwater Seepage" is equal to "Estimated Current Groundwater Seepage" reduced to account for the reduction in recharge due to capping of pits, haul roads, etc. under each alternative.

contaminant. Some minor water quality degradation in the form of increases in TDS, sulfate, etc. is expected to occur in surface water and alluvial groundwater surrounding the leach pad. These impacts would be primarily due to exposing a large area of bedrock to oxidation during construction are considered only moderately significant due to the poor quality of the water in the receiving drainage.

Reduced constituent loads are expected at Ruby and Carter Gulch due to removal of the Alder Gulch waste rock dump, the Ruby Gulch tailing, the proposed sorting of backfill and their effective reclamation of the Zortman pit complex. A reduction in volume requiring capture and treatment is also expected if precipitation falling on these reclaimed areas can be diverted around the capture ponds. As was discussed in Section 4.2.5, despite the use of best management practices, removal of the Ruby Gulch tailing as is proposed for Alternatives 3, 5, 6, and 7 is expected to result in limited amounts of sediment runoff into lower Ruby Gulch and potentially Ruby Creek. The impacts associated with such releases are expected to be relatively minor as similar sediments as those being disturbed have been present and have been moving within the drainage channel for many years. Special mitigation measures for the Ruby Gulch tailing removal and channel reclamation project include a sediment control plan with particular emphasis on potential impacts to the town of Zortman.

Formation of significant volumes of ARD contaminated water from spent ore pads is not likely under Alternative 7 due to the lengthy duration of sampling required to establish acceptable cyanide and metal concentrations and because of the minimal amount of infiltration expected through the enhanced reclamation covers.

Downstream surface water quality under Alternative 7 is expected to be similar to that currently observed (Table 4.2.1). The quality in many drainages may actually improve due to the enlargement of capture systems and added cutoff walls and recovery wells intercepting poor quality surface water (described in Appendix A).

Long-term water quality trends expected under Alternative 7 are shown schematically on the summary figure in Section 4.2.10.2. The total volume of water that would require capture and treatment is estimated at between 258 and 321 gpm (Table 4.2-9).

Pit Reclamation

Backfill for the Zortman pits would be derived from existing mine facilities and/or waste rock produced during continued mine development. This material, in conjunction with that generated by the proposed mining activities, would raise the pit to approximately 4,800 feet above mean sea level; the elevation necessary to drain freely into Ruby Gulch and Alder Spur reducing the potential for groundwater discharge to the north. This is due to the fact, that in the absence of any preferred flow path such as a permeable structure or drainage adit, groundwater divides tend to mimic surface drainage divides. However, due to the structural complexity of the Little Rocky Mountains, the potential for groundwater discharge to the north after backfilling the pits remains.

As for Alternatives 5 and 6 backfill at the Zortman pit complex could be restricted to materials with less than 5 percent sulfur, and materials in the zone of seasonal water level fluctuation would be limited to NAG waste (less than 0.2 percent sulfur). Backfilling consolidates the rock and may slow the oxidation (rates) of sulfides. Nevertheless, backfilling of the open pits with mined material -- either waste rock or spent ore -- is likely to degrade the water quality relative to baseline even if the waters do not become acidic. At both pits the saturated backfill will receive recharge of oxygenated water from the buried pit walls and likely become a source of continued discharge.

As a result of deepening the pits at Landusky to levels below the August and Gold Bug adits, discharge volumes are expected to decrease during mining activities. Once the pits are backfilled, water discharges are expected to recover to some degree, but adit discharges are expected to remain reduced due to the decreased volume of recharge through the low permeability cover on the pit floor. Under this alternative as with alternative 6, pit highwall runoff would be drained to Montana Gulch and treated before being discharged to Montana Gulch. A slight reduction in downstream water quality is expected due to the reduction of flow from a known source of metals (Gold Bug Adit) and the return of good quality runoff water to the stream after treatment (Table 4.2-1).

Current water level conditions suggest that water in the Suprise Shear Zone is draining northeast from the Landusky Mine area towards Swift Gulch. Therefore, under Alternative 7 some potential remains for a component of groundwater flow to the north and northeast, despite the free drainage of the pit complex to the south. This water, although likely limited in volume, may be of poor quality and may require capture and treatment, although currently capture and treatment is not required.

Reclamation Materials

As well as the reclamation materials obtained from removal of the Ruby Gulch tailing and salvaging of soils and gravels at Goslin Flats, some mining of limestone will be required at the Zortman mine from the LS-2 quarry in Alder Spur and the Montana Gulch limestone quarry at Landusky (see Exhibits 1 and 2). Impacts associated with the development, operation, and reclamation of these facilities are anticipated to be limited to some minor elevation of suspended solids concentrations in Montana Gulch and potentially Alder Spur if construction activities were to coincide with extreme periods of precipitation. These impacts are not anticipated to be significant due to their short-term nature and lack of any fishery or significant macroinvertebrate population in the immediate receiving waters.

Water Use

As with the other expansion alternatives, Alternative 7 would require an average water appropriation of 190 gpm for the expanded Zortman operation and 260 gpm at Landusky. These volumes include makeup water for the new process circuit, dust control, and ore wetting losses. The 190 gpm required at Zortman is already available from a permitted water supply well. At Landusky the current appropriation would be sufficient for the proposed operation. However, approximately 170 gpm of this water is currently derived from the Gold Bug adit discharge. As discussed, this alternative may reduce the volume of flow from the Gold Bug adit, so an additional source of water may be required. The additional worst case of 170 gpm is considered to be attainable with no significant impact to groundwater resources available in the Little Rocky Mountains.

4.2.9.1 Cumulative Impacts

Cumulative impacts associated with past, current and foreseeable activities at the Zortman and Landusky mine sites under Alternative 7 would include:

- Construction of the Goslin Flats leach pad degrading water quality in the vicinity of the leach pad in the short-term primarily due to disturbing the mineral rich shales.
- Enhanced reclamation covers that are expected to be successful in controlling infiltration.
- Pit backfill and reclamation with a low permeability barrier would reduce the amount of base flow under facilities, and the overall volume of water requiring capture and treatment.
- Approval of the mine expansion and construction of the conveyor to Goslin Flats, would likely result in future exploration activities. Water resource impacts associated with reasonably foreseeable activities would involve short-term increases in suspended solids and TDS concentrations. Road building would increase TSS and metal concentrations in drainage areas potentially unimpacted at present.
- It is reasonably foreseeable that the Big Flat Electric Cooperative would construct a 53-mile, 69-K-V transmission line from the Malta Western Area Power Administration Tie Substation to Goslin Flats (see Section 2.8.4.1). As the line would consist of single wood poles structures and would parallel Highway 191 along existing right-of-way for the majority of its route, no significant impact to water resources of the area is anticipated.
- The reasonably foreseeable development of the Pony Gulch ore body is less likely to generate acid rock drainage due to the buffering capacity of the limestone host rock. However excavation, road building, etc. would have an adverse impact on the present water quality in Pony Gulch. It is likely that these actions would cause adverse impacts including elevating TDS, TSS and sulfate concentrations, in the short- to mid-term.

Differences in cumulative impacts resulting from Alternative 7 compared to the other expansion alternatives include less disturbance and resultant water degradation by placing the waste rock repository on top of existing disturbances that require reclamation covers and use of the LS-1 and King Creek quarries only as a contingency only if more NAG materials are required. Cumulative impacts resulting from Alternative 7 are ranked as low negative.

4.2.9.2 Unavoidable Adverse Impacts

The diversion of the Zortman and Landusky pit floor runoff to the south into Ruby Gulch, Alder Spur and Montana Gulch leaves the adverse impact of decreased flow to the north unaddressed. This diversion of flow to the south is considered to be significant at King Creek. The redistribution of flow due to the discharge of treated waters at Ruby and Montana Gulches is also an unavoidable adverse impact, although it is not considered to be significant due to the predominantly ephemeral or intermittent nature of the drainages.

4.2.9.3 Short-term Use/Long-term Productivity

The presently undisturbed prairie at Goslin Flats acts predominantly as a water catchment area. The short-term productivity of this area would be lost due to the construction of the Goslin Flats leach pad. The catchment area would be almost entirely regained in the long-term following reclamation and resumption of previous runoff patterns, therefore there is no significant loss in long-term productivity at Goslin Flats.

4.2.9.4 Irreversible or Irretrievable Resource Commitments

The Goslin Flats leach pad would be constructed in an area where the water resources are currently not impacted by past mining activity, but presently contain naturally high concentrations of TDS and sulfate (Section 3.2.5). Despite the best available source control and capture and treatment technology, some irreversible impacts to the present surface water quality are expected in the immediate vicinity of the Goslin Flats leach pad. These impacts are not expected to be only moderately significant due to the current (baseline) poor quality of the water and the lack of any fishery in the receiving drainages. As part of the Zortman pit expansion, an additional 41 acres of watershed would be lost from the Lodgepole Creek drainage and diverted to the south (Table 4.2-2(a)). The total 67 acres of disturbance represents only approximately 1.5 percent of the total Lodgepole drainage area upstream of the Fort Belknap Indian Reservation, thus impacts to flow within the Lodgepole drainage from expansion of the Zortman pits would be minimal.

4.2.10 Water Resources Impacts Summary

4.2.10.1 Non-Mine Expansion Alternatives Impact Summary

Infiltration modeling of the non-extension alternatives shows that Alternative 3 would provide the best long-term barrier to infiltration. The following average percentages of available precipitation are predicted to infiltrate into facilities over the first 20 years of reclamation:

	Flat Area	Side Slopes
• Alternative 1	23%	23%
• Alternative 2	23%	23%
• Alternative 3	8%	10.5%

Alternative 2 would use an additional 6 inches of clay underlying the 8 inches of topsoil that is proposed for Alternative 1 wherever field testing indicates that a facility may have acid generating potential. Infiltration estimates have assumed that only 50 percent of the tested areas would end up having the composite clay and topsoil reclamation cover; the clay layer is also anticipated to become severely desiccated after a short time (due to freeze thaw and dehydration effects) to the extent that it would provide little if any further reduction in infiltration. The desiccated clay would be expected to provide a thicker growth medium for revegetation; however as only 50 percent of the reclaimed area would have had the clay placed, resultant average infiltration estimates are essentially the same as that made for 8 inches of soil only under Alternative 1.

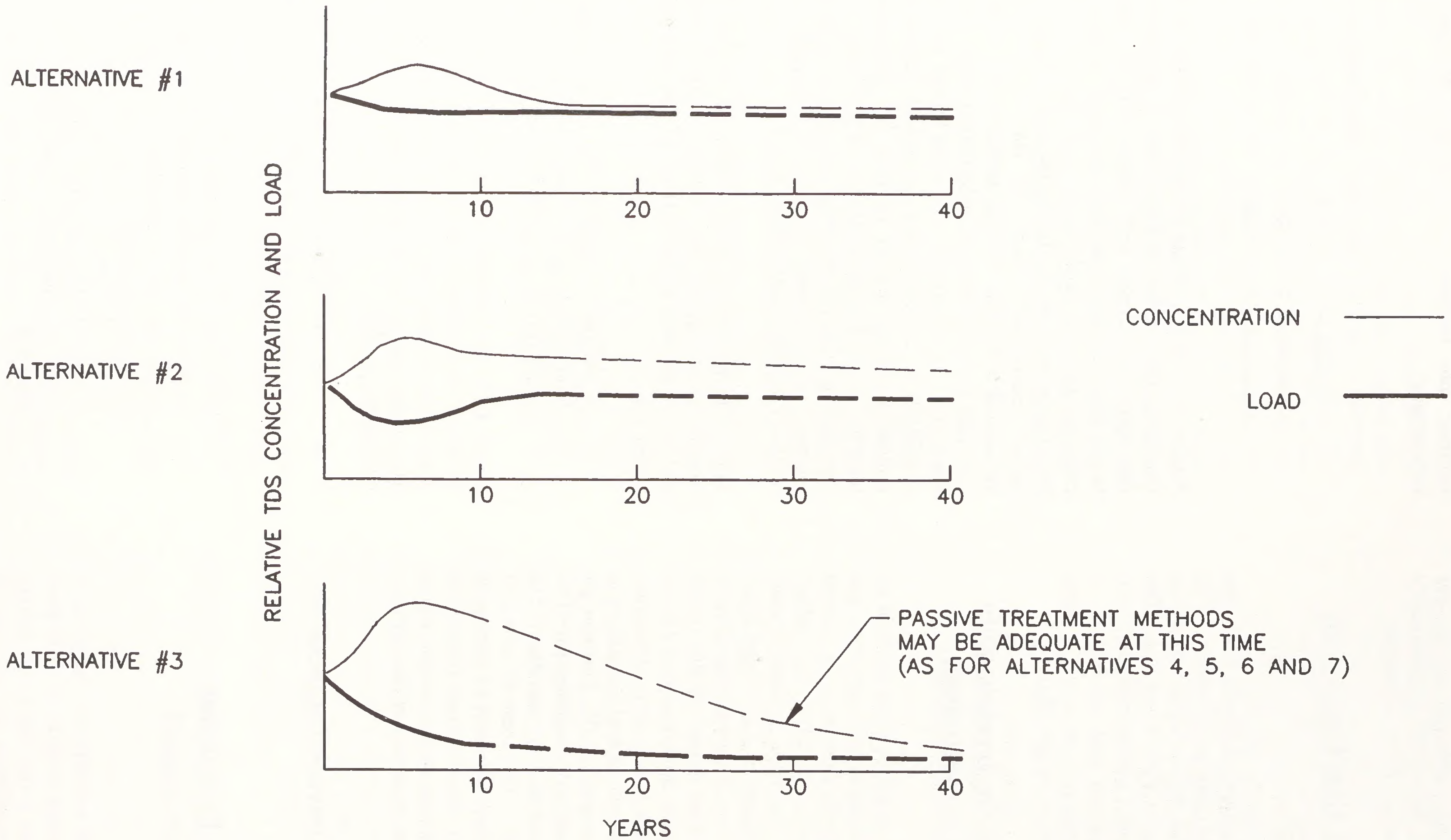
Total estimated annual average volumes of drainage that would require capture and treatment at the Zortman and Landusky mines in the short-term (approximately 20 years) are:

- Alternative 1, approximately 378 to 450 gpm
- Alternative 2, approximately 348 to 419 gpm
- Alternative 3, approximately 211 to 284 gpm

Figure 4.2-1 schematically summarizes the long-term trends in relative TDS (total water quality indicator) water concentrations and loads seeping from facilities. The major points to be noted regarding the three non-expansion alternatives are:

- Under Alternative 1, water quality conditions are expected in the long-term to remain similar to what is presently observed.

- Alternative 2 is expected to provide a short-term barrier to infiltration where the 6 inch clay cap is applied, causing short-term increases in concentration and decreases in loads. However, because the long-term reliability of the clay cap is questionable, long-term water quality may return to conditions similar to those presently observed.



NOTE:
TDS AS SHOWN IS MEANT TO BE REPRESENTATIVE OF TOTAL WATER QUALITY INCLUDING SULFATE, METALS ETC.

Job No. :	23173E
Prepared by :	I.R.F
Date :	12/29/94

ESTIMATED LONG-TERM POST RECLAMATION WATER QUALITY FOR NON EXPANSION ALTERNATIVES 1, 2 AND 3

FIG. 4.2-1

73001

- As part of Alternative 3, the Alder Gulch waste rock dump and the 85/86 leach pad and dike would be removed from southern drainages of the Zortman Mine.

- Alternative 3 provides water budget and GCL barrier reclamation covers which efficiently reduce infiltration into the underlying facilities by enhancing the evapotranspiration of water held in storage by the significant thickness of soil. The GCL covers provide a low permeability barrier, which enhances lateral drainage and is not as susceptible to desiccation from freeze thawing or dehydration as compacted clay.

- Under Alternative 3, short-term concentrations are expected to increase and loads are expected to reduce rapidly. In the long-term, the facilities are expected to reach static hydraulic conditions (little discharge), which would inhibit the generation and transportation of acid rock drainage.

In summary, this analysis shows that among the non expansion alternatives only under Alternative 3 would there be any opportunity to shut down active treatment of seepage, and replace it with passive treatment systems. Although Alternative 3 still has the potential to require long-term capture and treatment.

4.2.10.2 Mine Expansion Alternatives Impact Summary

Infiltration modeling of extension Alternatives, 4, 5, 6, and 7 shows all four to result in the similar percentage of infiltration on facility side slopes. Although the water barrier caps proposed in Alternative 4, 5, and 6 appear to attain the best or smallest amount of infiltration into the facilities, in the short-to mid-term; it is anticipated that the long-term integrity of the reclamation covers proposed for Alternative 7 will be better.

The following percentages of available precipitation are predicted to infiltrate into the facilities.

		Side Slope	
	Flat Area	3:1	2:1
• Alternative 4	0.03	7.8	8.0
• Alternative 5	0.005	7.8	
• Alternative 6	0.005	7.8	
• Alternative 7	8.0	10.5	

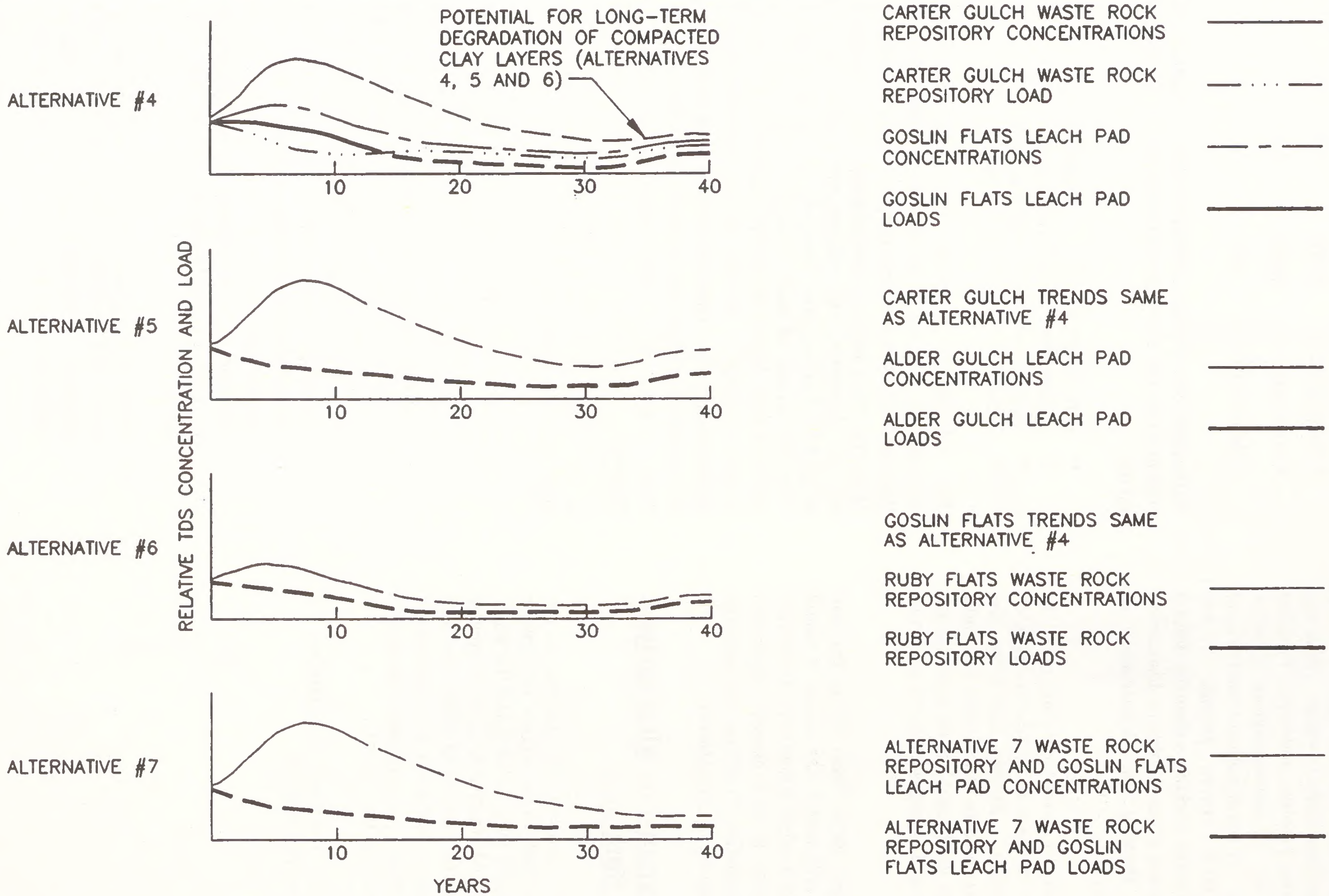
Estimated total average volumes requiring capture and treatment in the short to mid-term (20 years) are (in gpm):

- Alternative 4: 307 to 389 gpm
- Alternative 5: 322 to 423 gpm
- Alternative 6: 244 to 313 gpm
- Alternative 7: 258 to 321 gpm

The PVC/clay composite covers proposed for Alternatives 4, 5, and 6 obtain a lower infiltration rate than the GCL barrier covers proposed for Alternative 7. However, Alternative 7 avoids many other significant impacts associated with mining and hauling the clay needed for Reclamation Covers B, C, and Modified C. Also, the success of these reclamation covers does not rely on a high degree of Quality Assurance and Quality Control (QA/QC). Finally, the long-term integrity of the Alternative 7 reclamation cover is greater since they do not rely on compacted clay, which may desiccate over time. Figure 4.2-2 schematically summarizes the expected long-term trends in relative TDS concentrations and loads seeping from facilities. The major points to be noted regarding the four mine expansion alternatives are:

- Alternative 4 places the leach pad on Goslin Flats and the waste rock repository in Carter Gulch. The long-term reduction of acid rock drainage generation is expected to be effective at the Goslin flats facility, as it would eventually drain, becoming "high and dry." Water quality management would be difficult for a waste rock repository constructed in Carter Gulch with underdrainage providing an ongoing source of oxygen and water to transport acid rock drainage, thereby reducing the effectiveness of its enhanced reclamation cover in the long-term.

- Alternative 5 places both the leach pad and the waste rock repository within the Alder Gulch drainage. Although a significant reduction of infiltration and resultant acid rock drainage



NOTES:

1. TDS AS SHOWN IS MEANT TO BE REPRESENTATIVE OF TOTAL WATER QUALITY INCLUDING SULFATE, METALS, ETC.
2. EXISTING FACILITIES WOULD HAVE SOME LONG-TERM WATER QUALITY TRENDS AS SHOWN IN ALTERNATIVE #3 (FIGURE 4.2-1)

ESTIMATED POST RECLAMATION WATER QUALITY FOR EXPANSION ALTERNATIVES 4, 5, 6, AND 7

FIG. 4.2-2

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generation is expected, underdrainage would likely provide a significant source of acid rock drainage in the long-term. Construction of both facilities in this steep drainage with near perennial flow and sulfide rich bedrock also increases the potential for downstream impacts to water quality and constitutes a significant loss of high quality water resources.

- Alternative 6 places both the leach pad and the waste rock repository on Goslin Flats. Construction on flat land above the water table, combined with the proposed enhanced reclamation covers, is expected to allow both facilities to drain, essentially becoming "high and dry." The flat topography and resultant flat hydraulic gradient underlying these facilities would also allow effective monitoring and recovery of any unforeseen seepage from the facilities. Soil salvaging within the footprint of these facilities is expected to generate some short-term periods of elevated suspended solids in the surrounding drainages.

- Alternative 7 places the leach pad on the flats above the water table in an environment suited for effective, water quality management. It also places the waste rock repository on top of existing waste rock piles, leach pads and pits. This location creates little additional disturbance, concentrates the impact in drainage systems with existing mitigation measures and provides the reclamation cover required for the majority of the existing Zortman mine facilities. The combination of water barrier and water balance type-reclamation covers proposed with this alternative reduce infiltration and the volumes requiring treatment, but do not preclude the possible need for long-term capture and treatment of impacted waters.

In summary, under all four mine expansion alternatives, there is potential to scale down treatment of seepage at some point in the future. The long-term effectiveness of the enhanced reclamation covers is, however, better on the flat terrain surrounding the Little Rocky Mountains where the facilities would eventually drain in a controlled manner becoming "high and dry".

4.2.10.3 Comparison of Impacts - Water Resources and Geochemistry

Table 4.2-10 summarizes the positive and negative attributes of each alternative and assigns an overall impact ranking. This comparison provides an indication of the relative impacts for each mining and reclamation option. Rankings have been assigned based on professional opinion and the projected ability of the alternatives to attain and maintain acceptable water quality conditions over the long-term.

The following major conclusions are also pertinent:

- Capture and treatment as described in Chapter 2 and the Water Quality Improvement Plan would improve all downstream water quality regardless of cap success. Implementation of the water control, capture, and treatment measures described in Appendix A would provide for mine discharges to achieve compliance with the water quality standards under the various alternatives. However, by incorporating selective waste rock handling, runon-runoff controls and enhanced reclamation covers into the mine plan, the reliance on water capture and treatment to meet the discharge limits is minimized. Likewise the consequences of a system failure in the water capture and treatment systems are reduced where source control has first been employed to limit the volume and contaminant load of water that must be treated. Therefore, when the ARD source control measures are used in combination with seepage capture and treatment systems, long-term protection of water treatment is attained by Alternatives 3 and 7. Alternatives 4, 5, and 6 are near optimal. Alternatives 1 and 2 depend heavily upon water capture and treatment to meet the water quality standards at the point of compliance and have the least long-term reliability.

- Accurate predictions of water quality concentrations or loads are not attainable for a mining environment as complex as that at Zortman/Landusky. However, it is considered likely that post reclamation water quality will fall within the specified ranges. Predictions of relative water quality are most realistic in such settings.

- The water quality of all major drainages surrounding the mining operations has been adversely impacted to some degree.
- The HELP model is a useful tool for comparing the ability of different capping alternatives to reduce infiltration.
- The enhanced reclamation covers proposed for Alternatives 3 through 7 would rapidly decrease the load of contaminants requiring capture and treatment and provide long-term reclamation success.
- Seepage from reclaimed spent ore piles should not be released untreated into the environment.
- Capture and treatment, if implemented as planned, would reduce flows in drainages such as Alder Spur, Carter Gulch, Sullivan Creek and Mill Gulch.
- Long-term treatment may be necessary regardless of which alternative is implemented.
- The potential for groundwater flow to the north of the pits exists for all alternatives.
- Regional aquifers such as the Madison Limestone would not be degraded beyond the periphery of the Little Rocky Mountains by any of the alternatives analyzed.

TABLE 4.2-10
IMPACT ANALYSIS SUMMARY - WATER RESOURCES

Positive Attributes	Negative Attributes	Impact Ranking
Alternative #1 • No further exposure of potentially acid generating material • 8" of soil for revegetation • 23% infiltration on flats and side slopes • Improvements in downstream water quality (Improvement Plan)	• Inadequate reclamation covers • Capture and treat in the long-term is likely • Irretrievable loss of drainage area to northern tributaries (total of 115 acres) • Internal drainage of pits at Zortman and Landusky • Potential for poor quality groundwater to discharge to northern drainages • Cumulative impact ranking of high negative	High negative (-/H)
Alternative #2 • No further exposure of potentially acid generating material • NAG capillary break for pit floors • 6" of compacted clay on areas found to be acid generating • 23% infiltration on flats and side slopes • Improvement in downstream water quality (Improvement Plan)	• Unsatisfactory assessment of acid generating potential of facilities • Unsatisfactory reclamation coverage • Capture and treatment in long-term is likely • Internal drainage of pits at Zortman and Landusky • Irretrievable loss of drainage area to northern tributaries (total of 115 acres) • Potential for poor quality groundwater to discharge to northern drainages • Cumulative impact ranking of high negative	High negative (-/H)
Alternative #3 • No further exposure of potentially acid generating material • Use of water balance covers on slopes ≥25% • Removal of potential sources of ARD including 85/86 pad and buttress, Ruby Gulch tailings and Alder Gulch waste rock pile • Backfilling of pits to free drain to the south • Long-term integrity of reclamation covers with 8.0% infiltration on flats, 10.5% on slopes • Potential to eventually stop active treatment in some drainages • Thorough procedure for recognition of NAG rock • Improvement in downstream water quality (Improvement Plan) • Use of GCL liner on slopes <25%	• Some impact associated with salvaging soil, subsoil and gravel for water balance and water barrier reclamation covers • Irretrievable loss of drainage area to northern tributaries (total of 115 acres) • Potential for poor quality groundwater to discharge to northern drainages • Cumulative impact ranking of low negative to neutral	Neutral (N)

TABLE 4.2-10 - IMPACT ANALYSIS SUMMARY - WATER RESOURCES (Continued)

Positive Attributes	Negative Attributes	Impact Ranking
Alternative #4 • Use of PVC liner on slopes <5% • Use of a 12 inch thick clay liner on slopes ≥5% • Source of NAG material for caps results from planned mining • Waste rock facility placed in drainage with existing impacts to water quality - Alder Gulch • 0.03% infiltration on flats, 7.8% on slopes • Potential to eventually stop active treatment in some drainage	• Exposure of more potentially acid generating rock • Unsatisfactory procedure for classifying NAG rock • Leach pad placed in non-impacted drainage area • New facilities in 2 separate drainage areas • Potential for poor quality groundwater to discharge to northern drainages • Long-term performance of reclamation dependent on integrity of compacted clay layers • Cumulative impact ranking of moderate negative	Moderate negative (-/M)
Alternative #5 • Enhancing flow in King Creek from free draining pit to the north • Reduction of flow in Gold Bug adit, August adit, reducing known source of metals to Montana Gulch • 0.005% infiltration on flats, 7.8% on slopes • Potential to eventually stop active treatment in some drainages • Thorough procedure for recognition of NAG rock	• Construction of the Carter Gulch leach pad in a drainage with high quality water resources • Exposure of more potentially acid generating rock • Both facilities in steep terrain, where water monitoring and capture is difficult • Irretrievable loss of drainage area to the northern tributaries (total of 47 acres) • Potential for poor quality groundwater to discharge to some northern drainages • Long-term performance of reclamation dependent on integrity of compacted clay layers • Cumulative impact of high negative	Moderate to High negative (-/M to H)

TABLE 4.2-10 - IMPACTS SUMMARY FOR WATER RESOURCES (Concluded)

Positive Attributes	Negative Attributes	Impact Ranking
Alternative #6 • Both facilities in Goslin Flats area, where water monitoring and successful management is more readily attainable • 0.005% infiltration on flats, 7.8% on slopes • Potential to eventually stop active treatment in some drainages • Thorough procedure for recognition of NAG rock	• Minor water quality degradation associated with both facilities • Exposure of more potentially acid generating rock • Irretrievable loss of drainage area to northern tributaries (total of 156 acres) • Potential for poor quality groundwater to discharge to some northern drainages • Long-term performance of reclamation dependent on integrity of compacted clay layers • Cumulative impact ranking of moderately negative	Low to moderate negative (-/L to M)
Alternative #7 • Use of water budget covers on slopes ≥25% • Use of GCL liner on slopes <25% • Little additional disturbance required for waste rock repository • Potential to eventually stop active treatment in some drainages • 8.0% infiltration on flats, 10.5% on slopes • Waste rock stored above existing capture facility • Leach pad constructed at location suitable for effective water quality management • Thorough procedure for recognition of NAG rock	• Leach pad constructed in presently non-impacted drainage area • Irretrievable loss of drainage area to the northern tributaries (total of 156 acres) • Some impact associated with salvaging soil, subsoil and gravel for water budget reclamation cover • Potential for poor quality groundwater to discharge into some northern drainages • Cumulative impact ranking of low negative	Low negative (-/L)

Note:

Beneficial uses of water resources within the Little Rocky Mountains, include wildlife drinking water, limited macroinvertebrate habitat, some fisheries, recreation and domestic and agricultural water supply from both surface water and groundwater (see Section 3.2.7). The majority of these identified beneficial uses are made in mid to downstream reaches of the drainages. Significant impacts to many of these uses has occurred in the past as a result of historical and recent mining activities. However, with the implementation of the proposed water management practices under the Water Quality Improvement Plan (including capture and treatment), no significant impacts to downstream beneficial uses are anticipated in the future under any of the above alternatives. The degree to which maintenance of good water quality relies on capture and treatment depends on the efficiency of the various source control and reclamation measures proposed for each of the alternative.

4.3 SOIL AND RECLAMATION EFFECTIVENESS

4.3.1 Methodology

Issues and comments raised concerning soil and reclamation during the scoping process and comments on the Draft EIS are summarized in Section 1.6 and focus on the following:

- Adequacy of soil quantity and quality - volume of suitable cover soil for salvage and/or redistribution to an adequate thickness which will sustain a protective vegetative cover and the post-mining land use
- Stability of disturbed and reclaimed soil as measured primarily in terms of erosion potential and soil loss estimates
- Adequacy of post-closure and reclamation monitoring for rapid identification and remediation of localized failures

In response to these concerns, the following two significance criteria have been developed to aid in focusing the impact analyses on the key issues and in providing points of reference about which the analysis of the severity of the negative impacts will be completed:

- Restoration of less than 48 inches of suitable material, including at least 12 inches of cover soil, on final reclamation grades/surfaces to serve as an effective long-term plant growth medium.
- Soil loss as predicted by the Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1991) in excess of 2 tons/acre/year for reclaimed slopes and surfaces (EPA 1991, Richardson 1995).

Other key background points and assumptions pertinent to the use of a 12-inch cover soil in a 48-inch growth medium are:

- Montana Department of Environmental Quality (DEQ) policy has been to place 48 inches of non-acid generating material over acid producing materials based on Office of Surface Mining (OSM) guidelines for acid generating wastes produced in coal mining. The 48" layer is assumed to be a growth medium regardless of rock contents, texture, etc. as long as it is non-acid generating. It would become soil parent material.
- The Metal Mine Reclamation Act (MMRA) requires cover over pits that may produce objectionable effluent with at least 24 inches of suitable material.
- Mountain soil on slopes ranging from nearly level to greater than 65 percent (1.5H:1V) average 30 inches of suitable cover soil growth medium (topsoil and subsoil materials in the area) (Noel and Houlton 1991).
- Results of previous research on minimum and optimum replaced suitable soil thicknesses, supporting successful long-term establishment of a vegetative cover, indicate that replacement depths of 9 to 33 inches of topsoil/cover soil material promote the highest rates of plant establishment and greatest productivity on reclaimed areas in semi-arid environments (Barth and Martin 1982, Halversen et al. 1986, Pinchak 1983, Schuman and Taylor 1975, and USFS 1979).

The proposed cover soil thickness falls at the low end of the range of effective soil thicknesses even if 12 inches were used as discussed in Section 2.5. In addition, the high coarse fragment content of the cover soil would reduce moisture and nutrient holding capacity. Less moisture would be available particularly during dry periods. Reduced availability of nutrients, particularly nitrogen, would occur due to leaching. As a result, the vegetation would be limited due to stressful soil moisture and nutrient conditions. Optimum cover soil/topsoil depth is defined as the depth or thickness at which the rate of increase of plant establishment or productivity, as a function of cover soil thickness, becomes small or static (Coppinger et al. 1993). The optimum replacement thickness is dependent on numerous factors including cover soil and overburden/substrate quality, precipitation, and topographic position.

On acid generating materials, long-term (greater than 5 years) direct impacts for placement of 8 or fewer inches of cover soil would be high. In areas where 9 to 12 inches would be placed, long-term direct impacts would likely be moderate due to the greater cover soil thickness and improved soil moisture and nutrient retention capacities. Under favorable local conditions, 9 to 12 inches of cover soil may support a productive vegetation cover for the long-term if the substrate is not acid generating. With less than 24 inches of total non-acid generating growth media, impacts from 9-12 inches of soil replacement are assumed to be high.

Topsoil depths of 9 to 24 inches promote optimum establishment of perennial grasses over neutral overburden (Coppinger, et al 1993). The soil range noted above assumes that plants would eventually root into the overburden; thus, becoming part of the growth media. However, the development of acidic conditions in substrate materials, including exposed rock, waste rock, and leached ore, beneath less than 9 inches of replaced cover soil would either preclude or restrict rooting. In addition, there is the potential that the cover soil layer could be lost by erosion and acidification due to the movement of acidic moisture from:

- The acidified substrate up into the cover soil by soil absorption and capillary rise (driven by the evaporation of moisture from the soil surface)
- Lateral, acidic seeps exiting ore and waste rock facilities on lower slopes

Should acidic conditions develop in the cover soil, the affected area would have a much reduced cover of vegetation due to plant intolerance for acidic soil conditions. Under this condition, the susceptibility of the cover soil to accelerated erosion would increase. Given the shallow nature of the cover soil, soil losses could expose the underlying acid generating substrate, which could exacerbate soil losses above and below the affected area. In addition, cover soil placed in pit bottoms and on benches could become acidified by runoff from exposed acid-generating surfaces on pit highwalls. Long-term impacts would be high for 9-12 inch soil covers.

Indirect negative effects would include increased seepage levels within the substrate materials which could surface downslope affecting vegetation. Stressed plants and subsequent reduced cover provided by plant canopies and litter provide less resistance to the forces of water erosion and increased potential for accelerated soil loss from affected areas.

- The 12-inch thickness criterion for replaced cover soil would apply to reclamation of all facilities and disturbed areas including the Goslin Flats and Ruby Flats.
- As a result, categorization of impact for soil quantity and quality relative to pre-1979 disturbance conditions are as follows:

Short-term (1-5 years)	-	Low: New disturbance with salvage of cover soil materials
Long-term (5+ years)	-	Low: Replacement of >12 inches of cover soil in a 48 inch total non-acid generating growth medium.
		Moderate: 9-12 inches of cover soil in a 24-48 inch total non-acid generating growth medium.
		High: <9 inches of cover soil in a <24 inch total non-acid generating growth medium.

Key background points and/or assumptions pertinent to estimation of soil loss due to erosion in excess of the significance criteria of 2 tons/acre/year for reclaimed slopes and surfaces are:

- A loss of 2 tons of soil per acre per year approximates the rate of new soil development of 2 tons per acre per year in the area.
- Potential soil losses by water erosion from reclaimed disturbances located in the Zortman and Landusky mine areas have been estimated using RUSLE, which is an update of the USLE (USDA 1978). Values for the variables in the RUSLE/USLE, A = R K L S C P, are listed below. Each value is supported by a brief explanation. Calculations of soil loss by reclaimed facility for each alternative are presented in Table 4.3-1.

A — The soil loss per unit area, expressed in units selected for a soil erodibility factor (K) and for the period selected for precipitation and runoff value (R). In practice, A is usually selected to compute in tons/acre/year.

R = 15 — The precipitation and runoff value was provided by the data base for RUSLE and represents the value for Havre, Montana.

K = .21 — The soil erodibility value selected as representative of the higher coarse fragment content soil (currently stockpiled and yet to be disturbed) to be placed on steeper slopes.

TABLE 4.3-1
SUMMARY OF SOIL LOSS RATE FOR EACH ALTERNATIVE AND MAJOR FACILITIES AT ZORTMAN AND LANDUSKY MINES[1]

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7	
Facility	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)
Zortman														
• 79/80/81 Pad													N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40	3.53	0.82	3.13	1.04	3.13	1.04	3.13	1.04		
- Top Areas	0.15	0.06	0.15	0.06	1.58	0.46	0.10	0.03	0.10	0.03	0.10	0.03		
• 82 Pad													N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40	3.53	0.82	3.13	1.04	3.13	1.04	3.13	1.04		
- Top Areas	0.19	0.08	0.19	0.08	1.58	0.46	0.13	0.03	0.13	0.03	0.13	0.03		
• 83 Pad													N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40	3.53	0.82	3.13	1.04	3.13	1.04	3.13	1.04		
- Top Areas	0.21	0.09	0.21	0.09	1.58	0.46	0.14	0.04	0.14	0.04	0.14	0.04		
• 84 Pad													N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40	3.53	0.82	3.13	1.04	3.13	1.04	3.13	1.04		
- Top Areas	0.23	0.10	0.23	0.10	1.58	0.46	0.16	0.04	0.16	0.04	0.16	0.04		
• 85/86 Pad					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40										
- Top Areas	0.22	0.09	0.22	0.09										
• 89 Pad													N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40	3.53	0.82	3.13	1.04	3.13	1.04	3.13	1.04		
- Top Areas	0.19	0.08	0.19	0.08	1.58	0.46	0.13	0.03	0.13	0.03	0.13	0.03		
• Alder Gulch WRD					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
- Sideslopes	6.06	2.37	6.06	2.37										
- Top Areas	0.22	0.09	0.22	0.09										
• OK WRD					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
- Sideslopes	6.12	2.40	6.12	2.40										
- Top Areas	0.19	0.08	0.19	0.08										
• Goslin Flats Pad	N/A	N/A	N/A	N/A	N/A	N/A			N/A	N/A				
- Sideslopes							3.74	1.25			3.74	1.25	3.53	0.82
- Top Areas							0.24	0.06			0.24	0.06	1.58	0.46

TABLE 4.3-1 - SUMMARY OF SOIL LOSS RATE FOR EACH ALTERNATIVE
(Continued)

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7	
Facility	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)
• Carter Gulch WRR - Sideslopes - Top Areas	N/A	N/A	N/A	N/A	N/A	N/A	4.48 0.23	1.50 0.06	3.13 0.23	1.04 0.06	N/A	N/A	N/A	N/A
• Upper Alder Gulch Pad - Sideslopes - Top Areas	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.13 0.31	1.04 0.08	N/A	N/A	N/A	N/A
• Ruby Flats WRR - Sideslopes - Top Areas	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.13 0.24	1.04 0.06	N/A	N/A
• Alt. #7 WRC - Sideslopes - Top Areas	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.53 1.58	0.82 0.46
Landusky • 79 Pad - Sideslopes - Top Areas	6.12 0.15	2.40 0.06	6.12 0.14	2.40 0.05	3.53 1.58	0.82 0.46	3.13 0.10	1.04 0.03	3.13 0.10	1.04 0.03	3.13 0.10	1.04 0.03	3.53 1.58	0.82 0.46
• 80/82 Pad - Sideslopes - Top Areas	6.12 0.17	2.40 0.07	6.12 0.15	2.40 0.06	3.53 1.58	0.82 0.46	3.13 0.12	1.04 0.03	3.13 0.12	1.04 0.03	3.13 0.12	1.04 0.03	3.53 1.58	0.82 0.46
• 83 Pad - Sideslopes - Top Areas	6.12 0.15	2.40 0.06	6.12 0.14	2.40 0.05	3.53 1.58	0.82 0.46	3.13 0.10	1.04 0.03	3.13 0.10	1.04 0.03	3.13 0.10	1.04 0.03	3.53 1.58	0.82 0.46
• 84 Pad - Sideslopes - Top Areas	6.12 0.16	2.40 0.07	6.12 0.14	2.40 0.05	3.53 1.58	0.82 0.46	3.13 0.11	1.04 0.03	3.13 0.11	1.04 0.03	3.13 0.11	1.04 0.03	3.53 1.58	0.82 0.46
• 85/86 Pad - Sideslopes - Top Areas	6.12 0.18	2.40 0.08	6.12 0.16	2.40 0.06	3.53 1.58	0.82 0.46	3.13 0.12	1.04 0.03	3.13 0.12	1.04 0.03	3.13 0.12	1.04 0.03	3.53 1.58	0.82 0.46

TABLE 4.3-1 - SUMMARY OF SOIL LOSS RATE FOR EACH ALTERNATIVE
(Concluded)

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7	
Facility	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)	Short Term (Tons/ Ac/Yr)	Long Term (Tons/ Ac/Yr)
• 87/91 Pad														
- Sideslopes	3.89	1.52	3.89	1.52	3.53	0.82	3.13	1.04	3.13	1.04	3.13	1.04	3.53	0.82
- Top Areas	0.18	0.07	0.16	0.06	1.58	0.46	0.12	0.03	0.12	0.03	0.12	0.03	1.58	0.46
• Gold Bug WRD														
- Sideslopes	5.92	2.32	5.92	2.32	4.76	1.59	4.76	1.59	4.76	1.59	4.76	1.59	3.53	0.82
- Top Areas	0.15	0.06	0.14	0.05	0.10	0.03	0.10	0.03	0.10	0.03	0.10	0.03	1.58	0.46
• Mill Gulch WRD														
- Sideslopes	5.75	2.25	5.75	2.25	4.63	1.54	4.63	1.54	4.63	1.54	4.63	1.54	3.53	0.82
- Top Areas	0.17	0.07	0.15	0.06	0.12	0.03	0.12	0.03	0.12	0.03	0.12	0.03	1.58	0.46
• Montana Gulch WRD														
- Sideslopes	6.12	2.40	6.12	2.40	3.53	3.53	3.13	1.04	3.13	1.04	3.13	1.04	3.53	0.82
- Top Areas	0.15	0.06	0.14	0.05	1.58	1.58	0.10	0.03	0.10	0.03	0.10	0.03	1.58	0.46
• Sullivan Park WRD														
- Sideslopes	6.12	2.40	6.12	2.40	4.92	1.64	4.92	1.64	4.92	1.64	4.92	1.64	3.53	0.82
- Top Areas	0.16	0.07	0.14	0.05	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.03	1.58	0.46
• August #1, #2 WRD														
- Sideslopes	N/A	N/A	N/A	N/A	4.92	1.64	4.92	1.64	4.92	1.64	4.92	1.64	3.53	0.82
- Top Areas					0.10	0.03	0.10	0.03	0.10	0.03	0.10	0.03	1.58	0.46

*[1] A detailed presentation of the RUSLE calculations for the major Zortman and Landusky Mine Facilities is available in the Agencies' project file.

A rate of soil loss in excess of 2 tons/acre/year from reclaimed slopes and surfaces would be a significant impact (Section 4.3.1).

K = .40 The soil erodibility value selected as representative of the lower coarse fragment content, finer textured soil yet undisturbed in the Goslin Flats area to be placed on less steep (<5 percent slopes) facilities tops.

L The length of slope value - estimated slope lengths (distances between slope break benches) are presented by facility for each alternative in Table 4.3-1.

S Slope gradient in percent - slopes for facilities by alternative are presented in Table 4.3-1 - side slopes are 50 percent (2H:1V) to 33 percent (3H:1V) depending on alternative and site; slopes of facilities tops are ≤25 percent of all alternatives.

C Cover and management values - values used for this factor varied with (1) period of vegetation establishment, short-term equal to less than 3 years, long-term equal to period of 3 years and beyond; (2) slope as represented by side slopes for each facility by alternative and the tops for all facilities, all alternatives (25 percent slopes). Values for C are presented in Table 4.3-1.

P Supportive practice value - This value represents the natural topographic features or range conservation practices that slow runoff to varying degrees. The value of 1.0 was used in all calculations presented in Table 4.3-1; a value of 1.0 represents conditions of uniform slopes and smooth surface water flow.

- A detailed presentation of the RUSLE calculations for the major Zortman and Landusky mine facilities was prepared and submitted to the BLM and DEQ project files to serve as a reference document.

- Impacts for soil loss are based on the following criteria:

  Estimated soil loss (both short- and long-term) greater than 2 tons/acre/year - <u>high</u>, significant impact

  Estimated soil loss (both short- and long-term) between 1 and 2 tons/acre/year - <u>moderate</u> impact

  Estimated soil loss (both short- and long-term) less than 1 ton/acre/year - <u>low</u> impact

4.3.2 Impacts from Mining, 1979 to Present

Past implementation of exploration and mining-related activities has resulted in the disturbance and alteration of in-place, natural soil in both the Zortman and Landusky mine areas.

Prior to 1979, mining activities resulted in the disturbance of approximately 54 acres in the Zortman and Landusky mine areas. Soil were affected by excavations of adits and burial beneath waste rock dumps. With the onset of modern and more extensive mining efforts in 1979, impacts to native soil have resulted from the clearing of protective vegetation, and excavation and storage of cover soil materials (including topsoil and suitable subsoil), in areas disturbed for exploration roads and mining facilities, including open pits, heap leach facilities, waste rock storage areas, roads, processing areas, cover soil stockpiles, land application areas, and shop and storage areas. Direct negative effects on soil that have resulted from exploration, and the construction and operation of mine-related facilities include the following:

- Loss/interruption of pedogenic (soil) development, including breakdown of soil structure and mixing of distinct soil horizons

- Loss of soil material due to disturbance and exposure to forces of erosion

- Alteration of biological and nutrient conditions in soil materials stored in piles for extended periods

- Compaction of soil materials beneath facilities and in areas of natural soil crossed by vehicular traffic

- Loss or reduction of soil productivity

Measures to stabilize and protect soil stockpiles are described in reclamation plans attached as appendices to the separate permitted plans of operation, which address committed mitigation for Zortman and Landusky mines (ZMI 1994a and 1993). These measures have been or would be implemented to control soil loss and prevent additional disturbance to stockpiled cover soil.

Direct impacts to soil, as described above for mining activities during the 1979-to-present period, separately, and certainly collectively, can be classified as high. Although no significance criteria have been defined for these impacts on the soil resource if the soil was not salvaged, the effects would be significant, particularly as the soil disturbance affects the loss of productivity of the land (the removal of vegetation), the loss of wildlife habitat, the change in visual aesthetics, and the alteration of watershed characteristics. However, cover soil has been stockpiled and may be used to mitigate past effects of reclamation.

Upon reclamation and replacement of stockpiled cover soil to a depth of 8 inches, direct impacts would be low for at least the short-term (1-5 years) as soil are returned to a similar position in the landscape and recovery of productivity (reclaimed area and soil) is allowed to begin. Long-term (beyond 5 years) impacts are anticipated to be low to high depending on local conditions affecting cover soil quality and the protective, stabilizing vegetation it supports. If the growth medium is less than 24 inches thick, high impacts would result when:

- Soil loss exceeds new soil development on steep long slopes and acid producing materials are exposed and washed down the slope onto other areas;

- Roots are confined by underlying, acid-producing materials and plant growth and cover is limited by the lack of suitable soil depth; lack of protective vegetative cover may result in accelerated soil erosion, particularly on steep, long slopes;

- Lateral, acidic seeps exiting ore and waste rock facilities on lower slopes contaminate local and/or downslope soil;

- Acidifying moisture moves by capillary action up into the cover soil from acid generating waste, ore, or in-place rock below; and

- Indirect impacts of increased acidic flows off of reclaimed facilities on to soil in downstream drainages.

Direct impacts of soil contamination by acidifying moisture from substrates or lateral seeps would be toxic to protective vegetation on reclaimed facilities. Vegetative cover would be reduced causing increased runoff and accelerated erosion. Increased flows of potentially acidic moisture would result in the indirect effect of soil contamination from the acidic runoff and deposition of eroded, contaminated soil.

Current permitted areas of disturbance for mining activities total 401 acres for the Zortman Mine, with 67 acres reclaimed and 814 acres for the Landusky Mine, with 147 acres reclaimed (DSL/BLM 1993a,b). Stockpiled cover soil volumes available for use in reclamation of existing disturbance at the Zortman Mine and Landusky Mine are estimated to be 183,000 yd^3 and 2,172,000 yd^3, respectively. If stockpiled cover soil were to be used only for their respective mine area, cover soil volumes are sufficient to cover 375 surface acres on 2H:1V slopes at the Zortman Mine with approximately 4.0 inches of cover soil, and the 747 surface acres on 2H:1V slope at the Landusky Mine with approximately 24 inches of cover soil.

Replacement of only 4 inches of cover soil over Zortman Mine areas would result in significant high impacts in the long-term as a 4-inch thickness of cover soil is insufficient for long-term support of a stabilizing cover of vegetation, especially on steep slopes over acid generating materials. Reduced vegetative cover would result in accelerated erosion and soil loss. Replacement of 24 inches of cover soil over Landusky Mine areas would result in low impacts if over non-acid generating materials (i.e., >48" growth medium and >12" of cover soil) and moderate impacts over acid-generating materials (i.e., <48" growth medium even though soil is >12"). Cover soil loss would remain a potential, but the likelihood would be reduced due to increased thickness of the cover soil layer.

4.3.3 Impacts from Alternative 1

Redevelopment of a soil profile on reclaimed areas is accelerated by redistribution of stockpiled cover soil as a soil cover over final graded surfaces. (For the purposes of this analysis, it has been assumed that cover soil would be distributed over all disturbed areas/facilities at the permitted replacement depth of 8 inches.) Excess soil would remain stockpiled.

Cover Soil Quality

With the passage of time, inherent fertility levels originally present in salvaged cover soil are decreased due to reductions in organic matter content and microbial activity. The return of cover soil to the surface would restore the material to its pre-disturbance position and increase the potential for the reestablishment of vegetation, erosion control, and renewed soil development.

Limitations to successful vegetation reestablishment would be overcome by the supplemental addition of fertilizers and organic amendments as outlined in the reclamation programs presented in Section 2.5. Salvaged, currently stockpiled cover soil at Zortman and Landusky generally have high coarse fragment (larger than sand-sized particles) contents of 35 to 50 percent and greater. High coarse fragment contents in cover soil have been classified as less desirable plant growth media under some conditions. In this case, the stockpiled cover soil materials are native topsoil and some subsoil. By replacing these soil materials, the native soil profile that took up to 10,000 years to develop would at least be partially salvaged.

Cover Soil Quantity and Thickness

A minimum of 8 inches of cover soil over 375 acres of Zortman disturbances would require approximately 400,000 yd^3, which is 217,000 yd^3 more than the 183,000 yd^3 currently available in cover stockpiles in the Zortman Mine area. The importation of 217,000 yd^3 of cover soil from Landusky cover soil stockpiles would leave approximately 1,955,000 yd^3 for the reclamation of the Landusky Mine area. To achieve an 8-inch cover of soil over 747 acres of Landusky disturbances, approximately 796,000 yd^3 of cover soil would be required. Use of Landusky's stockpiled cover soil at both Zortman and Landusky for an 8-inch cover would leave approximately 1,159,000 yd^3 of cover soil in stockpiles in the Landusky Mine area.

Equal distribution of the remaining 1,159,000 yd^3 of stockpiled cover soil over the Landusky facilities alone or the combined 1,122 acres of Zortman and Landusky facilities and 39 acres of additional disturbance would result in the placement of an additional 11 inches (19 inches total) at Landusky or approximately 7 inches (15 inches total) at both mines, respectively. However, this soil is not proposed to be redistributed under Alternative 1.

The 8 inches of cover soil would provide a minimal growth medium for plants on the disturbances at closure. Mixed fill materials, exposed rock, waste rock, and leached ore are inferior growth media for plants due to their sterility, potential to produce acid, lack of organic matter, fertility, and suitable physical characteristics such as sufficient soil fines to hold moisture and nutrients. Due to the similarity in parent materials and soil development conditions, the importation of cover soil material to Zortman from Landusky would not affect vegetation response. The 8-inch thickness of cover soil should support the establishment of vegetation in the short-term (1-5 years) and impacts are therefore low. The lack of commitment by ZMI to use the rest of the stockpiled soil at Landusky in reclamation makes long-term impacts high for all disturbances in the long-term. Because <9 inches of cover soil are applied on all disturbances.

Cover Soil Erosion

Zortman Mine Facilities - Potential soil losses from reclaimed areas/facilities at the Zortman and Landusky mines have been estimated using the RUSLE (see Section 4.3.1). For Zortman Mine leach pads and waste dump facilities to be reclaimed under this alternative, estimated short-term soil losses (1-5 years) from side slopes (2H:1V) would be approximately 6.1 tons/acre/year for all facilities (Table 4.3-1). Lengths of side slopes between benches would be 224 feet for all facilities with the exception of the 250 foot slope lengths for the Alder Gulch waste dump. The 6.1 tons/acre/year rate of soil loss equals a rate of approximately 0.034 inches/year of soil loss from each facilities' side slopes. A loss of one inch of soil from these surfaces would take approximately 29 years. Direct short-term impacts due to soil loss and the reduction in thickness and volume of plant growth medium would be significant high for all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of Zortman Mine facilities would be approximately 2.4 tons/acre/year. The 2.4 tons/acre/year rate of soil loss equals a rate of approximately 0.013 inch/year of soil loss from each facilities' side slopes. The net loss of one inch of soil would require approximately 77 years. Direct negative long-term impacts would be high.

Soil loss from flatter top areas of the leach pads and waste dumps and other disturbed areas would be less than 1 ton/acre/year for both the short- and long-term (Table 4.3-1). Direct short- and long-term impacts on flatter areas would be low for all facilities and areas, assuming no revegetation failure.

Landusky Mine Facilities - Short- and long-term rates of soil loss and levels of impact for side slopes of most Landusky Mine facilities would be the same as those described above for the Zortman facilities as proposed slope angles (2H:1V) and lengths (224 feet) are similar. Exceptions are the Gold Bug waste repository (2.5H:1V and 269 feet long slopes), Mill Gulch waste repository (assumed 2.75H:1V and 293 feet long slopes), and the 87/91 leach pad (3H:1V and 200 feet long slopes). Again in the short-term, the 6.1 tons/acre/year rate of soil loss equals a rate of 0.034 inch/year and would require approximately 29 years for a one inch soil loss. The rate of soil loss from side slopes of the Gold Bug waste repository of 5.9 tons/acre/year equals a rate of 0.033 inch/year (30 years per inch of soil loss). The rate of soil loss from side slopes of the Mill Gulch waste repository of 5.8 tons/acre/year equals a rate of 0.032 inch/year (31 years per inch of soil loss). The rate of soil loss from side slopes of the 87/91 leach pad of 3.9 tons/acre/year equals a rate of 0.021 inch/year (48 years per inch of soil loss). Direct short-term impacts on most steeper side slopes would be significant high.

Estimated long-term soil losses (beyond 5 years) from side slopes of Landusky Mine facilities would exceed 2 tons/acre/year (approximately 2.3 to 2.4 tons/acre/year) for all facilities with the exception of the 87/91 leach pad (1.5 tons/acre/year). The rate of soil loss from side slopes of the 87/91 leach pad equals a rate of 0.008 inch/year (125 years per inch of soil loss); the remaining facilities' rates of soil loss equal 0.012 to 0.013 inch/year (83 to 77 years per inch of soil loss). Direct long-term impacts on most steeper side slopes would be significant high with the exception of side slopes of the 87/91 leach pad.

Direct short- and long-term impacts for the flatter tops would be low for all facilities, assuming no revegetation failure (Table 4.3-1).

Additional Actions

Reclamation of the existing Seaford and Williams clay pits and the existing King Creek limestone quarry under the specifications of this alternative would effectively restore the disturbed lands to comparable stability and utility. Grading to maximums of 3H:1V slopes and limited slope lengths would limit excessive soil loss due to erosion and 12 inches of cover soil over non-acid generating substrate would provide a growth medium comparable to adjacent undisturbed areas.

Soil of the approximately 285 acres in the Goslin Flats area to be used for the treatment and disposal of excess mining solutions would be affected by minor disturbances of limited compaction/rutting and loss of vegetative cover due to vehicular traffic associated with the construction and ultimate demolition of the land application system. The dilute nature of the barren solution to be sprayed onto the soil and the adequate adsorption capacity would result in the effective capture of most metals and other deleterious substances in the waste stream (Schafer and Associates 1993). Accumulations of most trace elements would not concentrate in levels that pose a threat to vegetation, human health, or any waters of the state. Possible exceptions would be some natural background metals, such as molybdenum and arsenic which could desorb from soil and be leached deeper into the soil profile.

4.3.3.1 Cumulative Impacts

Further mining at the Zortman and Landusky mines beyond that already permitted would not be allowed under this alternative. A significant portion of reclaimed areas would fail, due to minimal soil cover over potentially acid-generating rock materials, and additional reclamation and remediation measures would be required. Such measures would require the redisturbance and/or new disturbance of areas to access reclamation materials for use in improved cover systems and to remove and dispose of ineffective cover materials and contaminated materials. Past disturbance of soil total 1,248 acres including:

- 54 acres of historic mining disturbance from activities occurring prior to 1978.
- 1,161 acres of recent mining disturbance (both mines) between 1979 and the present.
- 33 acres of past disturbance from activities at the Seaford and Williams clay pits and the King Creek Quarry (limestone).

During recent mining activities (post 1979), soil materials have been salvaged and stockpiled for use in reclamation of the disturbed areas.

4.3.3.2 Unavoidable Adverse Impacts

It is assumed that a significant portion of the reclaimed areas would eventually fail from erosion of the cover soil on steep, long slopes. In addition, migration of acidic moisture from underlying acid forming waste or parent rock would likely occur. On those acres where vegetative and soil cover are lost, over 10,000 years of soil development would be lost. Exposed mine waste rock and ore would have to oxidize over time and soil development would take centuries to recover.

4.3.3.3 Short-term Use/Long-term Productivity

For areas where reclamation proves to be successful, the soil development process would be restored in a relatively short time. Where reclamation is unsuccessful, soil would be lost and long-term productivity of the soil system would be delayed for centuries. Comparable stability and utility would likely not be achieved in the post-mine landscape under this alternative.

4.3.3.4 Irreversible or Irretrievable Resources Commitments

The removal of vegetation and the excavation, storage and subsequent replacement of soil as part of mine construction, operations and reclamation has resulted in the loss of thousands of years of soil development.

However, replacement of soil materials during reclamation would enhance the restoration of the soil development process and soil productivity. There is no commitment in this alternative to use the excess soil in Landusky stockpiles. Unused stockpiled cover soil materials left in stockpiles is a valuable resource which would be wasted if not used in reclamation as surface cover.

On a significant portion of reclaimed acres, replaced soil would be lost from erosion and contamination from acid producing mine wastes and water. The complete loss of over 10,000 years of soil development would occur.

4.3.4 Impacts from Alternative 2

Effects from the redistribution of stockpiled cover soil over final graded surfaces in Alternative 1 are enhanced in Alternative 2 by the placement of Reclamation Cover A, a compacted, low hydraulic conductivity 6-inch clay layer beneath the 8-inch cover soil layer (Section 2.6.2.2) over all mine disturbance areas tested to be acid producing. (For the purposes of this analysis, it has been assumed that 6 inches of compacted clay and 8 inches of cover soil would be distributed over all mine waste units.) Clay could only be applied to slopes 2.5H:1V or less.

Cover Soil Quality

Impacts and limitations posed by stockpiled cover soil for both Zortman and Landusky mines would be as described for Alternative 1. The compacted clay layer is a physical barrier to plant roots and soil moisture. The bentonite clay is essentially neutral and would provide soil moisture storage and rooting depth as it weathers, due to freezing and thawing and desiccation from wetting and drying.

Cover Soil Quantity and Thickness

Acreages of disturbance and cover soil volumes and sources for the reclamation of Zortman and Landusky mine areas are the same as described for Alternative 1 in Section 4.3.3. Currently, there is no commitment to use excess soil in Alternative 2.

The presence of a low hydraulic conductivity clay layer beneath the cover soil layer would in the short-term:

- Improve moisture retention in the 8 inches of cover soil by limiting moisture loss from the cover soil layer to the substrate below - more water would be available to sustain plants
- Delay any migration of acidic moisture from acid generating substrate into the cover soil layer

These effects benefit vegetation productivity and cover, and erosion control. However, the 14-inch clay/cover soil system has several potential problems:

- The cover soil layer could be acidified by acidic runoff and erode leaving the clay layer exposed on steep, long slopes. The clay layer would then erode away.
- Saturated soil moisture conditions at the cover soil - clay layer interface could result in slippage of the cover soil layer, particularly on steeper slopes (2.5H:1V). The clay layer would then erode away.
- The shallow depth to the clay layer places the layer within the frost zone. Freeze/thaw cycles would compromise the integrity of the compacted clay layer. In addition, drying and subsequent cracking of the bentonitic clay layer would destroy the compacted clay layer and increase the hydraulic conductivity.

Should the soil/clay cover be compromised, indirect adverse effects of increased seepage would likely result as described in Alternative 1. It would just take longer for effects to show in a 14-inch layer than an 8-inch layer. Impacts regarding cover soil thickness would be low in the short-term and high in the long-term because a large percentage of revegetation is assumed to fail in the long-term, as described for Alternative 1.

Cover Soil Erosion
Impacts to Zortman and Landusky mines areas are the same as described for Alternative 1, even though the clay would delay exposure of the acid-producing substrate. It is assumed that a large percentage (less than anticipated for Alternative 1) of the reclaimed acres would eventually fail from erosion and soil acidification over the long-term.

Additional Actions
In response to needs for clay to be used in reclamation covers at the Zortman Mine, an additional 3 acres of disturbance involving soil salvage and stockpiling would occur at the Seaford clay pit. An additional 6 acres of disturbance including soil salvage would occur at the Williams clay pit as a result of clay mining for cover materials. Impacts to soil from new disturbance would be as described in Section 4.3.2. Both facilities would be reclaimed using on-site, stockpiled cover soil and revegetation measures presented in Section 2.5.2.8. Direct short-term impacts would be low for all pits and quarry as cover soil would be salvaged, stockpiled, and replaced at reclamation. Long-term impacts would be low as well due to 12 inches of cover soil being replaced over non-acid producing materials.

Impacts to soil as a result of land application of waste mining solutions would be as described above for Alternative 1. Completion of reclamation measures proposed under this alternative would be effective in restoring stability and utility as described in Section 4.3.

4.3.4.1 Cumulative Impacts

Cumulative impacts for activities under Alternative 2 are essentially similar to Alternative 1 except that 9 additional acres would be disturbed from activities at the clay pits and limestone quarries. It is assumed that a large percentage of reclaimed acres would fail. Total disturbance is 1,257 acres of disturbance.

4.3.4.2 Unavoidable Adverse Impacts

It is assumed that a large percentage of the reclaimed areas would eventually fail from erosion of the cover soil and subsequent erosion of the clay layer on long, steep slopes.

For failed areas, over 10,000 years of soil development would be lost. Exposed mine waste rock and ore would have to oxidize over time and soil development would take centuries to recover. In addition, new disturbances of soil at the Seaford and Williams clay pits would be unavoidable long-term negative actions necessary for the improved reclamation potential for the Zortman and Landusky mines.

4.3.4.3 Short-term Use/Long-term Productivity

For areas where reclamation proves to be successful, the soil development process would be restored in a relatively short time. Where reclamation is unsuccessful, soil would be lost and long-term productivity of the soil system would be delayed for centuries. Comparable stability and utility would likely not be achieved in the post-mine landscape under this alternative.

4.3.4.4 Irreversible or Irretrievable Resources Commitments

Commitments of soil resources for Alternative 2 would be similar to those described for Alternative 1 except that not only would soil be lost but mined clay would be wasted on acres where reclamation fails.

4.3.5 Impacts from Alternative 3

Effects from the redistribution of stockpiled cover soil over final graded surfaces in Alternative 2 are enhanced in Alternative 3 by:

- Reduction of slopes from approximately 2H:1V to 2.8H:1V (2.5H:1V for dikes) and placement of water balance cover (slopes greater than or equal to 25 percent) and water barrier cover (slopes less than 25 percent) on major facilities within the Zortman Mine complex including those previously reclaimed with approximately 8 inches of cover soil over unclassified mine wastes

- Reduction of slopes from approximately 2H:1V to 3H:1V and placement of water balance and water barrier covers on most major facilities and pit bottoms/fill surfaces within the Landusky Mine complex

For the purposes of this analysis, it has been assumed that 12 inches of cover soil would be distributed over all remaining disturbed areas/facilities including pit benches which would receive 12 inches of cover soil underlain by 12 inches of NAG subsoil or other material over potentially acid-generating surfaces.

Cover Soil Quality
Effects and limitations posed by currently stockpiled soil in the Little Rocky Mountains would be the same as

those described in Section 4.3.3. Cover soil materials for use in the reclamation of both the Zortman and Landusky mines would be the same as Alternatives 1-2 with the exception of the proposed 250-acre Goslin Flats soil borrow area.

Soil in the Goslin Flats area have several potential uses in reclamation cover systems. Approximately 567,000 yd^3 of cover soil material (organic matter content greater than 0.5 percent) could be salvaged from approximately 250 acres (essentially the same footprint as disturbed for the heap leach pad, ore crushing/ handling facility, and process facility in Alternative 4). About 280,000 yd^3 are resistant to erosion based on soil characteristics including texture and coarse fragment content. These cover soil materials would be better suited for placement on steeper slopes (2.5H:1V-3H:1V). The remaining 287,000 yd^3 of finer soil would be generally less resistant to erosion and better suited for placement on more level areas. Other important quality considerations of Goslin Flats soil include:

1) many contain calcium carbonate ($CaCO_3$) and would provide a net neutralizing effect, none are acid producing;

2) textures vary and include some loams to clay loams which have greater available water holding capacities; and

3) many subsoil are deep and have suitable characteristics for use in reclamation and would provide large volumes of quality soil materials as compared to mountain soil sources.

Direct impacts would be negative high resulting from acres of new disturbance (Goslin Flats) in the short-term. Replacement of stockpiled and borrowed cover soil over disturbed areas would reduce impacts to low.

Cover Soil Quantity and Thickness

A minimum of 12 inches of cover soil over approximately 339 acres of Zortman Mine facilities (areas of both water balance and water barrier covers) would require approximately 544,000 yd^3 of cover soil, which is 353,000 yd^3 more than the 191,000 yd^3 currently available in cover soil stockpiles and previously reclaimed areas in the Zortman Mine area (Table 3.3-1). Excavation/mining of known sources of soil materials from the Goslin Flats area (Noel and Houlton 1991) would yield a net of 164,000 yd^3 with replacement of 12 inches of soil over the 250-acre Goslin Flats soil borrow area during reclamation. Including the 191,000 yd^3 of cover soil from the mine area and the 164,000 yd^3 from the Goslin Flats borrow area, available cover soil volumes for the Zortman Mine area total 355,000 yd^3. This amount of available cover soil is 189,000 yd^3 short of the needed to provide 12 inches of cover soil over the Zortman Mine facilities.

The importation of 189,000 yd^3 of cover soil from existing cover soil stockpiles at the Landusky Mine to the Zortman Mine area would leave approximately 1,983,000 yd^3 for the reclamation of the Landusky mine facilities. To achieve 12 inches of cover soil over 714 acres of Landusky facilities, approximately 1,152,000 yd^3 would be required. Use of Landusky's stockpiled cover soil to support a minimum of 12 inches of cover soil at both Zortman and Landusky mines would leave approximately 831,000 yd^3 of cover soil in stockpiles at the Landusky Mine.

A minimum of 24 inches of subsoil over approximately 163 acres of Zortman Mine facilities to be reclaimed using the water balance cover would require approximately 526,000 yd^3 of subsoil. No subsoil was salvaged or stockpiled separately during previous mine development. The source of subsoil materials at the Zortman Mine would be the Goslin Flats soil borrow area. Excavation/mining of known sources of subsoil at the 250-acre Goslin Flats borrow area would yield an estimated 2,215,000 yd^3 of suitable subsoil. Use of 526,000 yd^3 of the available 2,215,000 yd^3 for reclamation of the Zortman Mine facilities to receive the water balance cover would leave approximately 1,689,000 yd^3 of suitable subsoil materials.

A minimum of 24 inches of subsoil over approximately 267 acres of Landusky Mine facilities to be reclaimed using the water balance cover would require approximately 862,000 yd^3 of subsoil. Source of subsoil materials at the Landusky Mine would be the 831,000 yd^3 of available cover soil (topsoil and subsoil) remaining in stockpiles at Landusky and an additional 31,000 yd^3 of subsoil material to be obtained from the Goslin Flats borrow area. Use of 31,000 yd^3 of subsoil at Landusky from the Goslin Flats borrow area would leave approximately 1,658,000 yd^3 of suitable subsoil material in-place at Goslin Flats for potential use as NAG material for water barrier covers to be installed during reclamation over slopes less than 25 percent at both the Zortman and Landusky mines. To avoid the need to haul subsoil from Goslin Flats to the Landusky Mine area, 31,000 yd^3 of stockpiled cover soil at Landusky would be retained for use as subsoil in the water balance cover for Landusky reclamation. Suitable subsoil (31,000 yd^3) from Goslin Flats would be used as additional cover soil at Zortman in place of stockpiled cover soil at Landusky.

Use of the water balance cover (12 inches of cover soil, 24 inches of subsoil, 12 inches of NAG) and the water barrier cover (12 inches of cover soil, 36 inches of NAG or subsoil, GCL) would:

- Improve moisture and nutrient availability to plants, in comparison to 8 inches of cover soil over 6 inches of clay, by providing additional suitable or improved growth media (12 inches plus).

- Prevent acidification of the cover soil layer from upward migration acidic moisture coming from acid-generating rock materials below.

- Minimize potential failures of the covers by providing: 1) a protected, vegetated soil cover capable of sustaining vegetation and stability for the long-term; 2) a layer in the covers which would be erosion resistant, a capillary break, and a drainage layer; and 3) a 48-inch cover of NAG materials over potentially toxic, acidic waste/ore materials.

The 12 inches of cover soil over areas of NAG materials on other disturbance provide similar benefits to those listed above. The 12 inches of soil over 12 inches of NAG materials on pit benches reduces impacts to moderate.

Impacts regarding cover soil thickness would be low in both short- and long-term, as potential impacts associated with erosion and soil acidification of the cover soil would be reduced by the addition of the thicker soil and overall growth medium on all disturbance including pit benches. It is assumed that 50 percent of all existing pit benches would be inaccessible. Of the accessible benches, some soil over time would be contaminated from highwall runoff.

Cover Soil Erosion

Zortman Mine Facilities - For Zortman Mine facilities to be reclaimed under this alternative, estimated short-term soil losses (1-5 years) from side slopes (slopes of 2.8H:1V and slope lengths of 230 feet) would be 3.5 tons/acre/year for all facilities (Table 4.3-1). The 3.5 tons/acre/year rate of soil loss equals a rate of approximately 0.019 inches/year of soil loss from each facilities' side slopes. A loss of one inch of soil from these surfaces would take approximately 53 years. Direct short-term impacts would be significant, high for soil loss from all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of Zortman Mine facilities would be approximately 0.82 tons/acre/year (Table 4.3-1). The 0.82 tons/acre/year rate of soil loss equals a rate of approximately 0.004 inches/year of soil loss from each facilities' side slopes. The loss of one inch of soil would require approximately 250 years. Direct long-term impacts would be low.

Soil loss from the flatter ($\leq$ 25 percent) top areas of the Zortman Mine facilities and other disturbed areas would be less than 2 tons/acre/year for both the short- and long-term (Table 4.3-1). Direct short- and long-term impacts on the flatter tops and other areas would be moderate and low, respectively.

Landusky Mine Facilities - For Landusky Mine leach pads and waste dump facilities to be reclaimed under this alternative, estimated short-term soil losses (1-5 years) from side slopes would range from 3.5 to 4.9 tons/acre/year (Table 4.3-1) Slopes for most facilities would be reduced to 2.8H:1V slopes and slope lengths of 230 feet. Exceptions are the Gold Bug waste repository (2.5H:1V and 269 feet long slopes), Mill Gulch waste repository (2.75H:1V and 293 feet long slopes), the Sullivan Park waste repository (2H:1V and 224 feet long slopes), and the August Nos. 1 and 2 waste dumps (2H:1V and 224 feet long slopes). Soil loss from facility side slopes would range from 0.017 to 0.027 inch/year (59 to 37 years per inch of soil loss, respectively). Direct short-term impacts due to soil loss and the reduction in thickness and volume of plant growth medium would be significant, high for all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of Landusky Mine facilities would range from 0.8 to 1.6 tons/acre/year (Table 4.3-1). The 0.8 and 1.6 tons/acre/year rate of soil loss equal rates of approximately 0.005 and 0.009 inches/year of soil loss from facilities' side slopes. The loss of one inch of soil would require approximately 200 and 111 years, respectively. Direct long-term impacts would be low to moderate.

Soil loss from flatter top areas of the leach pads and waste dumps and other disturbed areas would be less than 2 tons/acre/year for both the short- and long-term (Table 4.3-1). Direct negative short- and long-term impacts on flatter top and areas would be moderate and low, respectively.

Additional Actions

Impacts to soil as a result of land application of heap rinsate would be as described above for Alternatives 1 and 2.

4.3.5.1 Cumulative Impacts

Cumulative impacts from Alternative 3 include the 250 more acres of new disturbance over Alternative 1 and Alternative 2 for soil reclamation materials at Goslin Flats. Total disturbance increases to approximately 1,498 acres. It is assumed that reclaimed pit benches below acid producing pit highwalls would partially fail.

4.3.5.2 Unavoidable Adverse Impacts

New disturbances of soil at the Goslin Flats soil borrow area would be unavoidable actions necessary for the improved reclamation potential for the Zortman and Landusky mines. Reclamation is assumed to be successful on all reclaimed areas except inaccessible benches and portions of benches below acid producing pit highwalls.

4.3.5.3 Short-term Use/Long-term Productivity

The relatively short-term use and replacement of all soil materials previously salvaged during mine development as well as materials salvaged from the Goslin Flats soil borrow area would result in improved long-term productivity of the affected lands as compared to Alternatives 1 and 2. Comparable stability and utility in the long-term would be achieved in the post-mine landscape, except on portions of pit benches, below acid producing pit highwalls and existing pit benches that cannot be accessed.

4.3.5.4 Irreversible or Irretrievable Resources Commitments

Commitments of soil resources for Alternative 3 would be similar to those for Alternatives 1 and 2 except that soil materials from the Goslin Flats soil borrow area would be committed to the reclamation of the Zortman and Landusky Mines. Disturbance of soils at limestone quarries would not be required. Minimal waste of soil and NAG subsoil would result from portions of pit benches acidifying over time. All stockpiled cover soil materials would be used in reclamation.

4.3.6 Impacts from Alternative 4

The effects from redistribution of previously stockpiled cover soil and cover soil to be salvaged ahead of new disturbance over final graded surfaces would be similar to those of Alternative 3. However, under Alternative 4 reclamation results would improve from:

- Reduction of slopes from approximately 2H:1V to 3H:1V (2.5H:1V for dikes) and placement of Reclamation Covers B (slopes greater than 5 percent) and C (slopes less than 5 percent) on all heap leach facilities within the Zortman Mine complex, including those previously reclaimed with approximately 8 inches of cover soil over unclassified mine wastes

- Reduction of slopes from approximately 2H:1V to 3H:1V [exceptions Gold Bug waste repository (2.5H:lV); Mill Gulch waste repository (2.75H:1V); and August Nos. 1 and 2 waste dumps (2H:1V)] and placement of Reclamation Covers B and Modified C on all heap leach pads and waste rock dumps (Mill Gulch dump already covered by a cover system similar to B), and pit bottoms/fill surfaces within the Landusky Mine complex

(For the purposes of this analysis, it has been assumed that 6 inches of compacted clay and 8 inches of cover soil would be distributed over all remaining disturbed areas/facilities not covered by the Reclamation Covers B or C).

Although improved reclamation would result from the redistribution of cover soil, the effects would not compare with those of Alternative 3. Differences between the two alternatives would result from 1) the greater minimum surface soil layer thickness of 12 inches over all surfaces for Alternative 3 in comparison with 8 inches for Alternative 4 and 2) the placement of 36 inches of cover soil (12 inches of "topsoil" over 24 inches of subsoil) on steeper sideslope of facilities for Alternative 3 in comparison with 8 inches of "topsoil" over a 36-inch layer of NAG capillary break material. Direct impacts to soil would result from mine expansion of 972 acres including the Goslin Flats heap leach facility and associated conveyor, ore crushing/handling facility, process facility, waste rock dump, and cover soil stockpile. Impacts to the soil resource located within the footprint of the above facilities would be similar to those described in Section 4.3.2 for mine development from 1979 to date.

Cover Soil Quality

Effects and limitations posed by currently stockpiled and new soil salvaged in advance of mine expansion areas in the Little Rocky Mountains would be the same as those described in Section 4.3.5. Cover soil materials for use in the reclamation of both the Zortman and Landusky mines would be the same as described for Alternatives 1, 2, and 3, including soil materials of the Goslin Flats area.

Soil within the conveyor right-of-way would be bladed/windrowed into a berm on the edge of the right-of-way, revegetated, and subsequently bladed back over the cleared right-of-way and revegetated at closure as described in Section 2.8.2.6. Impacts would be mostly moderate in the short-term and low in the long-term for soil erosion and ability to re-establish vegetation because of the lack of acid-producing materials exposed along the conveyor route.

Soil beneath the proposed cover soil stockpile adjacent to the Goslin Flats heap leach pad would be buried beneath the stockpile for the life of the pile and subsequently ripped to break up any compaction and revegetated after cover soil redistribution at mine closure.

The above direct impacts to soil in the expansion area would be high resulting from 972 acres of disturbance in the short-term. Replacement of stockpiled cover soil would reduce impacts to low to moderate. Reclamation cover systems would contain almost 48 inches of growth medium but cover soil quality would be limited by <9 inches of replaced soil.

Cover Soil Quantity and Thickness

Cover soil volume requirements for reclaiming existing disturbed areas within the Zortman and Landusky mine areas in the mountains are described in Alternative 1. Cover soil volume requirements for reclaiming approximately 568 acres of new disturbance associated with expansion of the Zortman Mine and 30 acres of disturbances within the Landusky Mine, respectively, are approximately 610,900 yd^3 and 78,500 yd^3. Assuming the remaining 1,159,000 yd^3 of cover soil stored in stockpiles at the Landusky Mine would meet the needs, 690,400 yd^3 would remain to be redistributed over disturbed areas. There is no commitment to use this surplus cover.

A minimum of 8 inches of cover soil over 250 surface acres of the Goslin Flats heap leach would require approximately 247,500 yd^3 of cover soil material. Assuming approximately 80 acres for the nearly level top of the heap leach, approximately 86,000 yd^3 of the 309,000 yd^3 of soil suitable for placement on reduced slopes would be required. Approximately 220,000 yd^3 of material suitable for reduced slopes would remain. Assuming 184 surface acres for the 2.5H:1V slopes of the heap leach pile, approximately 196,000 of the 280,000 yd^3 of soil suitable for placement on steeper, 2.5H:1V slopes would be required. Approximately 84,000 yd^3 of material suitable for 2H:1V slopes would remain.

In comparison with Alternative 2, the presence of a 36-inch thick capillary break layer underlain by either a compacted clay layer (Cover B) or a combination of synthetic liner and clay layer (modified Cover C) would:

- Improve moisture availability to plants by providing additional material below the 8 inches of cover soil for moisture retention and increased rooting depths

- Prevent acidification of the cover soil layer by migration of moisture from the acid generating substrates. However, the potential for lateral movement of acidic seepage into soil downslope remains a possibility.

- Minimize potential failures of the covers by providing: 1) an erosion resistant layer (capillary break); 2) a drainage layer to channel excess water away at the capillary break or liner shield and clay layer or synthetic liner interface, respectively; and 3) an increased depth to the clay layer so that it is protected from desiccation and freeze/thaw effects.

However, in comparison with Alternative 3, the 12-inch surface soil layer would improve moisture and nutrient availability to plants over the 8-inch layer proposed for all facilities in Alternative 4. In addition, the placement of 24 inches of cover soil as subsoil on the approximately 2.8H:1V side slopes under Alternative 3 provides additional moisture/nutrient retention and capability to support an increased cover of vegetation which would improve soil stability, limit accelerated erosion, and increase evapotranspiration, the principal goal of the water balance cover.

Impacts regarding cover soil thickness would be moderate in both the short- and long-term. The impacts associated with soil loss and acidification of the cover soil would be reduced significantly in comparison to Alternative 2 by the addition of the capillary break and clay layers to the cover system. However, placement of only 8 inches of cover soil would limit development of vegetative cover, productivity and evapotranspiration in comparison to Alternative 3. Mine pit benches on acid generating materials would fail to reclaim due to inadequate growth medium.

Cover Soil Erosion

Zortman Mine Facilities - For Zortman Mine facilities to be reclaimed under Alternative 4, estimated short-term soil losses (1-5 years) from side slopes (3H:1V and 200 feet long) would be 3.1 tons/acre/year for all facilities, with the exception of the Goslin Flats heap leach facility - 3.8 tons/acre/year from 2.5H:1V and 200 feet long slopes (Table 4.3-1). The higher rate of projected soil loss is due to an increase in slope. The 3.1 tons/acre/year rate of soil loss equals a rate of approximately 0.017 inches/year of soil loss from each facilities' side slopes; 3.8 tons/acre/year and 4.5 tons/acre/year equal rates of 0.021 and 0.025 inch/year of soil loss. A loss of one inch of soil from these surfaces of the Goslin Flats heap leach facility, Carter Gulch waste repository, and the other facilities would take approximately 48, 40, and 59 years, respectively. Direct short-term impacts would be significant, high for soil loss from all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of the Goslin Flats heap leach facility, Carter Gulch waste repository, and the other Zortman Mine facilities would range from approximately 1.0 to 1.5 tons/acre/year (Table 4.3-1). The 1.0 and 1.5 tons/acre/year rates of soil loss equal a rate of approximately 0.006 to 0.008 inches/year of soil loss, respectively. The loss of one inch of soil would require approximately 166 and 125 years, respectively. Direct long-term impacts would be moderate for all facilities.

Soil loss from flatter top areas of the leach pads and waste dumps and other disturbed areas would be less than 1 ton/acre/year for both the short- and long-term. Direct short- and long-term impacts on flatter top and areas would be low.

Landusky Mine Facilities - For Landusky Mine leach pads and waste dump facilities to be reclaimed under this alternative, estimated short-term soil losses (1-5 years) from side slopes range from 3.2 to 4.9 tons/acre/year (Table 4.3-1). Slopes for most facilities would be reduced to 3H:1V slopes and slope lengths of 200 feet. Exceptions are the Gold Bug waste repository (2.5H:1V and 269 feet long slopes), Mill Gulch waste repository (assumed 2.75H:1V and 293 feet long slopes), the Sullivan Park waste repository (2H:1V and 224 feet long slopes), and the August Nos. 1 and 2 waste dumps (2H:1V and 224 feet long slopes). Soil loss from facility side slopes would range from 0.017 to 0.027 inch/year (59 to 37 years per inch of soil loss, respectively). Direct short-term impacts due to soil loss and the reduction in thickness and volume of plant growth medium would be significant, high for all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of Landusky Mine facilities would range from 1.0 to 1.6 tons/acre/year (Table 4.3-1). The 1.0 and 1.6 tons/acre/year rate of soil loss equal rates of approximately 0.006 and 0.009 inches/year of soil loss from facilities' side slopes. The loss of one inch of soil would require approximately 166 and 111 years, respectively. Direct long-term impacts would be moderate.

Soil loss from flatter top areas of the leach pads and waste dumps and other disturbed areas would be less than 1 ton/acre/year for both the short- and long-term. Direct short-term and long-term impacts on flatter areas would be low.

Additional Actions

In response to needs for clay and limestone to be used in reclamation of the Zortman Mine area, and construction and reclamation of the Goslin Flats heap leach pile, an additional 10 acres of the Seaford clay pit and 13 acres of a new limestone quarry (LS-1) located near Shell Butte would be disturbed. An additional 7 acres of the Williams clay pit and 3 acres of the King Creek limestone quarry would be disturbed to provide reclamation materials for the Landusky Mine. These reclamation material source areas would be reclaimed as described in Section 2.8.2.6.

Direct short-term impacts would be low for all pits and quarry as cover soil would be salvaged, stockpiled, and replaced at reclamation. Long-term impacts would be low.

Impacts to soil as a result of land application of heap rinsate would be as described above for Alternatives 1-3.

4.3.6.1 Cumulative Impacts

Cumulative impacts for activities under Alternative 4 would come from disturbances to 972 acres by proposed mine expansion at both Zortman and Landusky mines, assumed development of a mine in the Pony Gulch area in the reasonably foreseeable future, and from the expansion of reclamation materials source pits and quarries. Past and proposed new disturbance of soil include:

- 54 acres of historic mining disturbance from activities occurring prior to 1978

- 1,189 acres of recent mining disturbance (both mines) between 1979 and the present
- 972 acres of proposed new disturbance for both mines including 33 acres of proposed disturbance from activities at the clay pits and limestone quarries.
- 33 acres of past disturbance from activities at the Seaford and Williams clay pits and the King Creek Quarry (limestone)
- 155 acres of potential exploration and mine development in Pony Gulch.

Construction of the 69kV electrical transmission line from Malta to the Zortman Mine area would result in minimal impacts to soil as the line would:

- mostly follow/parallel existing linear ROWs,
- not require new access road construction, and
- necessitate minimal clearing of protective vegetation and blading of cuts and fills.

4.3.6.2 Unavoidable Adverse Impacts

It is assumed that a small percentage (less than for Alternatives 1 and 2 and more than Alternative 3) of the reclaimed acres would eventually fail from erosion on long, steep slopes and soil acidification. In addition, migration of acidic moisture from underlying acid forming waste or parent rock would likely occur. On areas of failed reclamation, over 10,000 years of soil development would be wasted. Exposed mine waste rock and ore would have to oxidize over time and soil development would take centuries to recover.

New disturbances of soil in the Goslin Flats, the mine expansion areas at the Seaford and Williams clay pits, and the new Zortman Mine limestone quarry and King Creek limestone quarry would be unavoidable actions necessary for the effective mineral extraction and improved reclamation potential for the Zortman and Landusky mines over Alternative 1. Reclamation potential would be similar to Alternative 2 for mine pit benches. Reclamation potential would be less than Alternative 3 for all facilities.

4.3.6.3 Short-term Use/Long-term Productivity

The relatively short-term use and replacement of some of the soil materials previously salvaged during mine development would result in improved long-term productivity of the affected lands as compared to Alternatives 1 and 2. Limited soil are protected from acidification below by 36 inches of NAG material. Comparable stability and utility in the long-term would be achieved in the post-mine landscape on most acres. Mine pit benches with acid generating characteristics would fail from a lack of adequate growth medium.

4.3.6.4 Irreversible or Irretrievable Resources Commitments

Some soil and clay would be lost due to reclamation failure on areas covered with 8" of soil and 6" of clay over acid-producing materials as in Alternative 2. Unused stockpiled cover soil materials is a valuable resource which would be wasted if not used in reclamation as surface cover.

4.3.7 Impacts from Alternative 5

Effects from redistribution of stockpiled cover soil over final graded surfaces would be similar to those described for Alternative 4 in which the effectiveness of covers for Alternatives 2, 3 and 4 are compared. Direct impacts to those few soil present would result from the proposed mine expansion of 923 acres including the Carter Gulch waste rock repository and Alder Gulch heap leach facility and associated ore crushing/handling facility, and process facility. Impacts to soil located within the footprints of the above facilities would be similar to those described in Section 4.3.2 for mine development since 1979 in the area.

Cover Soil Quality

Effects and limitations posed by currently stockpiled and new soil salvaged in advance of mine expansion areas in the Little Rocky Mountains would be the same as described in Section 4.3.5. Cover soil materials for use in the reclamation of both the Zortman and Landusky mines would be the same as described in Alternatives 1, 2, 3, and 4.

No soil salvage is planned for either the Upper Alder Gulch leach pad or the Carter Gulch waste rock depository due to steep slopes and lack of salvageable soil materials. Additional cover soil to reclaim these facilities would be obtained from the surplus of cover soil stockpiled at the Landusky Mine.

Direct impacts to soil in the expansion area would be high due to the disturbance of 923 acres in the short-term. Replacement of stockpiled cover soil would reduce impacts to low to moderate.

Cover Soil Quantity and Thickness

Reclamation of facilities would be the same as Alternative 4.

Cover soil volume requirements for reclaiming existing disturbed areas within the Zortman and Landusky mine areas in the mountains are described in Alternative 1. Cover soil volume requirements for reclaiming approximately 405 acres of new disturbance associated with expansion of the Zortman Mine and 30 acres of disturbances within the Landusky Mine, respectively, are approximately 435,600 yd^3 and 32,200 yd^3. Assuming no soil salvage ahead of disturbance, the remaining 1,159,000 yd^3 of cover soil stored in stockpiles at the Landusky Mine would meet the needs with approximately 691,200 yd^3 remaining to be redistributed over disturbed areas during reclamation. There is no commitment to use this surplus soil.

The effectiveness of the cover soil as a growth medium as part of Reclamation Covers B and Modified C on the new disturbances would be similar to those effects described in Alternative 4. Impacts would be moderate in both the short- and long-term.

Cover Soil Erosion

For both Zortman and Landusky mine facilities, short- and long-term soil losses and impact levels for both side slopes and tops would be as described for Alternative 4 at Zortman (with the exclusion of Goslin Flats and Carter Gulch facilities) and Alternative 3 at Landusky.

Additional Actions

In response to needs for clay and limestone to be used for construction and in reclamation of the Zortman Mine area, an additional 11.5 acres of the Seaford clay pit and 14 acres of a new limestone quarry (LS-1) located near Shell Butte would be disturbed. An additional 9 acres of the Williams clay pit and 3 acres of the King Creek limestone quarry would be disturbed to provide reclamation materials for the Landusky Mine. These reclamation material source areas would be reclaimed as described in Section 2.9.2.6.

Direct short-term negative impacts would be low for all pits and quarry as cover soil would be salvaged, stockpiled, and replaced at reclamation. Long-term impacts would be low.

Impacts to soil as a result of land application of waste mining solutions would be as described above for Alternatives 1-4.

4.3.7.1 Cumulative Impacts

Cumulative impacts to soil by proposed mine expansion at both Zortman and Landusky and from the expansion of reclamation materials source pits and quarries include:

- 54 acres of historic mining disturbance from activities occurring prior to 1978;
- 1,189 acres of recent mining disturbance (both mines) between 1979 and the present;
- 960.5 acres of proposed new disturbance for both mines including 37.5 acres of proposed disturbance from activities at the clay pits and limestone quarries;
- 33 acres of past disturbance from activities at the Seaford and Williams clay pits and the King Creek Quarry (limestone); and
- 155 acres of potential exploration.

Construction of the 69kV electrical transmission would have minimal impacts on soil as described in Section 4.3.6.1.

4.3.7.2 Unavoidable Adverse Impacts

It is assumed that a small percentage of the reclaimed acres would eventually fail from erosion on long, steep slopes and soil acidification. In addition, some migration of acidic moisture from underlying acid forming waste or parent rock would occur. On failed areas, over 10,000 years of soil development would be lost. Exposed mine waste rock and ore would have to oxidize over time and soil development would take centuries to recover.

New disturbances of those few soil present in the Upper Alder Gulch heap leach pad and at the Seaford and Williams clay pits and the new Zortman Mine limestone quarry and King Creek limestone quarry would be unavoidable actions necessary for the effective mineral extraction and improved reclamation potential for the Zortman and Landusky mines over Alternative 1.

Reclamation success would be similar to Alternative 2 for mine pit benches. Reclamation success would be less than Alternative 3. Reclamation success would be similar to Alternative 4.

4.3.7.3 Short-term Use/Long-term Productivity

The relatively short-term use and replacement of some of the soil materials previously salvaged during mine development would result in improved long-term productivity of the affected lands as compared to Alternatives 1 and 2. Limited soil are protected from acidic mine waste below by 36 inches of NAG material. Comparable stability and utility in the long-term would be achieved in the post-mine landscape on most acres as in Alternative 4. Mine pit benches with acid generating materials would fail from a lack of adequate growth medium.

4.3.7.4 Irreversible or Irretrievable Resources Commitments

Commitments of soil resources for Alternative 5 would be similar to those in Alternative 4. Some soil and clay would be lost due to limited areas of reclamation failure. Unused stockpile cover soil materials (volume) is a valuable resource which would be wasted if not used in reclamation as surface cover.

4.3.8 Impacts from Alternative 6

Effects from redistribution of stockpiled cover soil over final graded surfaces would be similar to those described for Alternatives 4 and 5. Direct impacts to soil would result from mine expansion of 951 acres including construction of the Goslin Flats heap leach facility and associated conveyor, ore crushing/handling facility, process facility, cover soil stockpile, and Ruby Flats waste rock repository. Impacts to the soil resource located within the footprint of the above facilities would be similar to those described in Section 4.3.2 for mine development from 1979 to date in the area.

Cover Soil Quality

Effects and limitations posed by currently stockpiled and new soil salvaged in advance of mine expansion areas in the Little Rocky Mountains would be the same as described in Section 4.3.5. Cover soil materials for use in the reclamation of both the Zortman and Landusky mines would be the same as described for Alternatives 1-5.

Soil in the Goslin Flats and Ruby Flats area have several potential uses in reclamation cover systems. Approximately 567,000 yd^3 of cover soil material (organic matter content greater than 0.5 percent) would be salvaged from 250 acres beneath the heap leach pad, ore crushing/handling facility, and process facility. Approximately 271,500 yd^3 of cover soil material would be salvaged from 203 acres beneath the Ruby Flats waste rock repository.

Impacts associated with the conveyor would be as described in Section 4.3.6 for Alternative 4.

Soil beneath the proposed cover soil stockpile adjacent to the Goslin Flats heap leach pad would be buried beneath the stockpile for the life of the pile and subsequently ripped to break up any compaction and revegetated after cover soil redistribution at mine closure.

The above direct impacts would be high in the short-term. Replacement of stockpiled cover soil would reduce impacts to low to moderate. About 451,500 yd^3 of soil are resistant to erosion based on soil characteristics including texture and coarse fragment content. These cover soil materials would be better suited for placement on steeper slopes (2.5H:1V-3H:1V). The remaining 409,000 yd^3 of soil would be generally less resistant to erosion and better suited for placement on more level areas.

Replacement of stockpiled cover soil would reduce impacts to low to moderate. Reclamation cover systems would contain almost 48 inches of growth medium but cover soil quality would be limited by <9 inches of replaced soil.

Cover Soil Quantity and Thickness

Reclamation of facilities would be the same as described in Alternative 4.

Cover soil volume requirements for reclaiming existing disturbed areas within the Zortman and Landusky mine areas in the mountains are described in Alternative 1. Cover soil volume requirements for reclaiming approximately 805 acres of new disturbance associated with expansion of the Zortman Mine and 37 acres of disturbances within the Landusky Mine, respectively, are approximately 524,800 yd^3 and 32,200 yd^3.

Salvage of 8 inches of cover soil material from beneath the proposed Goslin and Ruby Flats facilities would yield approximately 487,200 yd^3 of material. Salvage and use of this material would leave approximately 1,089,000 yd^3 of cover soil material in stockpiles at the Landusky Mine. There is no commitment to use this surplus soil.

The effectiveness of the cover soil as a growth medium as part of Reclamation Covers B and C on the Goslin Flats heap leach pile and Ruby Flats waste rock repository would be similar to those effects described in Alternative 4.

Cover Soil Erosion

For Zortman Mine facilities to be reclaimed under Alternative 6, estimated short-term soil losses (1-5 years) from side slopes (3H:1V and 200 feet long) would be 3.1 tons/acre/year for all facilities with the exception of the Goslin Flats heap leach facility - 3.7 tons/acre/year from 2.5H:1V slopes (Table 4.3-1). The 3.1 tons/acre/year rate of soil loss equals a rate of approximately 0.017 inches/year of soil loss from each facilities' side slopes; 3.7 tons/acre/year equals a rate of 0.021 inches of soil loss. A loss of one inch of soil from these surfaces of the Goslin Flats heap leach facility and the other facilities would take approximately 59 and 48 years, respectively. Direct short-term impacts would be significant, high for soil loss from all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of the Goslin Flats heap leach facility and the other Zortman Mine facilities would be approximately 1.2 and 1.0 tons/acre/year) (Table 4.3-1). The 1.2 and 1.0 tons/acre/year rates of soil loss equal a rate of approximately 0.007 and 0.006 inches/year of soil loss, respectively. The loss of one inch of soil would require approximately 143 and 166 years, respectively. Direct long-term impacts would be moderate for all Zortman facilities.

Soil loss from the flatter top areas of the Zortman Mine facilities and other disturbed areas would be less than 1 ton/acre/year for both the short- and long-term. Direct negative short- and long-term impacts on the flatter tops and other areas would be low for all facilities.

Short- and long-term direct negative impacts, and impact levels, for Landusky Mine facilities would be the same as those described for Alternatives 4 and 5 (expansion alternatives).

Additional Actions

In response to needs for clay and limestone to be used in reclamation of the Zortman Mine area, and construction and reclamation of the Goslin Flats heap leach pile, an additional 12 acres of the Seaford clay pit and 13 acres of the new limestone quarry (LS-1) located near Shell Butte would be disturbed. An additional 9 acres of the Williams clay pit and 3 acres of the King Creek limestone quarry would be disturbed to provide reclamation materials for the Landusky Mine. These reclamation material source areas would be reclaimed as described in Section 2.10.2.6.

Direct short-term impacts would be low for all disturbances as cover soil would be salvaged, stockpiled, and replaced at reclamation. Long-term impacts would be low.

Impacts to soil as a result of land application of waste mining solutions would be as described above for Alternatives 1-5.

4.3.8.1 Cumulative Impacts

Cumulative impacts for activities under Alternative 6 would come from historic and recent soil disturbances, disturbances by proposed mine expansion at both Zortman and Landusky mines, assumed development of the mine in the Pony Gulch area in the reasonably foreseeable future, and from the expansion of reclamation materials sources. Past and proposed new disturbance of soil include:

- 54 acres of historic mining disturbance from activities occurring prior to 1978;
- 1,189 acres of recent mining disturbance (both mines) between 1979 and the present;
- 988 acres of proposed new disturbance for both mines including 37 acres of proposed disturbance from activities at the clay pits and limestone quarries;
- 33 acres of past disturbance from activities at the Seaford and Williams clay pits and the King Creek Quarry (limestone); and
- 155 acres of potential disturbance due to exploration and the Pony Gulch mine.

Construction of the 69kV electrical transmission would have minimal impacts on soil as described in Section 4.3.6.1.

4.3.8.2 Unavoidable Adverse Impacts

It is assumed that a small percentage of the reclaimed acres would eventually fail from erosion on long, steep slopes and soil acidification. In addition, some migration of acidic moisture from underlying acid forming waste or parent rock would occur. On failed areas, over 10,000 years of soil development would be wasted. Exposed mine waste rock and ore would have to oxidize over time and soil development would take centuries to recover.

New disturbances of soil in the Goslin Flats and Ruby Flats areas and at the Seaford and Williams clay pits and the new Zortman Mine limestone quarry and King Creek limestone quarry would be unavoidable actions necessary for the effective mineral extraction and improved reclamation potential for the Zortman and Landusky mines over Alternative 1. Reclamation success would be similar to Alternative 2 for mine pit benches. Reclamation success would be less than Alternative 3. Reclamation success would be similar to Alternatives 4 and 5.

4.3.8.3 Short-term Use/Long-term Productivity

The relatively short-term use and replacement of soil materials previously salvaged during mine development would result in improved long-term productivity of the affected lands as compared to Alternatives 1 and 2. Limited cover soil are protected from acidic mine waste below by 36 inches of NAG material. Comparable stability and utility in the long-term would be achieved in the post-mine landscape on most acres. Mine pit benches on acid producing materials would fail from a lack of adequate growth medium.

4.3.8.4 Irreversible or Irretrievable Resources Commitments

Commitments of soil resources for Alternative 6 would be similar to those in Alternatives 4 and 5. Some soil and clay would be lost due to reclamation failure on areas covered with 8 inches of soil and 6 inches of clay over acid-producing materials as in Alternatives 2, 4, and 5. Unused stockpile cover soil material is a valuable resource which would be wasted if not used in reclamation as a surface cover.

4.3.9 Impacts from Alternative 7

Effects from redistribution of existing stockpiled cover soil over final graded surfaces would be similar to those of Alternative 3 where the water balance and water barrier covers would be used to cover disturbed areas at closure. Direct impacts to soil present would result from mine expansion including construction of the waste rock repository near the Zortman pit complex and the Goslin Flats heap leach facility and associated conveyor, ore crushing/handling facility, process facility, and cover soil stockpile. Impacts to soil located within the footprints of the above facilities would be similar to those described in Section 4.3.2 for mine development from 1979 to date in the area. These impacts include:

- Loss/interruption of pedogenic (soil) development, including breakdown of soil structure and mixing of distinct soil horizons
- Loss of soil material due to disturbance and exposure to forces of erosion
- Alteration of biological and nutrient conditions in soil materials stored in piles for extended periods
- Compaction of soil materials beneath facilities and in areas of natural soil crossed by vehicular traffic
- Loss or reduction of soil productivity

Cover Soil Quality

Effects and limitations posed by currently stockpiled and new soil salvaged in advance of mine expansion areas in the Little Rocky Mountains would be the same as described in Section 4.3.5. Cover soil materials for use in the reclamation of both the Zortman and Landusky mines would also be the same as described for all alternatives. Sources of cover soil material include:

- cover soil stockpiles at the Zortman Mine,
- cover soil stockpiles at the Landusky Mine,
- cover soil materials in the Goslin Flats area, and
- cover soil materials in proposed areas of disturbance.

Limited soil salvage is planned for the Zortman waste rock repository due to previous disturbance, steep slopes, and lack of salvageable soil materials. Resalvage of soil placed previously on existing facilities would occur to conserve soil reserves. Additional cover soil to reclaim these facilities would be obtained from the surplus of cover soil stockpiled at the Landusky Mine, or soil materials salvaged ahead of construction of the Goslin Flats heap leach facility.

Soil in the Goslin Flats area has potential uses in reclamation cover systems. Approximately 567,000 yd^3 of topsoil material would be salvaged from 250 acres beneath the heap leach pad, ore crushing/handling facility, and process facility. Approximately 2,215,000 yd^3 of suitable subsoil material would be available for salvage from the 250-acre Goslin Flats heap leach facility.

Direct impacts would be high resulting from acres of new disturbance in the short-term. Replacement of stockpiled and borrowed cover soil would reduce impacts to low in the long-term because of adequate soil quality, thickness, and growth medium.

Cover Soil Quantity and Thickness

A minimum of 12 inches of cover soil over approximately 848 acres of Zortman Mine facilities (areas of both water balance and water barrier covers) would require approximately 1,370,000 yd^3 of cover soil, which is 1,179,000 yd^3 more than the 191,000 yd^3 currently available in cover soil stockpiles and previously reclaimed areas in the Zortman Mine area (Table 3.3-1). Excavation/mining of known sources of topsoil materials from the Goslin Flats area would yield a net of 164,000 yd^3 with replacement of 12 inches of topsoil over the 250-acre Goslin Flats soil borrow area during reclamation. Including the 191,000 yd^3 of cover soil from the mine area and the 164,000 yd^3 from the Goslin Flats borrow area, available cover soil volumes for the Zortman Mine area total 355,000 yd^3. This total volume of available cover soil is 1,015,000 yd^3 short of the needed 1,370,000 yd^3 to provide a 12 inches of cover soil over the Zortman Mine facilities.

To achieve 12 inches of cover soil over 753 acres of Landusky facilities, approximately 1,215,000 yd^3 of a total existing stockpiled volume of 2,172,000 yd^3 would be required. Importation of Landusky's remaining stockpiled cover soil volume of 957,000 yd^3 to add to the 355,000 yd^3 of cover soil available at the Zortman Mine (stockpiles, reclaimed areas, and Goslin Flats) totals 1,312,000 yd^3 of available topsoil from the Goslin Flats area and cover soil from the stockpiles and reclaimed areas. As approximately 1,370,000 yd^3 would be needed to cover the Zortman Mine facilities with a minimum of 12 inches of cover soil, a deficiency of 58,000 yd^3 of cover soil materials for the described sources would occur.

A minimum of 24 inches of subsoil over approximately 400 acres of Zortman Mine facilities to be reclaimed using the water balance cover would require approximately 1,291,000 yd^3 of subsoil. No subsoil was salvaged separately or stockpiled during previous mine development. The source of subsoil materials at the Zortman Mine would be the Goslin Flats soil borrow area. Excavation/mining of known sources of subsoil at the 250-acre Goslin Flats borrow area would yield an estimated 2,215,000 yd^3 of suitable subsoil. Use of 1,291,000 yd^3 of the available 2,215,000 yd^3 for reclamation of the Zortman Mine facilities to receive the water balance cover would leave approximately 924,000 yd^3 of suitable subsoil materials.

A minimum of 24 inches of subsoil over approximately 267 acres of Landusky Mine facilities to be reclaimed using the water balance cover would require approximately 862,000 yd^3 of subsoil. No subsoil materials were salvaged or would be available at the Landusky Mine. Importation of 862,000 yd^3 of available subsoil from Goslin Flats to meet the need for subsoil for use in the water balance covers at the Landusky Mine would leave a remaining available subsoil volume of 62,000 yd^3.

As there would be a deficiency of 58,000 yd^3 of cover soil for reclaiming the Zortman Mine facilities, use of the remaining available subsoil materials at Goslin Flats (62,000 yd^3) would meet the cover soil requirements for the reclamation of the Zortman Mine facilities, and therefore as a final step, meet the soil requirements for the reclamation of all Zortman and Landusky mine facilities.

Benefits of the water balance and water barrier covers and the use of 12 inches of cover soil over NAG materials are as follows:

- Improve moisture and nutrient availability to plants, in comparison to 8 inches of cover soil over 6 inches of clay, by providing additional suitable or improved growth media (12 inches plus).
- Prevent acidification of the cover soil layer from upward migration of moisture coming from acid-generating rock materials below.
- Minimize potential failures of the covers by providing: 1) a protected, vegetated soil cover capable of sustaining vegetation and stability for the long-term; 2) a layer in the covers which would be erosion resistant, a capillary break, and a drainage layer; and 3) a 48-inch cover of NAG materials over potentially toxic, acidic waste/ore materials.

Impacts regarding cover soil thickness would be low in both the short- and long-term, as potential high impacts associated with erosion and soil acidification of the cover soil would be reduced to virtually no impact by the addition of the thicker soil cover on all mine disturbances including mine pit benches. It is assumed that ½ of existing mine pit benches are inaccessible. Some accessible benches will re-acidify because of runoff from acid-producing walls.

Cover Soil Erosion

Zortman Mine Facilities - For Zortman Mine leach pads and waste dump facilities to be reclaimed under this alternative, estimated short-term soil losses (1-5 years) from side slopes of facilities (2.8H:1V and 230 feet long slopes) would be 3.5 tons/acre/year for all facilities (Table 4.3-1). The 3.5 tons/acre/year rate of soil loss equals a rate of approximately 0.019 inches/year of soil loss from facilities' side slopes. A loss of one inch of soil from these surfaces would take approximately 53 years. Direct short-term impacts due to soil loss and the reduction in thickness and volume of plant growth medium would be significant high for all facilities.

Estimated long-term soil losses (beyond 5 years) from side slopes of Zortman Mine facilities would be approximately 0.82 to 1.0 tons/acre/year (Table 4.3-1). The 0.82 tons/acre/year rate of soil loss equals a loss of approximately 0.004 inch/year of soil loss from each facilities' side slopes. The loss of one inch of soil would require approximately 250 years. Direct long-term impacts would be low.

Soil loss from flatter top areas of the leach pads and waste dumps and other disturbed areas would be less than 2 tons/acre/year for both the short- and long-term (Table 4.3-1). Direct short- and long-term impacts on flatter areas would be moderate and low, respectively.

Landusky Mine Facilities - Rates of soil loss from Landusky Mine facilities would be as described for Alternative 3, Section 4.3.5. Short- and long-term rates of soil loss and levels of impact for side slopes of most Landusky Mine facilities would be the same as those described above for the Zortman facilities as proposed slope angles (2H:1V) and lengths (224 feet) are similar. Exceptions are the Gold Bug waste repository (2.5H:1V and 269 feet long slopes), Mill Gulch waste repository (assumed 2.75H:1V and 293 feet long slopes), and the 87/91 leach pad (3H:1V and 200 feet long slopes). Again in the short-term, the 6.1 tons/acre/year rate of soil loss equals a rate of 0.034 inch/year and would require approximately 29 years for a one inch soil loss. The rate of soil loss from side slopes of the Gold Bug waste repository of 5.9 tons/acre/year equals a rate of 0.033 inch/year (30 years per inch of soil loss). The rate of soil loss from side slopes of the Mill Gulch waste repository of 5.8 tons/acre/year equals a rate of 0.032 inch/year (31 years per inch of soil loss). The rate of soil loss from side slopes of the 87/91 leach pad of 3.9 tons/acre/year equals a rate of 0.021 inch/year (48 years per inch of soil loss). Direct short-term impacts on most steeper side slopes would be significant high.

Estimated long-term soil losses (beyond 5 years) from side slopes of Landusky Mine facilities would exceed 2 tons/acre/year (approximately 2.3 to 2.4 tons/acre/year) for all facilities with the exception of the 87/91 leach pad (1.5 tons/acre/year). The rate of soil loss from side slopes of the 87/91 leach pad equals a rate of 0.008 inch/year (125 years per inch of soil loss); the remaining facilities' rates of soil loss equal 0.012 to 0.013 inch/year (83 to 77 years per inch of soil loss). Direct long-term impacts on most steeper side slopes would be significant high with the exception of side slopes of the 87/91 leach pad.

Direct short- and long-term impacts for the flatter tops would be low for all facilities, assuming no revegetation failure (Table 4.3-1).

Additional Actions

Impacts to soil as a result of land application of waste mining solutions would be as described above for Alternatives 1-6. Soil of the approximately 285 acres in the Goslin Flats area to be used for the treatment and disposal of excess mining solutions would be affected by minor disturbances of limited compaction/rutting and loss of vegetative cover due to vehicular traffic associated with the construction and ultimate demolition of the land application system. The dilute nature of the barren solution to be sprayed onto the soil and the adequate adsorption capacity would result in the effective capture of most metals and other deleterious substances in the waste stream (Schafer and Associates 1993). Accumulations of most trace elements would not concentrate in levels that pose a threat to vegetation, human health, or any waters of the state. Possible exceptions would be some natural background metals, such as molybdenum and arsenic which could desorb from soil and be leached deeper into the soil profile. The 285-acre area would be displaced to the extent necessary to accommodate the proposed location of the Goslin Flats heap leach facility.

4.3.9.1 Cumulative Impacts

Cumulative impacts for activities under Alternative 7 would come from historic and recent soil disturbances, disturbances of soil by proposed mine expansion for both Zortman and Landusky, assumed development of the proposed mine in the Pony Gulch area.

Past and proposed new disturbance of soil include:

- 54 acres of historic mining disturbance from activities occurring prior to 1978;
- 1,189 acres of past permitted and 792 proposed mining disturbance (both mines including new disturbance at clay pits and limestone quarries);
- 33 acres of past disturbance from activities at the Seaford and Williams clay pits and the LS-2 limestone quarry; and
- 155 acres of potential disturbance due to exploration and the Pony Gulch mine.

Construction of the 69kV electrical transmission line from Malta to the Zortman Mine area would result in minimal impacts to soil as the line would:

- mostly follow/parallel existing linear ROWs,
- not require new access road construction, and
- necessitate minimal clearing of protective vegetation and blading of cuts and fills.

4.3.9.2 Unavoidable Adverse Impacts

New disturbances of those few soil present in the area of the new waste rock repository, new limestone quarries, and the Goslin Flats heap leach facility would be unavoidable actions necessary for the effective mineral extraction and improved reclamation potential for the Zortman and Landusky mines as in Alternative 3. Alternatives 3 and 7 would produce the same reclamation results. The BLM and DEQ assume reclamation would be possible on all disturbances except ½ of the existing pit benches. Some portion of the reclaimed accessible benches would fail from acidification from runoff from pit highwalls.

4.3.9.3 Short-term Use/Long-term Productivity

The relatively short-term use and replacement of all soil materials previously salvaged during mine development would result in improved long-term productivity of the affected lands. Comparable stability and utility in the long-term would be achieved in the post-mine landscape on all but a portion of the reclaimed mine pit benches and 50 percent of the mine pit benches that are inaccessible.

4.3.9.4 Irreversible or Irretrievable Resources Commitments

The removal of vegetation and the disturbance of soil during mine construction, operations, and reclamation has resulted in the loss of thousands of years of soil development. However, replacement of salvaged soil materials during reclamation would enhance the restoration of the soil development process and soil productivity.

Commitments of soil resources for Alternative 7 would be similar to those soil sources and quantities identified for Alternative 3, 4 and 6. In addition to stockpiled cover soil and reclaimed area sources, soil materials from beneath the Goslin Flats heap leach facility would be committed to the reclamation of the Zortman and Landusky mines.

Soil would be disturbed at new limestone quarries (LS-2 and Montana Gulch for the Zortman and Landusky mines, respectively). However, disturbed soil would be salvaged and replaced at these sites. Minimal soil would be wasted except those on mine pit benches that would re-acidify from pit wall runoff. All stockpiled cover soil materials would be used in reclamation.

4.4 VEGETATION, WETLANDS, AND OTHER WATERS OF THE U.S.

4.4.1 Methodology

Public Scoping Issues. The public scoping process for the expansion of the Zortman and Landusky mines identified several issues and concerns regarding potential impacts to vegetation, wetlands, and other waters of the U.S. in the project area related to expansion of existing facilities, construction of new facilities, and implementation of a reclamation program. The comments (not already addressed in Section 3.4) are summarized below.

- The quantity of species (diversity) on reclaimed acres lost by disturbance.
- Disturbance of threatened, endangered, or sensitive plant species/communities.
- Impacts to vegetation used by Native Americans for ceremonies, medicine and food.
- The long-term loss of trees and forestry resources.
- Impacts to riparian vegetation.
- Impacts to wetlands and non-wetland waters of the U.S.
- Adequacy of the proposed reclamation programs to achieve a suitable environment for natural plant succession over acid producing materials and a return to pre-mining levels of canopy cover, productivity, and utility in both the short- and long-term.

Significance Criteria and Impact Ratings. In response to these issues, the following significance criteria and impact ratings were developed to guide and focus the analysis of potential impacts to vegetation, wetlands, and other waters of the U.S. Impacts were ranked high, moderate, or low, and all impacts are considered negative, unless otherwise stated. High impacts are considered to be significant. Moderate or low impacts are not significant, but are considered to be adverse. Impacts are rated relative to baseline conditions, that is, before initiation of modern mining in 1979. A fundamental premise is that, for vegetation, mitigation efforts will never achieve the less disturbed baseline conditions.

1. Loss of Species Quantity (Diversity) - Short- and Long-term (0-70 years):

   - High Impact - Greater than 50 percent loss of species quantity in reclaimed areas as compared to undisturbed communities in the vegetation study area

2. Loss of Habitat for Species of Special Concern - Short- and Long-term (0-70 years):

   - High impact - Loss of greater than 1 percent of habitat in the vegetation study area supporting listed threatened or endangered plant species, or greater than 10 percent habitat loss supporting species of special concern

3. Impacts to Habitat Providing Sole Sources of Vegetation Used by Native Americans - Short- and Long-term (0-70 years):

   - High Impact - Greater than 10 percent loss of habitat in vegetation study area providing sole sources of vegetation used by Native Americans

4. Impacts to Forested Habitat - Short- and Long-term (0-70 years):

   The removal of forested habitat (as compared to grassland communities) would be considered a significant, negative high impact due to the amount of time (70-80 years) necessary to regenerate stands of comparable utility (merchantable timber, wildlife cover, visual screening of disturbances). Therefore, the following ratings were used for this criterion:

   - High Impact - Removal of greater than 75 percent of the forest habitat that existed in the disturbance area and/or greater than 25 percent of the forest habitat that existed in the vegetation study area
   - Moderate Impact - Removal of 25-75 percent forest habitat in disturbance area and/or 10-25 percent of forest habitat in study area
   - Low Impact - Removal of less than 25 percent forest habitat in disturbance area and/or less than 10 percent of forest habitat in vegetation study area
   - After 70-80 years - no significant difference

5. Disturbance to Riparian Habitat - Short- and Long-term (0-70 years):

   - High Impact - Loss of greater than 10 percent riparian habitat in the vegetation study area
   - Moderate Impact - Loss of 5-10 percent riparian habitat in the vegetation study area
   - Low Impact - Loss of less than 5 percent riparian habitat in the vegetation study area

6. Impacts to Wetlands and Non-Wetland Waters of the U.S. - Short- and Long-term (0-70 years)

   - High - Loss in waters of the U.S. which have substantial (high) or moderate value based on functions; or any change which reduces the value from substantial (high) to moderate, or moderate to marginal (low). However, if the size of the disturbance is small enough such that the loss or change is minimal, and no high value functions are lost, then the impact would be reduced to moderate.

   - Moderate - Loss in waters of the U.S. which have low value based on functions; or any change which reduces the value from low to impaired. However, if the size of the disturbance is small enough such that the loss or change is inconsequential, and no high value functions are lost, then the impact would be reduced to low.

   - Low - Loss in waters of the U.S. considered small/inconsequential.

The above ratings are first applied to the pre-mitigation condition of wetlands or other waters of the U.S.; a final rating is then given to reflect the effects of proposed mitigation for each alternative.

7. Ability of the Reclamation Plan to Provide Vegetation Cover Comparable to that of Natural Reference Sites - Long Term (5+ years):

   - While implementation of any or all of the reclamation plans (as detailed in Section 2 and highlighted in the following sections) would likely reduce impacts to the vegetation resources, not all revegetated areas could be sustained over the long-term; therefore, it is the long-term effectiveness that will drive the final impact assessment of reclamation activities. Included in the evaluation of the effectiveness of a proposed reclamation plan are many factors that influence the amount of cover, including characteristics of the reclamation covers such as capillary breaks,;and clay or geotextile liners to provide a barrier to the movement of moisture and air and the subsequent capillary rise of acidic moisture into the root zone; and an adequate cover soil depth to support a vegetative cover over the long-term. The reduction of slope angles to minimize erosion is also important to overall reclamation success. Other reclamation activities such as the removal of waste rock and Ruby Gulch tailing, seedbed preparation and the seed mix were considered in determining final impact ratings for the proposed reclamation plans.

Note: The following ratings refer to relative vegetative cover; in this use, "cover" means the percentage of ground surface covered by vegetation when the canopy is viewed from directly overhead.

- High Impact - Growth media over acid producing materials, following reclamation, expected to support a vegetative cover of less than 80 percent of the reference site cover
- Moderate Impact - Growth media over acid producing materials, following reclamation, expected to support a vegetative community of 80-89 percent of the reference site cover
- Low Impact - Growth media over acid producing materials, following reclamation, expected to support a vegetative cover of 90 percent or greater of the reference site cover

In the short-term, the loss of plant diversity on reclaimed acres for all alternatives would be considered a high, significant impact to vegetation resources; however, over the long-term most species could be expected to re-invade the disturbed sites and thus reduce long-term effects. Reclamation research studies over 20 years in the Northern Rocky Mountains and Great Plains area (Munshower and Fisher 1993) have shown that, even with the best reclamation plans, the total number of species (diversity) is substantially reduced for long periods of time; it can be centuries before the original diversity of a site is returned to pre-disturbance levels. However, even when diversity is lost, reclaimed communities can achieve comparable cover and productivity in 3-5 years for grasses and forbs, and in 70 to 80 years for shrubs and trees (Plantenberg, personal communication 1995).

It should be noted that the ultimate goal of revegetation at the Zortman and Landusky mines is to quickly reestablish grasses and forbs to control erosion, reduce seepage and subsequent acid rock drainage, maximize productivity and canopy cover, and create a suitable environment for natural plant succession to occur. Reclamation to obtain a pre-disturbance level of diversity is not the main goal of the revegetation program. Plant species used in revegetation are selected for their ability to become quickly established, provide a stable surface, and support a self-perpetuating community. It should also be noted that none of the native plant species would be removed completely from any of the Little Rocky Mountain plant communities identified in the disturbance area.

Assumptions. To analyze the significance of the above criteria, the following assumptions or estimations were used when specific information was incomplete or not available.

- Based on interviews and ethnographic studies by Deaver and Kooistra (1992) and Culwell et. al (1990), a list was developed identifying specific plant species used by the Native Americans for food, medicinal and ceremonial purposes (see Section 3.12). The list is assumed to be a complete documentation of the major relevant species.

  Interviews with the Native Americans did not reveal locations where plants are collected, but based on the reference list and vegetation surveys of the project area, specific vegetation used by the Native Americans either does not occur within the study area, or the plant species are fairly common throughout the Little Rocky Mountains. Since no unique plants or habitats would be eliminated, it is assumed no sole sources of vegetation would be impacted, especially if less than 10 percent of habitat is disturbed.

- Acres of disturbance by community type were calculated using a planimeter and overlaying the figures of existing and proposed facilities (see Section 2 for figures of each alternative) onto vegetation maps (WESTECH 1990). However, for some disturbances such as new roads, the power line corridor and the conveyor corridor, and some existing disturbance at the Landusky Mine, acreages were estimated based on the percentage of habitat in the disturbance area. Additionally, total acres, by community type, covered in the baseline study area were estimated based on the WESTECH (1990) maps. Because of differences in mapping techniques for vegetative communities, acres calculated for each alternative may vary from those documented as disturbed in other sections of the EIS (for example, Table 4.7-1).

Definitions.

Direct Impacts - Activities resulting in 1) the removal of the vegetative cover or disturbance of sensitive habitats or, 2) revegetation of grasses, forbs, shrubs, and trees, or 3) removal or fill of wetlands or other waters of the U.S.

Indirect Impacts - Activities that do not involve physical removal or fill, but which may have a detrimental effect on vegetation, wetlands, or other waters of the U.S. through impacts to soil or water, e.g. erosion and acid rock drainage, or loss of forestry resources and wildlife habitat. Alternatively, mitigation measures such as reduction of slope angle to reduce erosion potential, replacement of cover soil, and installation of reclamation covers or water quality improvement measures to minimize potential impacts of acid rock drainage would indirectly reduce negative impacts.

4.4.2 Impacts from Mining, 1979 to Present

Vegetation

A study on revegetation efforts and reclamation success (Spry 1986) was conducted at disturbed sites at the Zortman Mine including waste rock dumps, abandoned tailing, and clay pits. The purpose of the study was to develop a reclamation program that would meet the requirements mandated under the Montana Metal Mine Reclamation Act of 1972. Based upon environmental conditions (physical and chemical), and environmental factors limiting revegetation potential (moisture, wind, and soil nutrients), Spry was able to develop some recommendations for the revegetation of several disturbed areas near the Zortman Mine.

Results of the study indicated that low water availability (due to a drought in 1984) was the main limiting factor at all sites, indicating an enhanced water supply may be necessary for successful revegetation. In addition, applications of fertilizer and mulch may substantially enhance revegetation; however, further studies were necessary to determine appropriate application rates.

Spry used several grass species to quickly revegetate the disturbed areas. The results varied from site to site, e.g. bluebunch wheatgrass and sheep fescue provided satisfactory revegetation of the dumps, but showed poor to moderate germination at the tailing site. Tree and shrub species were successful when planted as seedlings, but germination was poor when the same species were seeded.

Spry concluded that further research would be needed to identify appropriate seed and fertilizer rates, timing, and seeding methods, to maximize plant establishment.

Reclamation Activities. Interim and final reclamation activities and revegetation trials have been ongoing since 1988 at both the Zortman and Landusky mines. A total of 214 acres on 27 sites had been reclaimed by the end of 1993, using a variety of grass and forb seed mixtures. Fifteen of the sites were also planted with trees and shrubs (ZMI 1993). Reclamation has been redisturbed on 72 acres at Gold Bug Pit and the Mill Gulch waste rock repository.

Revegetation efforts included using a variety of seed mixtures, seeding rates and methods, mulch types and rates, tackifier rates, seedbed preparation and shrub and tree planting to identify the optimal combination of species and methods to achieve post-operation land use objectives. Limited monitoring of the reclaimed sites has been conducted in 1988, 1989, 1990, and 1992 (ZMI 1993).

Grass species used for revegetation include a variety of wheatgrasses, brome, fescue, blue grass, little bluestem, ricegrass and needle grass. Forb mixtures include Cicer milkvetch, arrowleaf balsamroot, Lewis flax, clover, coneflower, yarrow, and birdsfoot trefoil. Shrub and tree species include chokecherry, rose, kinnickinnick, western snowberry, raspberry, lodgepole pine, ponderosa pine, and Douglas-fir. A complete list of species can be found in the 1993 WESTECH Revegetation Monitoring Report (ZMI 1993).

ZMI has made substantial improvements in the reclamation program, particularly in the revegetation efforts, since the 1980's. The company has hired a Montana nursery to collect locally adapted seed from native trees and shrubs. This seed is used to grow trees and shrubs that are replanted on the reclaimed areas.

Revegetation Monitoring. In general, reclamation efforts appear to be relatively successful. Total vegetative cover and plant density increased between 1990 and 1992 on most sites, particularly perennial grasses, and litter increased on 80 percent of the sites. Tree and shrub survival has been variable. Limited success of shrubs and trees due to plant mortality appears to be the result of competition by herbaceous plant species, an inhospitable growth medium, (compacted soil), wildlife depredation, or burying or pasting down woody plants during hydromulching. Countermeasures to these deterrents to shrub and tree survival could be developed to decrease mortality.

The reclamation and revegetation conducted to date indicates trends similar to other research in the Northern Great Plains. These trends include; 1) achievement of pre-mining cover and productivity for grasses and forbs in 3-5 years, assuming the growth medium remains neutral and erosion is controlled; 2) limited success with tree and shrub establishment because of short time frames; and 3) substantially reduced total number of species in reclaimed communities. Full vegetation re-establishment will take several decades.

It is generally reported that maximum vegetative stability cannot be attained on slopes steeper than 3H:1V (Gray and Leiser 1982; Law 1984; BLM 1992a). Slope angles of 3H:1V or less have a moderate to moderately low potential for erosion, while 2.5H:1V slopes have a moderately high to high potential for erosion. The velocity of surface water runoff increases with increasing steepness, thus increasing erosion and reducing the potential for successful revegetation. Recently, mining companies have been trying to document erosion can be controlled by rock-armoring steep slopes (Golden Sunlight Mines, Inc. 1995).

Direct Impacts

Direct impacts to vegetation resulting from currently permitted activities include the removal of primarily lodgepole pine community types as well as grasslands, and some shrub and ponderosa pine community types in the vicinity of both the Zortman and the Landusky mines. Approximately 401 acres of grasses, shrubs, forbs, trees, and previously disturbed land at the Zortman Mine and 814 acres at the Landusky Mine have been impacted by the construction of the mine pits, waste rock piles, leach pads, access roads, and construction of the operations facilities, and 33 acres at the Williams and Seaford clay pits and the King Creek limestone quarry. Approximately 13 acres of riparian vegetation in the vicinity of the Zortman Mine and approximately 3 acres near the Landusky Mine were impacted between 1979 and the present.

Table 4.4-1 lists the approximate number of acres of each community type impacted by mining activities between 1979 and 1994. The total includes approximately 54 acres of disturbance from other mining activities prior to 1978 and areas of rock outcrop and scree not previously vegetated. Therefore, since 1979, permitted mining activities have resulted in direct, high impacts through the removal of 1,194 acres of vegetation. If reclamation measures are successful, it would still take up to 70-80 years for forested habitats to establish a tree canopy that would appear similar to pre-disturbed communities.

TABLE 4.4-1
ACRES OF DIRECT DISTURBANCE BY VEGETATION COMMUNITY TYPE

Community[1]	Alternative 1		Alternative 2		Alternative 3		Alternative 4 (Company Proposed Action)		Alternative 5		Alternative 6		Alternative 7 (Preferred Alternative)	
	Zortman	Landusky	Zortman	Landusky	Zortman	Landusky	Zortman	Landusky	Zortman	Landusky	Zortman	Landusky	Zortman	Landusky
Grassland	21	99	21	99	221	99	411	7	328	7	684	7	411	7
Shrubland	12	--	12	--	57	--	121	--	72	--	178	--	121	--
Forested:														
Lodgepole pine	300	589	300	589	300	589	256	35	397	35	124	35	164	35
Ponderosa pine	8	116	8	116	13	116	34	13	37	13	33	13	34	13
Douglas fir	--	--	--	--	--	--	9	1	11	1	--	1	--	1
Deciduous (includes riparian)	13	3	13	3	13	3	10	--	27	--	10	--	9	--
Unvegetated	47	7	47	7	47	7	29	7	53	7	44	7	13	7
Wetlands[2]	--	0.03	--	0.03	--	0.03	1.06	0.03	0.02	0.03	1.06	0.03	1.06	0.03
Clay Pits	4	26	7	32	4	26	7	7	11.5	9	12	9	--	--
Limestone Quarry	--	3	--	3	--	3	13	3	15	10	15	10	--	--
Total New Disturbance	--	--	3	6.03	250	0.03	891.06	73.03	951.52	82.03	1,101.06	82.03	753.06	63.03
Total Disturbance: Previous plus Proposed	405	843.03	408	849.03	655	843.03	1,296	916.03	1,356.52	925.03	1,506.06	925.03	1158.06	906.03
Total Disturbed[3]	1,248		1,257		1498		2,212		2,282		2,431		2,064	
Total Forested	1,029		1,029		1,034		1,387		1,550		1,245		1,285	
Percent Study Area Forest Disturbed	11%		11%		11%		15%		17%		14%		14%	

Shaded area - disturbance from 1979 to the present.

[1] Source -Vegetation Maps - WESTECH 1992

[2] Source - ZMI 1995

[3] Includes 54 acres of disturbance from other mining activities before 1978 and area of outcrop/scree; number is rounded to nearest acre.

There have been no known impacts to threatened, endangered, or sensitive plant communities, nor to any sole sources of vegetation used by Native Americans. In summary, direct impacts to vegetation since 1979 include:

- 120 acres out of 2,700 acres, or 4 percent of grasslands in the study area
- 12 acres out of 800 acres, or about 2 percent of shrubland in the study area
- 889 acres out of 7,300 acres or, 12 percent of lodgepole forests in the study area
- 124 acres out of 3,700 acres, or about 3 percent of ponderosa pine forests in the study area
- 16 acres out of 1,300 acres or, 1 percent of the deciduous forests (riparian)

Direct impacts to forested areas equal about 11 percent of forested land in the study area and about 82 percent of the total disturbance; impacts are rated high.

Direct impacts to riparian areas are rated low.

Direct impacts to species diversity are rated high.

Indirect Impacts

Assuming all 594 acres of BLM land disturbed between 1979 and the present consisted of merchantable timber resources, approximately 3 percent of forestry resources were lost due to previous mining activities at both mines. This is likely an overestimation since much of the area was covered with "dog-hair" lodgepole pine that has limited use. Wildlife forage and habitat was also lost across the project area (see Section 4.5).

Wetlands and Non-Wetland Waters

Direct Impacts

No vegetated wetlands are believed to have been impacted from 1979 to the present, with the exception of possible sporadic disturbances from exploration activities (e.g., minor sedimentation effects). This is based on review of pre-disturbance aerial photographs and recollections of individuals familiar with the area prior to disturbance (ZMI 1995).

From 1979 to present, it is estimated that approximately 0.84 acre of potentially jurisdictional non-wetland waters of the U.S. (i.e., incised drainages) were directly impacted by mining activities at the Zortman Mine. The disturbances occurred in the following drainages: Carter Gulch (0.12 acre); Alder Spur and tributaries (0.11 acre); Ruby Gulch and tributaries (0.58 acre); and tributaries to Lodgepole Creek (0.03 acre) (ZMI 1995b). At the Landusky Mine, existing facilities have directly impacted 2.89 acres of non-wetland waters of the U.S. in six drainages: Montana Gulch with tributaries (0.75 acre), King Creek (0.35 acre), South End drainages (unnamed tributaries to Rock Creek) (0.06 acre), North End drainages (Swift Gulch) (0.21 acre), Rock Creek tributaries (Sullivan Creek) (0.34 acre), and Mill Gulch with tributaries (1.18 acres) (ZMI 1995b).

Based on the overall pre-1979 function/value ratings for the above-named drainages (see Table 3.4-3) and the significance criteria, past direct impacts to Montana Gulch, King Creek, Swift Gulch, and Alder Gulch would be rated high prior to mitigation. This is because these drainages have "moderate" pre-1979 value ratings and the impacts involve more than minimal acreage. Past impacts to the remaining drainages listed would be moderate (or low, in the case of the small area disturbed in the South End drainages) since these drainages all have "low" pre-1979 value ratings. Mitigation for past direct impacts would be included in any of the expansion alternatives and would involve 1.5:1 compensation for past direct losses. This would reduce the high impact ratings for these drainages to moderate (insignificant) levels and would further reduce moderate impacts to low levels. The non-expansion Alternatives 1 and 2 would not provide mitigation for these direct impacts; Alternative 3 would provide some mitigation in the form of restoration of Ruby Gulch.

Indirect Impacts

No specific indirect impacts to wetlands from 1979 to the present have been identified. As previously mentioned, it is possible that sporadic disturbances from exploration activities occurred during this period.

Other waters of the U.S. have been indirectly disturbed by mining and exploration related activities, resulting in increased erosion and sediment in surface runoff, acid rock drainage, leach pad leakage, construction of diversion ditches, and noise. Drainage acreage believed to have been impacted through reduced water quality since 1990 was estimated by the COE by examining water quality data from sampling stations and identifying deteriorated conditions and/or exceedences of MCLs since 1990. The length of drainage impacts was estimated based on locations of surface water sampling stations and/or confluences with the next significant drainage. Drainage width was estimated from data provided in a previous water quality report.

Using this approach, it was estimated that past mining activities since 1990 caused indirect impacts to 3.04 acres at the Zortman Mine and 11.56 acres at the Landusky Mine, for a total of 14.6 acres since 1990 (COE 1995). These indirect impacts occurred primarily in drainages that have "low" overall pre-1979 value ratings (Table 3.4-3); i.e., Ruby Gulch (3.04 acres) and Rock Creek (10.46 acres); impact ratings would therefore be moderate (pre-mitigation). However, part of the past indirect impacts identified involve 0.86 acre of King Creek, which is rated "moderate" in value (pre-1979). Therefore, this loss would be rated high, before mitigation.

The U.S. Army Corps of Engineers has estimated that a total of 16 acres of indirect impacts to non-wetland waters has occurred since 1979 (which include the 14.6 acres disturbed above). In this Final EIS, the 14.6 acres estimation is used for mitigation purposes, since it is the acreage of past impacts that the Corps has determined would need to be mitigated.

Mitigation would be provided for the past 14.6 acres of indirect impacts to non-wetland waters under all alternatives through implementation of the water capture and treatment program (Appendix A). The program would restore water quality in the affected drainages. This mitigation would reduce past high indirect impacts to moderate (insignificant) levels and would further reduce moderate impacts to low levels.

4.4.3 Impacts from Alternative 1

Under this No Action Alternative, ZMI would continue activities already permitted at both the Zortman and Landusky mines and previously permitted reclamation schedules for both mines would be implemented. In addition, a 205-acre land application area has been proposed for emergency land application disposal in the Goslin Flats area. This disposal area would replace the Carter Butte land application area where soil has been loaded to maximum metal attenuation capacity from previous emergency land application disposal.

Under Alternative 1, reclamation plans consist of placing a layer of cover soil approximately 8 inches thick on disturbed sites prior to reseeding and planting. Most slopes in the leach pad and waste rock areas would remain at approximately a 2H:1V angle and would be over 200 feet long. No geochemical testing is required of disturbed areas prior to reclamation to determine suitability of waste rock and ore as reclamation growth medium.

Vegetation

Direct Impacts

Under Alternative 1, there would be no other surface disturbance at either mine, and no additional direct impacts are anticipated to endangered, threatened, or sensitive species; riparian vegetation; sole sources of vegetation used by the Native Americans; or forestry resources and wildlife habitat.

Indirect Impacts

Indirect impacts to vegetation, under Alternative 1, result from an inadequate reclamation plan with a limited soil depth that, over the long-term, is unlikely to maintain a suitable environment for most vegetation, especially on acid-producing waste rock and ore. Impacts include erosion and soil loss, particularly on steep slopes, and a high potential for acidification of soil in areas such as the waste rock piles, leach pads, and the pit bottoms and walls. It is assumed that a majority of reclaimed areas would eventually fail.

- Soil - In the short-term, a replacement of 8 inches of cover soil would allow revegetation of grasses, forbs, shrubs and trees to become established relatively quickly in most areas, including the steep slopes in the leach pad area and waste rock piles. The pit walls would not revegetate. Wildlife forage would be increased, as would the visual quality of the project area.

  It is over the long-term that substantial impacts could be expected. The erosion potential at the Zortman Mine is 1.9 tons/acre/year, and at the Landusky Mine 1.5 tons/acre/year, indicating moderate impacts (Section 4.3.3). Even though the long term erosion potential is less than the 2.0 tons/acre/year significance criterion, other factors such as slope angle, slope length, and especially the limited depth of cover soil (<12 inches) would jeopardize long-term reclamation success on a majority of reclaimed acres. As a result, high impacts would occur due to the loss of cover soil and the moisture and nutrients it provides, resulting in a loss of vegetative productivity and ecological stability.

- Slope Angle - Erosion of the waste rock piles with steep, long (>200 feet) slopes left at the 2H:1V angle have the potential to become acidic as the relatively shallow layer of cover soil is eroded and the acid-producing material underneath is exposed to air and water and subsequent erosion. With the limited storage capacity in the cover soil, there is potential for capillary rise and lateral seepage of acid rock drainage and acidification of soil in the root zone. High impacts are assumed on the older waste rock piles where, due to less selective handling, there is more acid-producing material in close proximity to the surface. With continued

TABLE 4.4-2
WETLAND AND DRAINAGE DISTURBANCE AT ZORTMAN MINE[a]
(DIRECT AND INDIRECT)

Alternatives 1, 2, and 3 - No Action and existing facilities with various reclamation plans

Drainage	Alternatives 1, 2, and 3							
	Waters of the U.S.							
	Non-Wetland				Wetland			
	Length (feet)		Area (acres)		Length (feet)		Area (acres)	
	Existing	Proposed[b]	Existing	Proposed[b]	Existing	Proposed	Existing	Proposed
Carter Gulch	2,926	300	0.12	0.07	-	-	-	-
Alder Gulch and tributaries	-	-	-	-	-	-	-	-
Alder Spur with tributaries	4,599	300	0.11	0.02	-	-	-	-
Ruby Gulch with tributaries	9,008	970	0.58	0.31	-	-	-	-
Tributaries to Lodgepole Creek	1,061	-	0.03	-	-	-	-	-
Goslin Gulch and tributaries[c]	-	-	-	.040[d]	-	-	-	1.54[d]
Ruby Gulch[c]	5,250	-	2.41	-	-	-	-	-
Ruby Gulch Below Station Z-1B[c]	2,750	-	0.63	-	-	-	-	-
TOTAL	25,294	1,570	3.88	0.40/0.80[d]	-	-	-	1.54[d]
TOTAL EXISTING AND PROPOSED	26,864		4.28/4.68[d]		-		1.54[d]	

NOTES:
[a] Based on values provided by ZMI in 404 permit applications and DEIS comments (ZMI 1995 and 1995b); indirect impact acres provided by the COE (COE 1995) and DEIS comments; other indirect impact acres estimated by OEA Research for certain actions, and by Woodward-Clyde Consultants.
[b] Proposed acreage represents disturbance associated with water capture structures.
[c] Indirect impacts.
[d] Alternative 3 only - reflects disturbance in Goslin Gulch for borrow area.

TABLE 4.4-3
WETLAND AND DRAINAGE DISTURBANCE AT LANDUSKY MINE[a]
(DIRECT AND INDIRECT)

Landusky - Alternatives 1 through 7								
Drainage	Waters of the U.S.							
	Non-Wetland				Wetland			
	Length (feet)		Area (acres)		Length (feet)		Area (acres)	
	Existing	Proposed[b]	Existing	Proposed[b]	Existing	Proposed[b]	Existing	Proposed[b]
Montana Gulch with Tributaries	12,910	-	0.75	-	-	-	-	-
King Creek	4,313	300	0.35	0.03	-	-	-	-
South End Drainages	2,511	-	0.06	-	-	-	-	-
North End Drainages	2,116	-	0.21	-	-	-	-	-
Rock Creek Tributaries	5,542	124	0.34	0.02	-	1,408	-	0.03
Mill Gulch with Tributaries	12,062	300	1.18	0.03	-	-	-	-
King Creek Below L-5[c]	7,500	-	0.86	-	-	-	-	-
Rock Creek: Lower Zone of Disturbance to ZLW-12[c]	1,500	-	0.24	-	-	-	-	-
ZLW-12 to Mill Creek[c]	7,200	-	2.64	-	-	-	-	-
Mill Creek to Montana Gulch[c]	4,450	-	2.86	-	-	-	-	-
Montana Gulch to L-1[c]	5,400	-	4.96	-	-	-	-	-
TOTAL	65,504	724	14.45	0.08	-	-	-	-
TOTAL EXISTING AND PROPOSED	66,228		14.53		1,408		0.03	

NOTES:
[a] Based on values provided by ZMI in 404 permit applications and DEIS comments (ZMI 1995 and 1995b); indirect impact acres provided by the COE (COE 1995) and DEIS comments.
[b] Proposed acreage represents disturbance associated with water capture structures.
[c] Indirect impacts.

TABLE 4.4-4a
SUMMARY OF DIRECT IMPACTS TO WATERS OF THE U.S. (ACRES)
ALTERNATIVES 1 THROUGH 7

		Non-wetland				Wetland			
		Existing	Proposed	Total	TOTAL	Existing	Proposed	Total	TOTAL
Alt 1	Zortman	0.84	0.40	1.24	4.21	-	-	-	0.03
	Landusky	2.89	0.08	2.97		-	0.03	0.03	
Alt 2	Zortman	0.84	0.40	1.24	4.21	-	-	-	0.03
	Landusky	2.89	0.08	2.97		-	0.03	0.03	
Alt 3	Zortman	0.84	0.40	1.24	4.21	-	-	-	0.03
	Landusky	2.89	0.08	2.97		-	0.03	0.03	
Alt 4	Zortman	0.84	4.06	4.90	7.87	-	1.06	1.06	1.09
	Landusky	2.89	0.08	2.97		-	0.03	0.03	
Alt 5	Zortman	0.84	2.48	3.32	6.29	-	0.02	0.02	0.05
	Landusky	2.89	0.08	2.97		-	0.03	0.03	
Alt 6	Zortman	0.84	3.26	4.10	7.07	-	1.06	1.06	1.09
	Landusky	2.89	0.08	2.97		-	0.03	0.03	
Alt 7	Zortman	0.84	3.56	4.40	7.37	-	1.06	1.06	1.09
	Landusky	2.89	0.08	2.97		-	0.03	0.03	

TABLE 4.4-4b
SUMMARY OF INDIRECT IMPACTS TO WATERS OF THE U.S. (ACRES)
ALTERNATIVES 1 THROUGH 7

		Non-wetland				Wetland			
		Existing[1]	Proposed[2]	Total	TOTAL[1]	Existing	Proposed	Total	TOTAL
Alt 1	Zortman	3.04	-	-	14.6	-	-	-	-
	Landusky	11.56	-	-		-	-	-	
Alt 2	Zortman	3.04	-	-	14.6	-	-	-	-
	Landusky	11.56	-	-		-	-	-	
Alt 3	Zortman	3.04	0.4	3.44	15.0	-	1.54	1.54	1.54
	Landusky	11.56	-	-		-	-	-	
Alt 4	Zortman	3.04	7.3	10.34	21.9	-	0.48	0.48	0.48
	Landusky	11.56	-	-		-	-	-	
Alt 5	Zortman	3.04	0.4	3.44	15.0	-	0.24	0.24	0.24
	Landusky	11.56	-	-		-	-	-	
Alt 6	Zortman	3.04	8.7	11.74	23.3	-	4.07	4.07	4.07
	Landusky	11.56	-	-		-	-	-	
Alt 7	Zortman	3.04	7.3	10.34	21.9	-	0.48	0.48	0.48
	Landusky	11.56	-	-		-	-	-	

1 The 14.6 acres listed (3.04 and 11.56) is part of a total of 16.0 acres that have been indirectly impacted since 1979. The 14.6 acre figure is what is used for mitigation purposes, based on the Corps of Engineers' regulatory authority.

2 Proposed acreage is that area above and beyond the 14.6 acres that would be affected by new disturbances associated with mine expansion (Alternatives 4-7) or the Goslin Flats borrow area (Alternative 3).

erosion, acid rock drainage would daylight on the surface further impacting the soil and vegetation as acidic water seeps out on lower slopes and runs downhill.

Potential impacts to vegetation from soil acidification include phytotoxic effects such as reduced seed germination rates, reduced growth of roots and shoots, reduced vegetative cover, and death of some species (Lipton et al. 1993). As the revegetation failed, especially on the steep, long slopes of the waste rock dumps and leach pads, impacts would occur on an increasingly expanding area further downhill. Impacts would include loss of cover soil, increased exposure of acidic material, and loss of vegetative cover.

Wetlands and Non-Wetland Waters

Direct Impacts

Under Alternative 1, construction of the water quality improvement structures would impact 0.48 acre of non-wetland waters of the U.S., (0.40 acre at the Zortman Mine and 0.08 acre at the Landusky Mine) and 0.03 acre of wetland at the Landusky Mine. (See Tables 4.4-2, 4.4-3, and 4.4-4a.)

The 0.03 acre of wetland direct impacts would occur in a tributary to Rock Creek, which has a "low" value; therefore, impacts are rated low because of the value and the small amount of acreage involved. The 0.40 acre of direct disturbance to non-wetland waters at the Zortman Mine would occur in Carter Gulch (0.07 acre), Alder Spur (0.02 acre) and Ruby Gulch (0.31 acre). Impacts to these drainages would also be rated moderate before mitigation since Carter and Ruby Gulches are "low" value drainages, and the disturbance in Alder Spur is minimal and would affect no high value functions. At the Landusky Mine, direct impacts would occur in Rock Creek (0.02 acre), Mill Creek (0.03 acre) and King Creek (0.03 acre). The Rock Creek and Mill Creek pre-mitigation ratings would be low, because of "low" stream value ratings combined with minimal acres of disturbance. King Creek impacts would be moderate (pre-mitigation), because King Creek is a "moderate" value drainage, but only 0.03 acre are involved and no high value functions would be lost. Mitigation would not be provided for these direct impacts under Alternative 1.

Indirect Impacts

No indirect impacts to wetlands of the U.S. are expected under Alternative 1 (Table 4.4-4b). Potential indirect impacts to non-wetland waters are described in Table 4.4-5. The majority of these impacts would occur in the same 16.0 acres as previously described in Section 4.4.2, resulting in moderate to high (pre-mitigation) impacts. Implementation of the capture and treatment measures would serve to mitigation these impacts below the capture and treatment structures and reduce impacts to less than significant. However, it is likely that the system would require capture and treatment of degraded waters indefinitely. The area most affected by the indirect impacts would be the upper parts of drainages located above capture and treatment systems.

4.4.3.1 Cumulative Impacts

Cumulative impacts from Alternative 1 include the following:

- 54 acres of disturbance from historical mining activities prior to 1978 (some of which is rock outcrops and scree)
- 33 acres of vegetation removed by disturbance at the Williams and Seaford Clay pits and the King Creek, limestone quarry
- 1,161 acres of vegetation removed due to mining activities between 1979 and the present
- 20.21 acres of disturbance (4.21 acres direct impacts, 16.0 acres indirect impacts) to non-wetland waters of the U.S., and 0.03 acre of disturbance to wetlands.

Past mining activities have directly impacted a total of 1,248 acres of vegetation. Impacts include the removal of vegetation, loss of over 80 percent of forested habitat in the disturbance area and wildlife forage and habitat that would take up to 70 to 80 years to return to pre-mining conditions, assuming reclamation is successful. However, revegetation failure is expected, and, left untouched, impacts would take centuries to recover. Cumulative impacts to vegetation resources under Alternative 1 are rated high.

Cumulative impacts (pre-mitigation) to wetlands are rated low, since the only impacts are the 0.03 acre of Rock Creek for the water capture facility. Cumulative impacts to non-wetland waters are rated high, due to the past loss of some waters of moderate value. Mitigation provided by the water capture and treatment system would reduce indirect impacts to a moderate to low

TABLE 4.4-5
DESCRIPTION OF POTENTIAL INDIRECT IMPACTS TO NON-WETLAND WATERS OF THE U.S. ALTERNATIVES 1 THROUGH 7

I. COMPONENT OF AQUATIC ENVIRONMENT: WATER CHEMISTRY AND QUANTITY	
Alternative 1	• Other than water and capture treatment, little or no improvement expected over the long-term due to expected failure of reclamation cover. Ongoing degradation would continue in upper reaches of drainages, above capture and treatment facilities. • System will require capture and treatment indefinitely to meet water quality standards; however, this would provide beneficial impacts for downstream drainages, and any biota within those drainages. • Flows in Alder Gulch, Carter Gulch, King Creek, Mill Gulch, and Sullivan Creek would decrease from diversion to water quality treatment facilities. • Flows in Montana Gulch and Ruby Creek would increase or remain perennial from diversion from other systems.
Alternative 2	• Similar to Alternative 1 except that reclamation success is expected to be slightly improved.
Alternative 3	• Short-term increase in TDS, sulfate, and metals followed by long-term improvement in Ruby and Carter Gulches, Sullivan Creek, Mill Gulch, Montana Gulch, where drainage may eventually not require active treatment. • Short-term (mostly TDS) degradation in Goslin Gulch and Ruby Creek due to salvaging of soil and subsoil in Goslin Flats for water budget covers, especially after extreme precipitation events. • Use of water balance cover (high reclamation success) and removal of ARD sources would reduce ARD and improve downstream water quality. • Water capture and treatment would improve and assure downstream water quality and provide beneficial impacts to downstream biota. • Decreased flow from springs and drainage adits in headwaters due to effective capping of open pit areas, improving water quality by reducing amount of flow needing capture and treatment. • Flow in Alder Gulch, Carter Gulch, King Creek, Mill Gulch and Sullivan Creek would be reduced due to diversion to Ruby Gulch and Montana Gulch for treatment and discharge. • Ruby Gulch and Montana Gulch would have increased flows or remain perennial.
Alternative 4	• Increased exploration would have short-term adverse effects on water resources, including TDS and suspended solids increases in currently unimpacted drainages. • Exposure of more potentially acid-generating rock could create downstream water chemistry impacts; however, water capture and treatment and moderate success of reclamation would result in improvement over the long-term. • Flows from springs and drainage adits in headwaters may decrease due to effective capping of open pit area and improve downstream water quality over present due to reduced recharge in pits. • Short-term degradation in Lodgepole and Beaver creeks due to construction and operation of LS-1 limestone quarry and also in King Creek from limestone quarry construction and operation. • Reduction in metals source to Montana Gulch. • Downstream indirect impacts from new activities in Carter Gulch and Goslin Flats, two previously undisturbed drainages. • Flows in Alder Gulch, Carter Gulch, King Creek, Mill Gulch, and Sullivan Creek would decrease from diversion to water quality treatment. • Flows in Montana Gulch and Ruby Creek would increase or remain perennial from diversion from other systems.

TABLE 4.4-5 - DESCRIPTION OF POTENTIAL INDIRECT IMPACTS (NON-WETLAND WATERS) (Continued)

Alternative 5	• Increased acreage disturbed, resulting in more exposure to ARD sources; water capture and treatment and moderate level of reclamation success would result in improvement over the long run. • Flows from springs and drainage adits in headwaters may decrease due to effective capping of open pit area, improving downstream water quality over present due to reduced recharge in pits. • Short-term degradation in Lodgepole and Beaver creeks due to construction and operation of LS-1 limestone quarry and also in King Creek from limestone quarry construction and operation. • Reduction in metals source to Montana Gulch. • Carter Gulch waste rock repository and Alder Gulch leach pad would affect one already moderately impacted drainage area. • Both facilities are located in steep terrain, where water monitoring and capture is difficult and may result in higher impacts to downstream waters and biota if water capture systems fail. • Although still expected to be ephemeral, flows in King Creek would be increased from Landusky Pit complex runoff. • Flows in Alder Gulch, Carter Gulch, King Creek, Mill Gulch, and Sullivan Creek would decrease from diversion to water quality treatment facilities; flows in Ruby Creek and Montana Gulch would slightly increase or remain perennial from diversion from other systems.
Alternative 6	• Disturbance would increase exposure to ARD sources; water capture and treatment and moderate level of reclamation success would result in improvement in the long-run. • Flows from springs and drainage adits in headwaters may decrease from effective capping of open pits. Short-term degradation in Lodgepole and Beaver creeks due to construction and operation of LS-1 limestone quarry and possibly in King Creek. • Reduction in metals source to Montana Gulch. • Downstream indirect impacts from two new facilities in unimpacted drainage areas (Goslin Flats and Ruby Flats). • Flows in Alder Gulch, Carter Gulch, King Creek, Mill Gulch, and Sullivan Creek would decrease from diversion to water quality treatment facilities. • Flows in Montana Gulch and Ruby Creek would increase or remain perennial from diversion from other systems.
Alternative 7	• Disturbance least of all expansion alternatives; would expose ARD sources, but water capture and treatment and high level of reclamation success expected with water balance cover would improve downstream water quality. • Flows from springs and drainage adits in headwaters may decrease from effective capping of open pits, improving downstream water quality slightly over present due to reduction of recharge in open pit complexes. • Reduction in metals source to Montana Gulch. • Goslin Flats leach pad would impact currently non-impacted area and would reduce catchment area in local drainages over the short-term. • Flows in Alder Gulch, Alder Spur, King Creek, Mill Gulch, and Sullivan Creek would decrease from diversion to water quality treatment facilities. • Flows in Montana Gulch and Ruby Creek would increase or remain perennial from diversion, capture and treatment from other systems.
II. COMPONENT OF AQUATIC ENVIRONMENT: WATER QUALITY - SEDIMENTATION	
Alternative 1	• High short-term effects from runoff during storms, at site and at Williams clay pit, followed by long-term low impacts from runoff from reclaimed areas (controlled by sediment traps and settling ponds).
Alternative 2	• Slightly better conditions than Alternative 1 owing to slightly higher expected reclamation success.

TABLE 4.4-5 - DESCRIPTION OF POTENTIAL INDIRECT IMPACTS (NON-WETLAND WATERS) (Continued)

Alternative 3	• High short-term impacts from runoff of suspended solids from Goslin Flats soil and subsoil salvage for water budget covers, especially after storms. • Lower long-term impacts than Alternatives 1 or 2 due to high level of reclamation success expected at mine sites, reclamation at Goslin Flats, and use of sediment traps/ponds.
Alternative 4	• High short-term degradation expected in Lodgepole and Beaver creeks from runoff from LS-1 limestone quarry until BMPs are constructed. • Similar high short-term effects expected in King Creek due to quarry construction and operation and in Goslin Gulch due to construction activities. • Runoff also expected from newly disturbed areas and haul roads, causing short- and long-term adverse impacts to receiving drainages. • Long-term impacts reduced by reclamation (moderate success) and use of traps/ponds.
Alternative 5	• High short-term degradation expected in Lodgepole and Beaver creeks from runoff from LS-1 limestone quarry until BMPs are constructed. • Similar high short-term effects expected in King Creek due to quarry construction and operation. • Runoff also expected from newly disturbed areas and haul roads, causing high short- and lower long-term adverse impacts to receiving drainages. Steep terrain may exacerbate indirect sedimentation effects on downstream biota. • Long-term impacts reduced by reclamation (moderate success) and use of traps/ponds.
Alternative 6	• Short-term degradation expected in Lodgepole and Beaver creeks from runoff from LS-1 limestone quarry until BMPs are constructed. • Similar short-term effects expected in King Creek due to quarry construction and operation. • Runoff also expected from newly disturbed areas and haul roads, causing short- and long-term adverse impacts to receiving drainages. • Long-term impacts reduced by reclamation (moderate success).
Alternative 7	• Higher short-term impacts from runoff of suspended solids from Goslin Flats soil and subsoil salvage for water budget caps, especially after storms, until BMP facilities are on line. • Runoff also expected from newly disturbed areas and haul roads, causing short- and long-term adverse impacts to receiving drainages. • Long-term impacts substantially reduced due to high level of reclamation success expected.
III. COMPONENT OF AQUATIC ENVIRONMENT: THREATENED AND ENDANGERED SPECIES - LISTED SPECIES, CANDIDATE SPECIES	
All	• No anticipated significant impacts from any alternative. • Loss of some watering habitat for bats including C2 species: big-eared bat (as well as other wildlife) mitigated through creation of ponds in same area. • Access to capture water prior to treatment for acid/metals can be prevented through covering of capture waters with netting or balls.
Alternative 1	• No expected impacts.
Alternative 2	• No expected impacts.
Alternative 3	• No expected impacts.

TABLE 4.4-5 - DESCRIPTION OF POTENTIAL INDIRECT IMPACTS (NON-WETLAND WATERS) (Concluded)

Alternative 4	• Loss of water sources in Goslin Flats area considered negative low impact, considering other available water in the area and mitigation.
Alternative 5	• No expected impacts.
Alternative 6	• Loss of water sources in Goslin Flats area considered negative low impact, considering other available water in the area and mitigation.
Alternative 7	• Loss of water sources in Goslin Flats area considered negative low impact, considering other available water in the area and mitigation.
IV. COMPONENT OF AQUATIC ENVIRONMENT: SPECIAL AQUATIC SITES/WETLANDS	
All	• Wetlands discussed separately in Section 4.4; other special aquatic sites (e.g., mudflats, shallows, reefs, riffle/pools, sanctuaries/refuges) - not applicable in this area.
V. HUMAN USE CHARACTERISTICS	
	Municipal and private water supplies
	Drinking Water:
Alternatives 1-5	• No impact.
Alternative 6	• Potential contamination of town of Zortman water supply because of waste rock repository location near water supply well.
Alternative 7	• No impact.
	Stock Water:
All	• See discussion of candidate species and wildlife above. • Livestock could be affected if they have access to capture waters prior to treatment; proposed mitigation can prevent access by livestock and wildlife (fencing, covers). • Loss of two stock ponds in Goslin Flats mitigated by replacement with new ponds in that area (Alternatives 4, 5, and 7).
	Other Human Use Characteristics (e.g., recreational fisheries, aesthetics, parks, monuments, wilderness areas, preserves) - not applicable in this area.

N/A - Not applicable

level. Because no mitigation is proposed for past direct impacts to non-wetland waters the final cumulative impact rating remains high.

4.4.3.2 Unavoidable Adverse Impacts

The following unavoidable adverse impacts would occur under Alternative 1:

- Large portions of reclaimed area cover soil would likely become acidic, resulting in phytotoxic impacts on vegetation, and acid drainage starts moving downslope from areas where reclamation fails.
- The total number of species in reclaimed communities would take centuries to recover.
- Failure of the reclamation cover and inadequate pit reclamation would produce drainage that would result in degradation of waters of the U.S. above the capture and treatment systems.
- Direct impacts to wetlands and non-wetland waters would not be mitigated, resulting in adverse impacts.

4.4.3.3 Short-term Use/Long-term Productivity

On the limited successfully reclaimed acres, total plant cover and productivity would return to pre-mining levels in grassland communities within 3-5 years, and in forested communities within 70-80 years. Some wildlife forage use by sheep and deer on reclaimed communities has already been documented. On the majority of sites where reclamation fails, cover and productivity and subsequent use by wildlife and man would not return to pre-mining levels for centuries. Some acid tolerant species would develop dominance in the area. Comparable stability and utility would not be achieved in the post-mine landscape.

Over the long-term, species diversity would slowly increase, but it may be centuries before it is returned to pre-mining levels.

4.4.3.4 Irreversible or Irretrievable Resource Commitments

No irreversible or irretrievable vegetation resource commitments are anticipated under Alternative 1. No impacts are anticipated to threatened, endangered, or sensitive species, and no known sole sources of vegetation used by the Native Americans would be impacted. However, without mitigation, there would be an irretrievable loss of 0.03 acre of wetland and 4.21 acres of non-wetland waters, due to past and proposed direct disturbances.

4.4.4 Impacts from Alternative 2

This alternative is similar to Alternative 1 in that expansion of the Zortman and Landusky mines would not be approved, but it includes ZMI proposed improvements in reclamation procedures. These procedures would be the same for both mines. Under this alternative, additional reclamation material would be obtained from off-site sources. An additional 9 acres would be disturbed at the clay pits to obtain capping material.

The focus of the revised reclamation plan is to improve control and treatment of acid rock drainage. The revegetation program under the revised plan is generally unchanged. Compared to Alternative 1, the activities would improve reclaimed area vegetation. These actions include:

- Access and haul roads would be ripped to alleviate surface compaction, and then graded and revegetated;
- Steep slopes would be reduced to a 3H:1V angle where feasible, although slope lengths would remain >200 feet in length; and
- The potential for damage to vegetation from acidification of soil due to acid rock drainage would be reduced by the placement of a 6-inch clay cap over areas where sampling shows the potential for acid production before 8 inches of soil is replaced.

Vegetation

Direct Impacts

No other surface disturbance would occur at either mine site and there would be no further direct impacts to existing vegetation communities. Nine vegetated acres would be disturbed at the clay pits to provide clay for the reclamation cover. No impacts to threatened, endangered, or sensitive plant species, nor to any known sole sources of plant species used by the Native Americans are expected. Finally, no additional impacts to forested resources are expected.

Indirect Impacts

Improved reclamation procedures under Alternative 2 - reduction of soil compaction, reduction of some slope angles, and reduction of potential acid rock drainage impacts - would increase the potential for successful revegetation as compared to Alternative 1. In the long-term, though, this reclamation plan would not provide a sustainable, suitable environment for successful revegetation on a large portion of the reclaimed disturbances.

- Soil - Long-term impacts from soil erosion at the Zortman and Landusky mines would be the same as described in Alternative 1, resulting in high impacts.

  Alleviating surface soil compaction on access and haul roads would result in an improved, more hospitable seed bed and enhance the potential for successful revegetation for these areas in non-acid generating bedrock materials.

- Slope Angle - Reducing steep long slopes (>200 feet) to a 3H:1V angle would reduce water runoff and erosion, provide a more stable seed bed and increase the potential for successful revegetation on those slopes. For long slopes left at a 2H:1V angle, impacts would be the same as described in Alternative 1.

- Reclamation Cover - Modified reclamation plans include the placement of a 6-inch clay cap over areas where sampling shows the potential for acid production before soil replacement. The potential for acidification of soil due to acid rock drainage from capillary rise and lateral seepage of acidic moisture from waste rock, spent ore or rock substrata would be reduced and/or delayed. The 6-inch clay layer would also improve moisture retention and enhance revegetation success. In the short-term, the 14-inch cover would improve vegetation re-establishment as compared to the 8-inch cover in Alternative 1.

  In the long-term, for the same reason as discussed in Section 4.3.3, the 14-inch cover is not expected to withstand weathering and erosion on a large portion of the reclaimed acreage. The clay would freeze, thaw, and desiccate, and not provide the protection needed over acid producing materials. Additionally, due to the shallow depth of the clay layer, tree, shrub, grass, and forb roots would penetrate the clay and expose vegetation to the acidic conditions underneath. Should the cover subsequently fail from acidification and lateral seepage, high negative impacts from erosion and acidification of soil would be the same as discussed in Alternative 1.

Wetlands and Other Waters of the U.S.

Direct Impacts

Direct impacts would be the same as Alternative 1. Construction of the water quality improvement structures would impact 0.48 acre of non-wetland waters of the U.S., (0.40 acre at the Zortman Mine and 0.08 acre at the Landusky Mine) and 0.03 acre of wetland at the Landusky Mine. (See Tables 4.4-2, 4.4-3, and 4.4-4a.) This would result in low or moderate, pre-mitigation impacts, and mitigation for these is not included in Alternative 2.

Indirect Impacts

No indirect impacts to wetlands are expected under this alternative (Table 4.4-4b). Potential indirect impacts to non-wetland waters are as described for Alternative 1 and include the 16.0 acres of indirect impacts, with mitigation provided by the implementation of the water capture and treatment system.

4.4.4.1 Cumulative Impacts

Cumulative impacts from Alternative 2 would be the same as those described above for Alternative 1 in Section 4.4.3.1, but would include an additional 9 acres of vegetation disturbance at the clay pits, for a total of 1,257 acres of disturbance. Cumulative impacts are rated high for vegetation. For wetlands, cumulative impacts are rated low; for non-wetland waters, cumulative impacts are rated high, due to past impacts to "moderate" value drainages and lack of mitigation for these impacts.

4.4.4.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as discussed in Alternative 1.

4.4.4.3 Short-term Use/Long-term Productivity

On the limited successfully reclaimed acres, total vegetative cover and productivity would return to pre-mining levels in grassland communities within 3-5 years and in forested communities within 70-80 years. Some wildlife forage use by sheep and deer on reclaimed communities has already been documented. On the majority of sites where reclamation fails, cover and productivity and subsequent use by wildlife and humans would not return to pre-mining levels for centuries. Some acid tolerant species would develop dominance in the area. Comparable stability and utility could not be achieved in the post-mine landscape. Over the long-term, species diversity will slowly increase but it may be centuries before it is returned to pre-mining levels.

4.4.4.4 Irreversible or Irretrievable Resource Commitments

No irreversible or irretrievable vegetation resource commitments are anticipated under Alternative 2. No impacts are anticipated to threatened, endangered, or sensitive species, and no known sole sources of vegetation used by the Native Americans would be impacted. However, without mitigation, there would be an irretrievable loss of 0.03 acre of wetlands and 4.21 acres of non-wetland waters, due to past and proposed direct disturbances.

4.4.5 Impacts from Alternative 3

This alternative is similar to Alternatives 1 and 2, in that there would be no further expansion of the Zortman and Landusky mines. However, Alternative 3 incorporates the use of reclamation covers that are designed to promote long-term revegetation success, prevent water contamination, and reduce acid rock drainage. Goslin Flats would be used as the borrow source for the reclamation cover materials.

A water balance reclamation cover would be used on slopes $\geq$ 25 percent to maximize effectiveness of reclamation. The revised surface reclamation plan also includes reducing most slopes to an overall 3H:1V angle. Access and haul roads would be ripped to reduce compaction prior to revegetation efforts. Roads would be covered with clay if it is determined they contain acid producing material. Material from the Alder Gulch waste rock repository, the 85/86 leach pad and dike, the OK waste rock dump, the sulfide storage area and Montana Gulch waste rock dump would be used to backfill the pit complexes at the two mines. This measure would also reduce potential acid rock drainage problems at these facilities. Other existing facilities would be tested for acid generation and covered accordingly. These additional reclamation measures would significantly reduce potential acidification of soil and the resulting phytotoxic effects to vegetation.

At Goslin Flats, reclamation of borrowed areas would consist of regrading, replacement of topsoil and seeding.

Vegetation

Direct Impacts

About 250 acres of grasslands and shrublands in the Goslin Flats area would be disturbed to provide subsoil material for the water balance covers. No disturbance at the clay pits and limestone quarries is expected to be needed to provide additional reclamation materials. Impacts to forested areas equal 11 percent of forest in the study area and 69 percent of the disturbance area (Table 4.4-1). Direct impacts to forested habitat would be moderate.

Indirect Impacts

Enhanced reclamation activities proposed with Alternative 3 would significantly increase the potential for successful revegetation and provide an environment capable of promoting natural plant succession and sustaining productivity into the future. Indirect impacts would be minimal, and a minimal amount of revegetation failure is expected.

- Soil - Potential long-term cover soil loss at the Zortman Mine is 0.8 tons/acre/year and 0.8 at the Landusky Mine (Section 4.3.5). Thicker cover systems would prevent soil acidification and keep erosion rates low. As a result, low impacts to vegetation would occur due to the loss of some cover soil on a small portion of reclaimed acreages, mainly mine pit benches.

- Slope Angle - Slope reduction to a 3H:1V angle would reduce soil erosion, rilling, and offsite sedimentation. It would also provide a more stable seedbed and significantly enhance the potential for successful revegetation.

- Reclamation Cover - The 48-inch cover system (cover soil, and subsoil or NAG material plus GCL) would prevent the capillary rise and lateral seepage of acidic moisture, and decrease impacts to vegetation by limiting acidification of the growth medium.

- Relocation of Acid Producing Material - The Alder Gulch waste rock dump, the entire 85/86 leach pad and dike, the OK waste rock dump, and the sulfide stockpile at the Zortman Mine would be removed and used to backfill the pit complex to a free-draining configuration. This reclamation measure would relocate potentially acid generating material from these sites, reduce potential acidification of soil in the reclaimed areas, and increase the likelihood for successful revegetation. A large part of the acid-producing pit floor would then be revegetated. Pit walls above the backfill would still be acid-producing.

<u>Wetlands and Other Waters of the U.S.</u>

<u>Direct Impacts</u>

Direct impacts to waters and wetlands of the U.S. would occur for construction of water quality improvement structures, as previously described for Alternatives 1 and 2. This would involve .03 acre of wetland at Landusky, and 0.48 acre of non-wetland waters at both mines. (See Tables 4.4-2, 4.4-3 and 4.4-4a.) Direct impacts to wetlands at Goslin Flats would be avoided by maintaining adequate buffers (of at least 200 feet) between wetlands and borrow areas. Therefore, pre-mitigation impacts would be rated low to moderate. Alternative 3 includes mitigation to compensate for a portion of past impacts to waters of the U.S. This involves removal of the historic mine tailing from Ruby Gulch drainage above the town of Zortman and restoration of the streambed channel. The access road would be relocated out of the Ruby Gulch streambed. The Ruby Gulch restoration would provide 2.6 acres of mitigation; this would provide 1:1 compensation for the new direct impacts (as well as mitigation for some of the past direct impacts); therefore the impact rating would be reduced to low.

<u>Indirect Impacts</u>

Indirect impacts to wetlands would occur due to the use of the Goslin Flats area as a borrow source for the reclamation covers. Approximately 1.54 acres of wetlands could be indirectly affected by sedimentation during heavy precipitation events, noise, and possibly changes in hydrology associated with the removal of soil and subsurface materials. Since Goslin Flats is a "low" value drainage, pre-mitigation impacts would be moderate, and they would most likely be limited in duration to the period of borrow source disturbance. The reclamation proposed for Goslin Flats, the provision of a 200 foot buffer, and the use of Best Management Practices (BMPs) would reduce the predicted indirect sedimentation effects.

Potential indirect impacts to non-wetland waters are described in Table 4.4-5. These include the same indirect impacts (16.0 acres since 1979; 14.6 acres since 1990) as described for Alternatives 1 and 2, plus additional indirect effects that could occur due to the use of Goslin Flats as a borrow source area. The Goslin Flat impacts are estimated at approximately 0.4 acres, which includes the drainage extending downstream from the Goslin Flats borrow area to its confluence with Ruby Gulch. This 0.4 acre impact would be rated moderate before mitigation.

Mitigation for these indirect impacts includes implementation of the water capture and treatment system, the use of BMPs, and the proposed buffer zones in Goslin Flats. With this mitigation, impacts would be reduced to low levels.

4.4.5.1 <u>Cumulative Impacts</u>

For vegetation, cumulative impacts from Alternative 3 would be similar to those described for Alternatives 1 and 2. Additional direct and indirect impacts would occur on up to 25 acres of ponderosa pine forest and grasslands if the LS-2 and Montana Gulch limestone quarries are needed for reclamation covers, for a total of 1,523 acres. Successful revegetation in the long-term would reduce impacts to vegetation on reclaimed acres including the pit floor. In the long-term, very few areas are expected to be impacted by erosion and seepage on steep, long slopes and in drainage ways. Post-reclamation cumulative impacts to vegetation are rated low.

Cumulative impacts for wetlands would be higher than those described for Alternatives 1 and 2, because of the use of the Goslin Flats as a borrow source area. Cumulative wetland impacts are rated moderate. Cumulative impacts to non-wetland waters includes the same 20.21 acres of disturbance to non-wetland waters from past and proposed water quality-related impacts, and approximately 0.4 acre of new indirect disturbance to Goslin Gulch non-wetland waters. Additional impacts could occur with expansion of the limestone quarries. The water quality improvement plan would offset indirect cumulative impacts to waters of the U.S. to less than significant. For direct impacts, past disturbance totals 4.21 acres, of which 1.31 acres are considered high impact areas (in King Creek, Montana Gulch, and Swift Gulch). New disturbance for water quality facility construction totals 0.48 acres. The proposed restoration in Ruby Gulch would provide 2.6 acres of mitigation, and this would provide mitigation for at least the 1.31 acres of past high impacts at a 1.5:1 mitigation ratio, for a total of 1.97 acres, as well as the new preferred impacts of 0.48 acres at 1:1 (a total of 2.45 mitigation acres). The remaining 2.9 (4.21-1.31) acres of past impacts that were rated moderate would essentially have no mitigation (except the remaining 0.15 acre credit of the 2.6 acres of Ruby Gulch restoration). Therefore, cumulative impacts are rated moderate.

4.4.5.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts to vegetation would include loss of mature forest cover and species diversity. Unavoidable adverse impacts to wetlands could occur if the excavation of materials in Goslin Flats would cause impacts to wetlands due to changes in hydrology that could not be mitigated.

4.4.5.3 Short-term Use/Long-term Productivity

With successful reclamation on most of the disturbed acres, total plant cover and productivity would return to pre-mining levels in grassland communities within 3-5 years and in forested communities within 70-80 years. Over the long-term, species diversity would slowly increase, but it may be centuries before it returns to pre-mining levels. Comparable stability and utility would be achieved in the post-mine landscape on all but some mine pit benches.

4.4.5.4 Irreversible or Irretrievable Resource Commitments

No irreversible or irretrievable vegetation resource commitments are anticipated under Alternative 3. No impacts are anticipated to threatened, endangered, or sensitive species, and no known sole sources of vegetation used by the Native Americans would be impacted. Irretrievable loss of non-wetland waters would occur, since the proposed mitigation in Ruby Gulch would not fully compensate for all past direct impacts, leaving approximately 2.9 acres without mitigation.

4.4.6 Impacts from Alternative 4

This alternative consists of the company-proposed actions for mine life extension, and corrective measures. Major actions at the Zortman Mine would include expansion of the pit complex, construction of a heap leach facility at Goslin Flats, and construction of an ore conveyor system through Alder Gulch to Goslin Flats. At the Landusky Mine, major actions include the expansion of the Queen Rose and August Pits, development of the South Gold Bug pit, and development of a quarry in the King Creek drainage to obtain limestone for use in reclamation.

ZMI would implement enhanced reclamation practices for new facilities and those facilities already disturbed at the two mines. Concurrent reclamation is proposed for some of the facilities such as mined-out pits, waste rock dumps, leach pads, dikes, and soil stockpiles (for stabilization). At cessation of mining, final reclamation would occur at additional facilities, including the limestone quarry, clay pit, processing facilities and structures, haul and access roads, process ponds, soil stockpile areas, the Goslin Flats heap leach pad, and the conveyor corridor.

Reclamation procedures proposed for this alternative include:

- A 6 inch clay cap and 8 inches of cover soil on haul roads and pit benches where testing shows a sulfur content greater than 0.2 percent (Cover A).

- A 12 inch clay cap, 36-inch non-acid generating (NAG) waste rock capillary break and 8 to 12 inches of cover soil on all facilities with greater than 0.2 percent sulfur and slopes 5 percent or greater (Cover B).

- A synthetic liner, a 3 inch clay cap, and 36 inch NAG waste rock capillary break and 8 to 12 inches of cover soil on all facilities with greater than 0.2 percent sulfur and slopes less than 3 percent (Cover C).

- Reduction of steep, long slopes, where feasible, to a 3H:1V angle.

- The mine pits would be partially backfilled with spent ore and waste rock, thus reducing potential acid rock drainage problems in these areas.

Vegetation

Direct Impacts

Alternative 4 would result in direct removal of 891 acres of forest, grassland, and shrubland communities in the vicinity of the Zortman complex for expansion of the mine facilities, including the mine pit, waste rock facility, construction of a heap leach pad at Goslin Flats, limestone quarry, construction of a conveyor between the Zortman Mine and the Goslin Flats area, a power line corridor between Landusky and Zortman, process and handling facilities, and access and haul roads.

In the Landusky area, approximately 73 acres of vegetation would be removed for an LAD support area, reclamation access, drainage construction, and quarry areas and access. Total acres of disturbance include approximately 36 acres of previously disturbed or unvegetated land (pre-1979).

Direct impacts to vegetation include:

- 418 acres out of 2,700 acres, or 16 percent of grasslands in the study area
- 121 acres out of 800 acres, or about 15 percent of shrubland in the study area
- 291 acres out of 7,300 acres or, 4 percent of lodgepole forests in the study area
- 47 acres out of 3,700 acres, or about 1 percent of ponderosa pine forests in the study area
- 10 acres out of 300 acres or, about 3 percent of Douglas-fir forests in the study area
- 10 acres out of 1,300 acres or, less than 1 percent of the deciduous forests (riparian) habitat (primarily in the drainages of the Goslin Flats area and the drainages crossed by the conveyor).

Note: This includes 285 acres of grassland/shrubland in the land application area where vegetation would not be physically removed.

Total forested acres impacted equal about 1,387 acres or 15 percent of forested land in the study area and about 63 percent of the total disturbance; direct impacts are rated moderate. Direct impacts to riparian areas are rated low.

The reclamation plan includes revegetation with the following seed mix:

- 14 species of grasses; a 84 percent loss of diversity
- 6 species of forbs; a 98 percent loss of diversity
- 10 species of shrubs; a 77 percent loss of diversity
- 3 species of trees; a 58 percent loss of diversity

Invasion of native species on reclaimed areas would be slow (Munshower and Fisher 1993), and direct impacts to species diversity are rated high.

There are no known listed threatened, endangered, or sensitive plant species in the areas proposed for disturbance, and no known sole sources of plant species used for various purposes by Native Americans are in the project area.

Indirect Impacts

- Soil - Moderate negative impacts to vegetation would occur due to the loss of some cover soil material, based on soil thickness and growth medium deficiencies.

  Cover soil thickness would range from 8 to 12 inches, with 10 inches average providing slightly better protection from acid rock drainage in the vegetation root zone than Alternatives 1 and 2, but not as good as Alternative 3.

- Slope Angle - Slopes would be reduced to a 3H:1V angle where feasible and as topography allows. Slope lengths would be over 200 feet. Erosion, stability and potential for successful revegetation would be as discussed in Alternative 3, with slope angles reduced to 3:1 providing a significantly improved potential for reclamation success.

- Reclamation Covers - Impacts and predicted success would be the same as discussed in Alternative 2 for Cover A (3- to 12-inch clay, 8-inch soil), and covers B and C would significantly reduce potential acid conditions in soil and the resulting phytotoxic effects to vegetation.

During the first season following seeding or planting, revegetated areas would be evaluated for initial revegetation success. During the second season, monitoring would include quantitative and qualitative evaluations of canopy cover, species composition and tree planting success. Areas with poor germination and/or growth would be evaluated to determine causes of any unsuccessful revegetation. Reclamation techniques would be modified to address any identified problems. Attempts to revegetate problem areas would be made until successful. Monitoring would be conducted biannually until vegetation composition is stable.

Wetlands and Other Waters of the U.S.

Direct Impacts

Mining and reclamation activities at the Zortman Mine would directly impact approximately 1.06 acres of vegetated wetlands, and the installation of water capture structures would directly impact 0.03 acre at the Landusky Mine (refer to Table 4.4-6 and 4.4-4a). Direct impacts to the 0.03 acre in Rock Creek tributaries are rated low (pre-mitigation), because Rock Creek is a "low" value drainage and only a small area is involved. Direct impacts to wetlands at the Zortman Mine would occur in Goslin Gulch and are rated moderate (pre-mitigation), based on the "low" overall value rating for

Goslin Flats wetlands. Mitigation measures proposed by ZMI in a 404 permit application for Alternative 4 are designed to restore the function of jurisdictional waters post-mining. These measures include creation of wetlands (2.18 acres) in a tributary to Ruby Creek east of Goslin Flats and in Upper Goslin Gulch, as well as creation of 0.51 acre of wetland in the upper portion of Montana Gulch (Zortman 1995). This would provide mitigation for direct impacts to wetlands and would reduce the impact rating to a low level.

New direct impacts to non-wetland waters include 4.06 acres at the Zortman Mine and 0.08 acre at the Landusky Mine. This includes 0.4 acre at the Zortman Mine and 0.08 acre at the Landusky Mine affected by installation of water capture structures. The remaining 3.66 acres at the Zortman Mine would be affected by fill required by various mine expansion activities (see Tables 4.4-6 and 4.4-4b.) At the Zortman Mine, nearly all these impacts would occur in the following drainages and their tributaries: Carter Gulch (0.14 acre), Alder Gulch and Alder Spur (1.09 acres), Ruby Gulch (0.48 acre) and Goslin Gulch (2.28 acres). All but Alder Gulch are considered "low" value drainages, and impacts would be rated as moderate (pre-mitigation). Alder Gulch is rated in a "moderate" value drainage, and the loss of 1.09 acres would be rated as a high impact (pre-mitigation). Another 0.07 acre of direct disturbance that would occur in Lodgepole Creek tributaries (which have a "moderate" value) would be a moderate impact, given the small amount of area affected (pre-mitigation). At the Landusky Mine, the 0.08 acre direct impacts would occur in Rock Creek tributaries (0.02 acre), Mill Gulch (0.03 acre) and King Creek (0.03 acre); all impacts would be rated moderate, as previously described under Alternative 1.

Post-reclamation drainage re-establishment is proposed by ZMI (1995) in its 404 permit application as mitigation for direct impacts to non-wetland waters. However, if Alternative 4 were implemented, additional mitigation would be required to meet 404 permit requirements. Therefore, it is assumed that mitigation would consist of essentially the same mitigation plan described in Appendix F with slightly higher mitigation acreage requirements due to slightly higher number of acres directly impacted. This would involve mitigation for past impacts at a 1:5:1 ratio and proposed impacts at a 1:1 ratio, with emphasis placed on replacement of past or existing function and values. This mitigation would reduce any high impacts to moderate (insignificant) levels, and would further reduce moderate impacts to low levels.

<u>Indirect Impacts</u>

Approximately 0.48 acre of wetlands associated with the Goslin Flats leach pad may be indirectly disturbed. These indirect impacts include such things as sedimentation, leach pad leakages, noise, and changes in the water regime. These impacts would be rated moderate (pre-mitigation), since Goslin Flats wetlands are considered "low" in overall value (Table 3.4-2). However, mitigation would be provided in the form of wetland creation, as described in ZMI's 404 permit application (ZMI 1995) and in Appendix F. This mitigation would lower this impact rating to low.

Construction of the proposed facilities for Alternative 4 would also result in indirect impacts to downstream non-wetland waters of the U.S., as described in Table 4.4-5. The indirect effects of most concern would be the short-term water quality impacts, especially in currently unimpacted drainages, and the long-term impacts associated with only a moderately successful reclamation cover and the exposure of more potentially ARD source material. There are also impacts predicted from use of the limestone quarries.

The area of new indirect impacts for Alternative 4 has been estimated at 7.3 acres: 7.08 acres in the Goslin and Ruby Gulch drainages (downstream to Ruby Gulch's confluence with CK Creek), and 0.22 acre in Antoine Spur, a tributary to Carter Gulch. These impacts would be rated moderate (pre-mitigation), since the drainages involved are of "low" value. Mitigation such as that proposed for Alternative 7 (described in Appendix F) would be provided to compensate for these impacts and reduce the impact rating to low.

4.4.6.1 Cumulative Impacts

Cumulative impacts under Alternative 4 would include the 1,248 acres of existing disturbance from previous activities plus the proposed 972 acres of new disturbance, for a total of approximately 2,220 acres of disturbance. This total includes approximately 90 acres of rock outcrop, scree, or areas that were previously disturbed and not covered with vegetation, plus 60 acres at the clay pits and limestone quarries.

Additional direct and indirect impacts to vegetation would occur if any of the reasonably foreseeable developments take place. Potential impacts would include the loss of vegetation, forestry resources, and wildlife habitat of primarily lodgepole pine type communities on up to 128 acres associated with exploration activities. Should the Pony Gulch ore body be developed, an additional 13.5 acres of lodgepole pine

TABLE 4.4-6
WETLAND AND DRAINAGE DISTURBANCE AT ZORTMAN MINE[a]
(DIRECT AND INDIRECT)

Alternative 4 - Pit Expansion, Carter Gulch Waste Rock Repository, Goslin Flats Leach Pad

Zortman - Alternative 4								
Drainage	Waters of the U.S.							
	Non-Wetland				Wetland			
	Length (feet)		Area (acres)		Length (feet)		Area (acres)	
	Existing	Proposed[b]	Existing	Proposed	Existing	Proposed	Existing	Proposed
Carter Gulch	2,626	1,768	0.12	0.14	-	-	-	-
Alder Gulch and Tributaries	-	11,756	-	1.05	-	-	-	-
Alder Spur with Tributaries	4,599	1,009	0.11	0.04	-	-	-	-
Ruby Gulch with Tributaries	9,008	-	0.58	0.48	-	-	-	-
Goslin Gulch and Tributaries	-	13,410	-	2.28	-	3,176	-	1.06
Tributaries to Lodgepole Creek	1,061	2,313	0.03	0.07	-	-	-	-
Ruby Gulch[c]	5,250	-	2.41	3.96	-	-	-	-
Below Station Z-1B[c]	2,750	-	0.63	-	-	-	-	-
Goslin Flats[c]	-	-	-	3.12	-	-	-	0.48
Antoine Spur (Carter Gulch)[c]	-	-	-	0.22	-	-	-	-
TOTAL	25,294	33,643	3.88	11.36	-	3,176	-	1.54
TOTAL EXISTING AND PROPOSED	58,937		15.24		3,176		1.54	

NOTES:

a Based on values provided by ZMI in 404 permit applications and DEIS comments (ZMI 1995 and 1995b); indirect impact acres provided by the COE (COE 1995) and DEIS comments; other indirect impact acres estimated by OEA Research for certain actions and Woodward-Clyde Consultants.
b Proposed acreage includes water capture structures.
c Indirect impacts.

and grasslands would be impacted. Development of limestone quarries would also disturb additional vegetated areas, as would the clearing for the powerline. Cumulative impacts to vegetation resources are rated moderate, although comparable stability and utility would be achieved on most of the disturbed areas.

Cumulative direct and indirect impacts from past activities, those activities proposed under Alternative 4, and foreseeable future actions would result in a total of 31.17 acres of disturbance to non-wetland waters of the U.S., and 1.57 acres of disturbance to wetlands. Should Pony Gulch be developed, additional non-wetland waters would be affected, both directly and indirectly. Additional disturbance at the limestone quarries would likely result in wetland or non-wetland water impacts, as would any crossing by the powerline of jurisdictional waters of the U.S. Cumulative impacts (pre-mitigation) to wetlands are rated moderate and cumulative impacts to non-wetland waters of the U.S. are rated high, due to the loss of some waters of moderate value. Mitigation, similar to that described in Appendix F, would reduce these cumulative impacts to moderate to low (insignificant) levels.

4.4.6.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts to vegetation would be the same as described for previous alternatives. The potential for soil acidification is less than that predicted for Alternatives 1 and 2, but greater than Alternative 3. Adverse impacts to wetland and non-wetland waters would be avoided by successful implementation of mitigation measures similar to those described in Appendix F.

4.4.6.3 Short-term Use/Long-term Productivity

Short-term use and long-term productivity would be the same as described in Alternative 1. The potential for reclamation failure is less than that predicted for Alternatives 1 and 2, and greater than Alternative 3.

4.4.6.4 Irreversible or Irretrievable Resource Commitments

As in Alternatives 1-3, even with the additional disturbance, no irreversible or irretrievable vegetation resource commitments are anticipated under Alternative 4. No impacts are anticipated to endangered, threatened, or sensitive species, and no known sole sources of vegetation used by the Native Americans will be impacted. No habitat for plant communities would be reduced in the study area by more than 15 percent. Any wetland/non-wetland water losses would be compensated through the proposed mitigation.

4.4.7 Impacts from Alternative 5

Alternative 5 includes expansion of both the Zortman and Landusky mines, but with agency-developed mitigations added to the expansion and reclamation plans. The major modification is the relocation of the heap leach facility to Upper Alder Gulch, which would also eliminate the need for the conveyor system. Impacts to vegetation would be shifted from grasslands, shrublands, and wetlands in Goslin Flats, to the primarily lodgepole pine and riparian communities in Alder Gulch.

Reclamation activities would be carried out generally as described for Alternative 4. The Ruby Gulch tailing, OK waste rock dump, and Alder Gulch waste rock would be removed. At the Landusky Mine, ZMI would remove more waste rock fill from the head of King Creek to backfill the Landusky pit complex.

Agency-developed mitigations, as described for Alternative 3, would be incorporated into this Alternative.

Vegetation

Direct Impacts

This alternative presents a shift of impacts from about 205 acres of grasslands and shrublands in Goslin Flats (in Alternative 4) to about 180 acres in the primarily lodgepole pine forest of Upper Alder Gulch. In other words, short-term impacts to grasslands and wildlife forage are shifted to long-term impacts to forests and forestry resources and riparian vegetation.

Alternative 5 involves substantially fewer impacts to wildlife forage and habitat, and minimal impacts to wetlands as described below. However, impacts to riparian areas increase. Alternative 5 includes approximately 25 acres of disturbance at the LS-1 and King Creek limestone quarries described in Alternative 4. All other direct impacts would be as described for Alternative 4.

Direct impacts to vegetation include:

- 335 acres out of 2,700 acres, or about 12 percent of grasslands in the study area
- 72 acres out of 800 acres, or about 9 percent of shrublands in the study area
- 432 acres out of 7,300 acres or, 6 percent of lodgepole pine forests in the study area
- 50 acres out of 3,700 acres or, about 1 percent of ponderosa pine forests in the study area
- 12 acres out of 300 acres or, about 4 percent of Douglas-fir forest in the study area
- 27 acres out of 1,300 acres or, 2 percent of deciduous woodland (riparian) in the study area

Note: This includes 285 acres of grassland/shrubland in the land application area where vegetation would not be physically removed.

Impacts to forested areas equal about 17 percent of forested land in the study area and about 68 percent of the total disturbance; direct impacts are rated moderate.

Based on the significance criteria, direct impacts to riparian vegetation are rated low. However, impacts to 17 acres of high quality riparian habitat in Upper Alder Gulch could be considered significant locally. Locating the heap leach facility in Upper Alder Gulch would eliminate a very diverse riparian community that provides good wildlife habitat and is relatively uncommon in the area.

Direct impacts to species diversity in the reclaimed area are rated high, the same as those discussed for all other alternatives.

Indirect Impacts

Agency-developed mitigation measures would significantly increase the potential for successful revegetation and, in the long-term, the utility and productivity of the vegetation resources would return to conditions similar to those prior to mining activity on most of the disturbed area.

ZMI would be required to implement a surface reclamation monitoring plan that evaluates the continued performance of such features as; 1) reclamation covers, 2) revegetation success and performance, and 3) erosion control measures, and continue monitoring until such time as the reclamation bond is released.

Wetlands and Non-Wetland Waters

Direct Impacts

Mining and reclamation activities at the Zortman Mine associated with Alternative 5 would directly impact approximately 0.02 acre of vegetated wetlands in Alder Gulch. At the Landusky Mine, 0.03 acre of wetlands in Rock Creek tributaries would be directly affected for installation of the water capture structures (Tables 4.4-7 and 4.4-4a). These impacts are rated moderate and low, respectively (pre-mitigation). This is because Alder Gulch is a "moderate" value drainage, but minimal acreage (0.02 acre) is involved. Rock Creek is "low" in overall value (Table 3.4-2). Mitigation in the form of replacement wetlands would be required and would reduce these impact ratings to low levels.

Approximately 2.48 acres (Zortman Mine) and 0.08 acre (Landusky Mine) of non-wetland waters would be directly impacted by proposed activities. This includes 0.40 acre (Zortman Mine) and 0.08 acre (Landusky Mine) affected by water capture structures. The remaining acreage represents various mining activities in different drainages. (See Tables 4.4-7 and 4.4-4b.) At the Zortman Mine, nearly all these impacts would occur in the following drainages and their tributaries: Carter Gulch (0.14 acre), Alder Gulch and Alder Spur (1.97 acres), and Ruby Gulch (0.31 acre). All but Alder Gulch are considered "low" value drainages, and impacts would be rated moderate (pre-mitigation). Alder Gulch and its tributaries are "moderate" value drainages and the loss of 1.97 acres would be rated as a high impact (pre-mitigation). Another 0.06 acre of direct disturbance that would occur in Lodgepole Creek tributaries ("moderate" value) would be a moderate impact (pre-mitigation), given the small acreage involved. At the Landusky Mine, the 0.08 acre of direct impacts would occur in Rock Creek tributaries (0.02 acre), Mill Gulch (0.03 acre), and in King Creek (0.03 acre); all impacts would be rated moderate, as discussed under Alternative 1.

Mitigation would be required to compensate for direct impacts to non-wetland waters and would consist of essentially the same mitigation plan proposed for Alternative 7 (Appendix F), with slightly lower mitigation acreage requirements due to the lower number of acres directly impacted. This would involve mitigation for past impacts at a 1.5:1 ratio and proposed impacts at a 1:1 ratio, with emphasis on replacement of past or existing functions and values. These projects would include removal of historic Ruby Gulch tailings above the town of Zortman and restoration of the streambed channel, as well as other projects involving creation/enhancement or restoration of non-wetland

TABLE 4.4-7
WETLAND AND DRAINAGE DISTURBANCE AT ZORTMAN MINE[a] (DIRECT AND INDIRECT)

Alternative 5 - Pit Expansion, Carter Gulch Waste Rock Repository, Alder Gulch Leach Pad

Zortman - Alternative 5								
Drainage	Waters of the U.S.							
	Non-Wetland				Wetland			
	Length (feet)		Area (acres)		Length (feet)		Area (acres)	
	Existing	Proposed[b]	Existing	Proposed[b]	Existing	Proposed	Existing	Proposed
Carter Gulch	2,626	1,768	0.12	0.14	-	-	-	-
Alder Gulch and Tributaries	-	26,836	-	1.93	-	100	-	0.02
Alder Spur with Tributaries	4,599	1,009	0.11	0.04	-	-	-	-
Ruby Gulch with Tributaries	9,008	970	0.58	0.31	-	-	-	-
Goslin Gulch and Tributaries	-	-	-	-	-	-	-	-
Tributaries to Lodgepole Creek	1,061	2,164	0.03	0.06	-	-	-	-
Ruby Gulch[c]	5,250	-	2.41	-	-	-	-	-
Below Station Z-1B[c]	2,750	-	0.63	-	-	-	-	-
Alder Gulch[c]	-	-	-	0.40	-	-	-	0.24
TOTAL	25,294	32,747	3.88	2.88	-	100	-	0.26
TOTAL EXISTING AND PROPOSED	58,041+		6.76		100+		0.26	

NOTES:

[a] Based on values provided by ZMI in 404 permit applications and DEIS comments (ZMI 1995 and 1995b); indirect impact acres provided by the COE (COE 1995) and DEIS comments; other indirect impact acres estimated by OEA Research for certain actions and Woodward-Clyde Consultants.
[b] Proposed acreage includes water capture structures.
[c] Indirect impacts.

waters. This mitigation would reduce any high direct impacts to moderate (insignificant) levels, and would further reduce moderate impacts to low levels.

Indirect Impacts

Approximately 0.24 acre of wetland would be indirectly impacted. This is from potential effects of the Alder Gulch leach pad on nearby wetlands. This would be a high impact (pre-mitigation), since Alder Gulch is a "moderate" value wetland, and it is expected that these impacts would reduce its value. However, with replacement wetland mitigation, similar to that described in Appendix F, this impact would be reduced to a moderate (insignificant) level.

Construction of the proposed facilities for Alternative 5 would also result in indirect impacts to downstream non-wetland waters of the U.S., as described in Table 4.4-5. Indirect impacts would be similar to those described for Alternative 4.

The area of newly impacted non-wetland waters in downstream Alder Gulch is estimated at 0.40 acre. This would be a high impact (pre-mitigation), since Alder Gulch is rated "moderate" in value. However, with implementation of the water quality capture and treatment measures as part of the mitigation plan for Alternative 5, this impact would be reduced to a moderate (insignificant) rating.

4.4.7.1 Cumulative Impacts

Cumulative impacts under Alternative 5 would include the 1,248 acres of existing disturbance from current activities, and approximately 923 acres of new disturbance, for a total of about 2,112 acres of disturbance. This total includes approximately 114 acres of rock outcrop, scree, or areas that were previously disturbed and not covered with vegetation, plus 78 acres at the clay pits and limestone quarries.

Additional direct and indirect impacts to vegetation would occur to 128 acres of primarily lodgepole pine communities that could be disturbed during exploration activities. An additional 16 acres at the LS-1 and King Creek limestone quarries would be disturbed. Cumulative impacts to vegetation resources are rated moderate, although comparable stability and utility would be achieved on most disturbed areas.

Cumulative direct and indirect impacts from past activities, those activities proposed under Alternative 5, and foreseeable future actions would result in a total of 22.69 acres of disturbance to non-wetland waters of the U.S., and 0.29 acre of disturbance to wetlands. Additional impacts to wetlands and non-wetland waters would occur with the development of limestone quarries in or near drainages and the powerline (if jurisdictional waters are crossed), as described for Alternative 4. Cumulative impacts (pre-mitigation) to wetlands are rated high, due to impacts to wetlands in Alder Gulch. Cumulative impacts to non-wetland waters are also rated high, due to the loss of some acreage of water of moderate value. Mitigation similar to that described in Appendix F would be imposed, reducing cumulative impacts to wetlands and other waters of the U.S. to moderate to low (insignificant) levels.

4.4.7.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would essentially be the same as discussed in Alternative 4.

4.4.7.3 Short-term Use/Long-term Productivity

Short-term use and long-term productivity would be the same as described in Alternative 4.

4.4.7.4 Irreversible or Irretrievable Resource Commitments

As in Alternatives 1-3 and similar to Alternative 4, even with the additional disturbance, no irreversible or irretrievable vegetation resource commitments are anticipated under Alternative 5. No impacts are anticipated to endangered, threatened, or sensitive species, and no known sole sources of vegetation used by the Native Americans would be impacted. No habitat for plant communities would be reduced in the study area by more than 17 percent. Any wetland/non-wetland water losses would be compensated through the proposed mitigation.

4.4.8 Impacts from Alternative 6

Alternative 6 includes expansion of both the Zortman and Landusky mines, but with agency-developed mitigations on the expansion and reclamation plans. The major modification is that the waste rock repository would be relocated to the Ruby Flats, just east of the Goslin Flats leach pad.

Reclamation activities would be carried out as described in Alternative 5, except that pit backfill would come in part from construction of a drainage notch to Montana Gulch. Most long slopes would be reduced to a 3H:1V angle, and reclamation covers would be as described in Alternative 5.

Vegetation

Direct Impacts

This alternative presents a shift of impacts from waste rock deposition on 180 acres of lodgepole pine forest to 203 acres of grasslands and shrublands in Ruby Flats. In other words, long-term impacts to forests and forestry resources are shifted to short-term impacts to grasslands and wildlife habitat and forage. Impacts to species diversity would be as described for all other alternatives.

Approximately 25 acres would be disturbed at the LS-1 and King Creek limestone quarries for reclamation material.

Direct impacts to vegetation include:

- 691 acres out of 2,700 acres, or 26 percent of grassland in the study area
- 178 acres out of 800 acres, or about 22 percent of shrubland in the study area
- 159 acres out of 7,300 acres or, 2 percent of lodgepole pine forest in the study area
- 46 acres out of 3,700 acres or, about 1 percent ponderosa pine forest in the study area
- 1 acre out of 300 acres or, less than 1 percent of Douglas-fir forest in the study area
- 10 acres out of 1,300 acres or, less than 1 percent of deciduous woodland (riparian) habitat in the study area (primarily in the drainages of the Goslin Flats area and the drainages crossed by the conveyor).

Note: This includes 285 acres of grassland/shrubland in the land application area where vegetation would not be physically removed.

Impacts to forested areas equal about 14 percent of forested land in the study area and about 51 percent of the total disturbance; direct impacts are rated moderate.

Direct impacts to riparian areas are rated low.

Direct impacts to species diversity in the disturbed area are rated high, the same as discussed for all other alternatives.

Indirect Impacts

Indirect impacts would be as discussed in Alternative 5.

ZMI would be required to implement a surface reclamation monitoring plan that evaluates the continued performance of such features as 1) reclamation covers, 2) revegetation success and performance, and 3) erosion control measures, and continue monitoring until such time as the reclamation bond is released.

Wetlands and Non-Wetland Waters

Direct Impacts

Mining and reclamation activities associated with Alternative 6 would directly impact approximately 1.06 acres of vegetated wetland at the Zortman Mine, and 0.03 acre at the Landusky Mine, similar to Alternative 4 (Tables 4.4-8 and 4.4-4a). As described under Alternative 4, these impacts would be rated low to moderate (pre-mitigation) and, with replacement wetland mitigation (such as proposed in the mitigation plan presented in Appendix F). These impacts would be reduced to a low level.

Direct impacts also include 3.26 acres of non-wetland waters at the Zortman Mine, and 0.08 acre at the Landusky Mine. This includes the 0.40 and 0.08 acre for water capture structures at the Zortman Mine and Landusky Mine, respectively. The remaining acreage would be affected by filling of waters for construction of various facilities. (See Table 4.4-8 and 4.4-4b.)

These direct impacts would occur primarily in the Ruby Creek and Goslin Gulch drainages. These are "low" value drainages, and resultant impacts would be rated moderate (pre-mitigation). Some direct impacts would occur to Alder Gulch and its tributaries (0.24 acre) and these would be considered a high impact, since Alder Gulch is a "moderate" value stream. The 0.06 acre disturbance in Lodgepole Creek would be rated a moderate impact, since the amount of acreage involved is minimal and would not affect any high value functions of the drainage. At the Landusky Mine, impacts would be as described for Alternatives 4 and 5, i.e., moderate-rated disturbances in small areas of King Creek and low impacts to Rock and Mill Gulches. Mitigation would be required to compensate for direct impacts and would consist of mitigation similar to that proposed for Alternative 7 (Appendix F), with slightly lower mitigation acreage requirements due to the lower acreage of direct impacts. As described for Alternative 5, these would include removal of historic Ruby Gulch tailings and restoration of the streambed, as well as other creation/embankment/restoration projects. This mitigation would reduce any high direct impacts to non-wetland waters to moderate (insignificant) levels, and would further reduce moderate impacts to low levels.

TABLE 4.4-8
WETLAND AND DRAINAGE DISTURBANCE AT ZORTMAN MINE[a] (DIRECT AND INDIRECT)

Alternative 6 - Pit Expansion, Ruby Terrace Waste Rock Repository, Goslin Flats Leach Pad

Drainage	Zortman - Alternative 6							
	Waters of the U.S.							
	Non-Wetland				Wetland			
	Length (feet)		Area (acres)		Length (feet)		Area (acres)	
	Existing	Proposed[b]	Existing	Proposed[b]	Existing	Proposed	Existing	Proposed
Carter Gulch	2,626	300	0.12	0.07	-	-	-	-
Alder Gulch and Tributaries	-	2,101	-	0.20	-	-	-	-
Alder Spur with Tributaries	4,599	1,009	0.11	0.04	-	-	-	-
Ruby Gulch with Tributaries	9,008	5,205	0.58	0.61	-	-	-	-
Goslin Gulch and Tributaries	-	13,410	-	2.28	-	3,176	-	1.06
Tributaries to Lodgepole Creek	1,061	2,164	0.03	0.06	-	-	-	-
Ruby Gulch[c]	5,250	-	2.41	3.96	-	-	-	.59
Below Station Z-1B[c]	2,750	-	0.63	-	-	-	-	-
Camp Creek	-	-	-	1.4	-	-	-	3.00
Goslin Flats[c]	-	-	-	3.12	-	-	-	0.48
Antoine Spur (Carter Gulch)[c]	-	-	-	0.22	-	-	-	-
TOTAL	25,294	24,189	3.88	11.96	-	3,176	-	5.13
TOTAL EXISTING AND PROPOSED	49,483		15.84		3,176		5.13	

NOTES:

[a] Based on values provided by ZMI in 404 permit applications and DEIS comments (ZMI 1995 and 1995b); indirect impact acres provided by the COE (COE 1995) and DEIS comments; other indirect impact acres estimated by OEA Research for certain actions and Woodward-Clyde Consultants.

[b] Proposed acreage includes water capture structures.

[c] Indirect impacts.

Indirect Impacts
No indirect impacts to wetlands would occur at the Landusky Mine. However, approximately 4.07 acres would be indirectly impacted at the Zortman Mine. This includes indirect impacts of 0.48 acre associated with the Goslin Flats leach pad (same as Alternative 4), but also 0.59 acre in a tributary of Ruby Creek (Ruby Tributary A) and approximately 3.0 acres in Camp Creek that could be indirectly impacted from the operation of the waste rock repository on Ruby Flats (see Figure 2.10-1). The impacts in Ruby Creek and Goslin Flats would be rated moderate; however, since the Camp Creek wetlands are of "moderate" overall value (Table 3.4-2), this would be rated as a high indirect impact (pre-mitigation). Mitigation would be required and provided in the form of replacement wetlands, such as what is proposed in Appendix F. With mitigation, indirect impacts to wetlands would be reduced to moderate or low levels.

Construction of Alternative 6 proposed facilities would also result in indirect impacts to downstream waters of the U.S., as described in Table 4.4-5. Indirect impacts are estimated at 8.7 acres: the same 7.3 acres as described for Alternative 4, and an additional 1.4 acres in the downstream Camp Creek drainage. The 7.3 acres would be moderate (pre-mitigation) impacts, as previously described. However, the 1.4 acres in the "moderate" value Camp Creek drainage would be high (pre-mitigation) impacts. Mitigation for indirect impacts would be provided, similar to that described in Appendix F, and would include the capture and treatment measures to improve water quality conditions. With this mitigation, the high impacts would be reduced to moderate (insignificant) levels, and moderate impacts reduced to low levels.

4.4.8.1 Cumulative Impacts

Cumulative impacts to vegetation under Alternative 6 would include the 1,248 acres of existing disturbance from current activities, and 951 acres of proposed disturbance, for a total of approximately 2,199 acres of disturbance. This total includes approximately 105 acres of rock outcrop, scree, or areas previously disturbed and not currently covered with vegetation, and 78 acres at the clay pits and quarries.

Additional direct and indirect impacts to vegetation would occur if any of the reasonably foreseeable developments take place. Impacts would include the loss of vegetation on up to 155 acres of primarily lodgepole pine type communities associated with exploration activities. An additional 16 acres at the LS-1 and King Creek limestone quarries would be disturbed for reclamation material. Should the Pony Gulch ore body be developed, an additional 14 acres of lodgepole pine and grasslands would be impacted. Cumulative impacts to vegetation are rated moderate, although comparable stability and utility would be achieved on most of the disturbed area.

Cumulative direct and indirect impacts from past activities, those activities proposed under Alternative 6, and foreseeable future actions would result in a total of 31.77 acres of disturbance to non-wetland waters of the U.S. and 5.16 acres of disturbance to wetlands. As described for Alternative 4, additional impacts would occur with the development of Pony Gulch, limestone quarries in or near drainages, and the powerlines (if jurisdictional waters are crossed). Cumulative impacts (pre-mitigation) are rated high for both wetlands and non-wetland waters, due to impact to wetlands in Camp Creek and loss of some drainages of moderate value. With mitigation comparable to that outlined in Appendix F, cumulative impacts to wetlands and other waters of the U.S. would be reduced to moderate to low (insignificant) levels.

4.4.8.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be essentially as discussed in Alternative 4.

4.4.8.3 Short-term Use/Long-term Productivity

Short-term use and long-term productivity would essentially be the same as described in Alternative 4.

4.4.8.4 Irreversible or Irretrievable Resource Commitments

The impacts are essentially the same as in Alternatives 4 and 5, except that grassland/shrubland in the study area would be reduced by 22 percent. This is an important reduction, but not an irreversible or irretrievable resource commitment in the long run. Any wetland/non-wetland water losses would be compensated through the proposed mitigation.

4.4.9 Impacts from Alternative 7

Alternative 7 includes expansion of both the Zortman and Landusky mines, but with agency-developed mitigations on the expansion and reclamation plans. The major modification is elimination of a new waste rock repository and placement of most of the waste rock on top of existing facilities.

Activities would be carried out as described in Alternative 4, with the following additional modifications relative to vegetation resources.

- Reclamation covers would be a combination of water balance and water barrier covers, the same as under Alternative 3.

- Tree planting would be limited in the revegetation plan. Grasses, forbs and shrubs would be used to enhance wildlife habitat. Lack of open parks and meadows is the limiting factor for wildlife. Scattered clumps of trees may be planted to provide cover and improve aesthetics, particularly in the drainages. The location and numbers of trees would be established at the time of final reclamation.

- Crested wheatgrass would be removed from the seed mix, due to low palatability for wildlife and a tendency for it to crowd out other more suitable species.

- In most cases, slopes would be reduced to a 3H:1V angle.

Vegetation

Direct Impacts

This alternative presents reduction of impacts to forest and grassland for waste rock deposition, as compared to Alternatives 4, 5, or 6. Long-term impacts to vegetation would be reduced by placing the waste rock on previously disturbed sites currently rather than clearing an undisturbed site to create a new waste rock repository.

Impacts to species diversity would be as described for all other alternatives. The revised plan would help wildlife forage and habitat, but would impact reestablishment of trees.

Direct impacts to vegetation include:

- 418 acres out of 2,700 acres, or 16 percent of grassland in the study area
- 121 acres out of 800 acres, or about 15 percent of shrubland in the study area
- 199 acres out of 7,300 acres or, 3 percent of lodgepole pine forest in the study area
- 34 acres out of 3,700 acres or, less than 1 percent ponderosa pine forest in the study area
- 9 acres out of 1,300 acres or, less than 1 percent of deciduous woodland (riparian) habitat in the study area (in the drainages of the Goslin Flats area and the drainages crossed by the conveyor).
- 1.09 acres out of 21.8 acres, or less than 1 percent of wetlands in the study area
- 2.99 acres of non-wetland waters

Note: This includes 285 acres of grassland/shrubland in the land application area where vegetation would not be physically removed.

Impacts to forested areas equal about 14 percent of forested land in the study area and about 62 percent of the total disturbance; direct impacts are rated moderate.

Direct impacts to riparian areas are rated low.

Direct impacts to species diversity in the disturbed area are rated high, as discussed for all other alternatives.

Indirect Impacts

- Slopes - most facilities would be reclaimed to a 3:1 slope, with constructed benches for erosion control every 100 vertical feet. The long-term potential for erosion at the Zortman Mine is 0.8 tons/acre/year and 0.8 tons/acre/year at the Landusky Mine (Section 4.3.9), resulting in low impacts to vegetation.

- Reclamation Cover - Improvements in the design of the reclamation cover, as discussed in Section 4.4.5, further reduce the potential for failure of the cover systems in the long term. Revegetation is assumed to be successful on all but a portion of mine pit benches that would reacidify from pit wall runoff. Vegetation cover is expected to be returned to 90 percent or greater of similar undisturbed communities. The disturbed acres would provide comparable stability and utility as required by the Metal Mine Reclamation Act.

ZMI would be required to submit a surface reclamation monitoring plan to the Agencies that evaluates the continued performance of such features as; 1) reclamation covers, 2) revegetation success and performance, and 3) erosion control measures, and continue monitoring until such time as the reclamation bond is released.

Wetlands and Non-Wetland Waters

Direct Impacts

Mining and reclamation activities associated with Alternative 7 would impact approximately 1.06 acres of vegetated wetlands at the Zortman Mine and 0.03 acre at the Landusky Mine, similar to Alternative 4 (Tables 4.4-9 and 4.4-4a). Direct impacts to the 0.03 acre in Rock Creek tributaries at the Landusky Mine are rated low (pre-mitigation), because Rock Creek is a "low" value drainage and only a small area is involved. Direct impacts to wetlands at the Zortman Mine would occur in Goslin Gulch and are rated moderate, based on the "low" overall value for Goslin Flats wetlands. Mitigation proposed to compensate for these direct impacts and past direct impacts to wetlands would include creation of replacement wetlands in Ruby Creek Tributary A, Upper Goslin Gulch, and Montana Gulch and is described in detail in the Aquatic Ecosystem Mitigation Plan in Appendix F. With the mitigation described in this plan, direct impacts would be reduced to low levels.

Direct impacts to non-wetland waters would include 3.56 acres at the Zortman Mine and 0.08 acre at the Landusky Mine. This includes the 0.40 and 0.08 acre for water capture structures at the two mines. The remaining acreage would be affected by filling of waters for construction of various facilities. (See Tables 4.4-9 and 4.4-4b.)

At the Zortman Mine, these impacts would occur in the following drainages and their tributaries: Carter Gulch (0.07 acre), Alder Gulch (0.20 acre), Alder Spur (0.14 acre), Ruby Gulch (0.81 acre), and especially Goslin Gulch (2.28 acres). All these except Alder Gulch and Alder Spur have "low" value ratings, and impacts would therefore be moderate (pre-mitigation). Alder Gulch/Spur impacts of 0.24 acre would be rated high, since these drainages are of "moderate" value. The 0.06 acre of direct disturbance that would occur in Lodgepole Creek tributaries, which have a "moderate" value would be a moderate impact (pre-mitigation), because of the small acreage involved and the lack of effect on high value functions. At the Landusky Mine, the 0.08 acre direct impacts would occur in Rock Creek (0.02 acre), Mill Gulch (0.03 acre), and King Creek (0.03 acre). The King Creek impact would be rated moderate (pre-mitigation), since it involves a small area of a "moderate" value drainage and does not affect any high value functions. The other impacts would be considered low, for similar reasons.

Mitigation is proposed to compensate for these direct impacts, as well as past direct impacts to non-wetland waters. The mitigation plan for Alternative 7 is found in Appendix F. It includes several projects involving creation/restoration/enhancement of area non-wetland waters, including the removal of historic Ruby Gulch tailings and restoration of the streambed. This mitigation would reduce any high impacts to non-wetland waters to moderate (insignificant) levels, and further reduced moderate impacts to low levels.

Indirect Impacts

Indirect impacts to wetlands include approximately 0.48 acres associated with the Goslin Flats leach pad, similar to Alternative 4. These indirect impacts include such things as sedimentation, leach pad leakages, noise, and changes in the water regime. These impacts would be rated as moderate (pre-mitigation), since Goslin Flats wetlands are considered "low" in overall value (Table 3.4-2). Mitigation proposed for Alternative 7 (Appendix F) includes at least 1:1 compensation for these new indirect impacts in the form of replacement wetlands. This mitigation would lower the impact rating to low.

Implementation of Alternative 7 would also result in indirect impacts to downstream waters of the U.S., as described in Table 4.4-5. Indirect impacts would be similar to those described for Alternative 4 and include 7.3 acres: 7.08 acres in the Goslin and Ruby Gulch drainages (downstream to Ruby Gulch's confluence with CK Creek), and 0.22 acre in Antoine Spur, a tributary to Carter Gulch. These impacts would be rated moderate (pre-mitigation), since the drainages involves are of "low" value. Alternative 7 disturbs less acreage (the least of all expansion alternatives) and incorporates both the water balance cover and the water capture and treatment measures; all of these would create positive effects on downstream water quality. This and the other mitigation included in Appendix F would compensate for indirect effects and lower the impact rating to low.

4.4.9.1 Cumulative Impacts

Cumulative impacts to vegetation under Alternative 7 would include the 1,248 acres of existing disturbance from current activities, and 772 acres of proposed disturbance for a total of 2,020 acres. This total includes 74 acres of rock outcrop, scree, or areas previously disturbed and not currently covered with vegetation.

Additional direct and indirect impacts to vegetation would occur from any of the reasonably foreseeable developments. Impacts would be as described in Alternative 4, plus an additional 25 acres of ponderosa pine forest and grasslands disturbed at the LS-2 and Montana Gulch limestone quarries. Cumulative impacts to vegetation are rated low, although comparable stability and utility would be achieved on most of the disturbed area. This is 33 acres less than the 54 acres

TABLE 4.4-9
WETLAND AND DRAINAGE DISTURBANCE AT ZORTMAN MINE[a]
(DIRECT AND INDIRECT)

Alternative 7 - Pit Expansion, Zortman Waste Rock Cap, Goslin Flats Leach Pad

Zortman - Alternative 7								
Drainage	Waters of the U.S.							
	Non-Wetland				Wetland			
	Length (feet)		Area (acres)		Length (feet)		Area (acres)	
	Existing	Proposed[b]	Existing	Proposed[b]	Existing	Proposed	Existing	Proposed
Carter Gulch	2,626	300	0.12	0.07	-	-	-	-
Alder Gulch and Tributaries	-	2,101	-	0.20	-	-	-	-
Alder Spur with Tributaries	4,599	5,052	0.11	0.14	-	-	-	-
Ruby Gulch with Tributaries	9,008	8,188	0.58	0.81	-	-	-	-
Goslin Gulch and Tributaries	-	13,410	-	2.28	-	3,176	-	1.06
Tributaries to Lodgepole Creek	1,061	2,164	0.03	0.06	-	-	-	-
Ruby Gulch[c]	5,250	-	2.41	3.96	-	-	-	-
Below Station Z-1B[c]	2,750	-	0.63	-	-	-	-	-
Goslin Flats[c]	-	-	-	3.12	-	-	-	0.48
Antoine Spur (Carter Gulch)[c]	-	-	-	0.22	-	-	-	-
TOTAL	25,294	30,915	3.88	10.86	-	3,176	-	1.54
TOTAL EXISTING AND PROPOSED	56,209		14.74		3,176		1.54	

NOTES:
[a] Based on values provided by ZMI in 404 permit applications and DEIS comments (ZMI 1995 and 1995b); indirect impact acres provided by the COE (COE 1995) and DEIS comments; other indirect impact acres estimated by OEA Research for certain actions and Woodward-Clyde Consultants.
[b] Proposed acreage includes water capture structures.
[c] Indirect impacts.

of pre-mining unvegetated acres that existed before mining commenced in 1979.

Cumulative direct and indirect impacts from past activities, those activities proposed under Alternative 7, and foreseeable future actions would result in a total of 30.67 acres of disturbance to non-wetland waters of the U.S., and 1.57 acres of disturbance to wetlands. As described for Alternative 4, additional impacts would occur with the development of Pony Gulch, limestone quarries in or near drainages, and the powerlines (if jurisdictional waters are crossed). Cumulative impacts (pre-mitigation) to wetlands are rated moderate and cumulative impacts (pre-mitigation) to non-wetland waters are rated high, due to loss of some drainages of moderate value. With successful implementation of the mitigation plan outlined in Appendix F, cumulative impacts to wetlands and other waters of the U.S. would be reduced to moderate to low (insignificant) levels.

4.4.9.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts to vegetation would include loss of species diversity and mature forest cover in reclaimed communities. Adverse impacts to wetland and non-wetland waters would be avoided by successful implementation of the proposed mitigation measures in Appendix F.

4.4.9.3 Short-term Use/Long-term Productivity

It is expected that on most of the reclaimed acres, total plant cover and productivity would return to pre-mining levels within 3 to 5 years, and provide improved conditions for wildlife. Over the long-term, species diversity would slowly increase but it may be centuries before it is returned to pre-mining levels. Eventually, forested habitat would return to suitable sites which were reclaimed to grasslands in the short-term.

4.4.9.4 Irreversible or Irretrievable Resource Commitments

These impacts would be similar to those described for previous alternatives. Even with the additional disturbance, no irreversible or irretrievable vegetation resource commitments are anticipated under Alternative 7. No impacts are anticipated to endangered, threatened, or sensitive species, and no known sole sources of vegetation used by the Native Americans will be impacted. No habitat for plant communities would be reduced in the study area by more than 15 percent. Any wetland/non-wetland water losses would be compensated through the proposed mitigation.

4.4.10 Impacts Summary

A summary of impacts from each alternative is presented in Table 4.4-10. This table highlights some of the most important resource areas that were assessed in Section 4.4 for vegetation, wetlands, and other waters of the U.S. and provides summaries of impacted areas and/or impact ratings. Tables 4.4-a and b, also provide summaries of acres of wetland and non-wetland waters directly and indirectly impacted under each alternative action.

TABLE 4.4-10
IMPACTS SUMMARY - VEGETATION AND WETLANDS

Resource	Units	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Threatened, endangered, sensitive species habitat	Acres	NI	NI	NI	NI	NI	NI	NI
Sole source of vegetation used by Native Americans	Acres	NI	NI	NI	NI	NI	NI	NI
Riparian vegetation[b]	Acres	--/16	--/16	--/16	10/26	27/43	10/26	9/25
Forest[b]	Acres	--/1029 (H)	--/1029 (H)	5/1034 (M)	358/1387 (M)	521/1550 (M)	216/1245 (M)	256/1285 (M)
Species diversity	% loss (in disturbed area)	92	92	92	92	92	92	93
Vegetative Cover	%	<80	<80	>90	80-89	80-89	80-89	>90
Effect of Reclamation Plan		H	H	L	M	M	M	L
Cumulative Impact Rating - Vegetation		H	H	L	M	M	M	L
Wetland[a] Direct impacts	Acres	0.03	0.03	0.03	1.09	0.05	1.09	1.09
Wetland[a] Indirect impacts	Acres	-	-	1.54	.48	.24	4.07	.48
Non-Wetland waters - Direct Impact[b]	Acres	.48/4.21	.48/4.21	.48/4.21	4.14/7.87	2.59/6.29	3.34/7.07	3.64/7.37
Non-Wetland waters - Indirect Impact[b]	Acres	0/16.0[c]	0/16.0[c]	0.40/16.0[c]	7.3/16.0[c]	0.40/16.0[c]	8.7/16.0[c]	7.3/16.0[c]
Cumulative Impact Rating - Wetlands - Pre-mitigation		L	L	M	M	H	H	M
Cumulative Impact Ratings - Wetlands - Post-mitigation		L	L	M	L	M/L	M/L	L
Cumulative Impact Rating - Non-wetland waters - Pre-mitigation		H	H	H	H	H	H	H
Cumulative Impact Rating - Non-wetland waters - Post-mitigation		H	H	M	M/L	M/L	M/L	M/L

[a] No previous disturbance to wetlands was identified.
[b] X/Y - X - Acres disturbed as a result of implementing the alternative, Y - Cumulative acres disturbed - previous and proposed
[c] 16.0 total acres have been indirectly impacted from 1979-present; of this, 14.6 acres is used for mitigation purposes, based on the Corps of Engineers' regulatory authority.

H - High (Significant) Impact
M - Moderate Impact
L - Low Impact
NI - Negligible Impact

4.5 WILDLIFE AND AQUATICS

4.5.1 Methodology

Issues concerning wildlife impacted by mine expansion, operations, and reclamation activities were developed from the public scoping process and consultation with local, state and federal agencies. These issues and concerns are summarized in Section 1.7 and listed below:

- Loss or disturbance to federal threatened or endangered wildlife species and their habitats.
- Loss or disturbance to federal Category 1 and 2 candidate species.
- Degraded water quality and adverse impacts on fish and aquatic organisms.
- Increased wildlife mortality from mining activities.
- Adverse impacts to bats occupying or hibernating at Azure Cave.

Based on these issues, significance criteria were developed to evaluate impacts to fisheries and wildlife from the seven alternatives. General significance criteria used in the evaluation of impacts include:

- Disturbed area contains habitat officially designated as critical habitat for federal threatened or endangered species by the USFWS; this would be a high impact. (Note: No areas designated as critical habitat for any threatened or endangered species occur within the study area).
- Disturbed area contains habitat or known use areas for federal candidate species. Relative impact level is based on extent of habitat disturbed on a species by species basis.
- Mine activities directly disturb known populations or individuals of federal and state sensitive species, particularly bats and nesting raptors. Any direct disturbance is considered high negative and significant; indirect disturbance is considered low or moderate, depending on nature and extent of the disturbance.
- Noise (decibels) of mine activities at Azure Cave exceed levels considered potentially detrimental to hibernating bats. Noise levels in the range experienced in urban residential areas (55-69 dBA) (areas known to support bats) or lower levels are considered negligible.
- Potential wildlife mortality from mining related activity (cyanide ponds, haul truck collisions) experiences an increase above pre-mine levels that is detrimental to wildlife populations in the Little Rocky Mountains. Mortality at existing (1979-present) level is considered low negative to overall populations. Levels below existing 1979-present levels are considered negligible; levels that exceed existing 1979-present levels, but are not considered to be detrimental to wildlife populations, are considered moderate negative; and levels that are detrimental to wildlife populations are considered high negative and significant.
- Effectiveness of reclamation for wildlife.
- Acres of habitat lost exceeding 5, 10, and 15 percent of the approximately 20,500 acres of wildlife habitat available in the Little Rocky Mountains as examined by Scow (1978). These are considered low, moderate, and high negative impacts, respectively.
- Residual water quality or increases in suspended solids and stream bottom sediments in receiving streams that could be detrimental to fish and aquatic macroinvertebrate populations, as described in Sections 4.4 (Waters of the U.S.) and 4.2.

Evaluations and comparisons of impacts of alternatives based on the above significance criteria were separated into subsections. These subsections include habitat loss, bighorn sheep, wildlife mortality, noise, nesting raptors, reptiles and amphibians, special status species, residual water quality, and reclamation. Special status species included federally listed threatened and endangered species, Federal Category 1 and 2 candidate species, and state sensitive species. Several special status species described in Section 3.5 either do not occur within the proposed mine area or occupy habitats not likely to be impacted by any alternatives and thus were not further evaluated. These species include:

- Bald Eagle
- Peregrine Falcon
- Piping Plover
- Black-footed Ferret
- Burrowing Owl
- Ferruginous Hawk
- Mountain Plover
- Northern Goshawk
- Loggerhead Shrike
- Baird's Sparrow
- Long-billed Curlew

Impacts to big game and upland game species are generally evaluated collectively under habitat loss and wildlife mortality sections.

Methods used in this evaluation involved a review of existing information including baseline reports, previous environmental impact statements, permit applications, scientific journals, and consultation with local, state and federal agency personnel.

Several analyses, based on existing information, were conducted that develop a relative index of impacts by the different alternatives. Although these calculations may not have produced absolute numbers for potential impact, they did provide a consistent estimate of the relative impacts by alternative. The precision of the estimates were dependent on the quality of the available data. When baseline or specific information was lacking, basic assumptions were made during the analyses. These assumptions are explained in the text.

Specific methods of analysis included: (1) obtaining information on the occurrence of federal threatened and endangered species and their potential habitat from baseline studies, the USFWS, BLM, MDFWP and the Montana Natural Heritage Program (MNHP); (2) calculating wildlife mortality based on the scientific literature, baseline and wildlife monitoring reports, and estimates of increased traffic by alternative; (3) evaluating noise impacts to hibernating bats based on calculations presented in Section 4.9, and consulting with experts from Bat Conservation International (BCI); (4) evaluating residual water quality based on calculations presented in Section 4.2; (5) evaluating impacts to nesting raptors using baseline reports and element occurrence searches conducted by the MNHP; and (6) estimating habitat loss by comparing total acreage of disturbance reported by alternative to a baseline evaluation of the Little Rocky Mountains south of the Fort Belknap Indian Reservation, conducted by Scow (1979). The baseline evaluation by Scow (1979) did not encompass the entire Little Rocky Mountains; therefore, estimates of habitat loss provided in this report are extremely conservative.

The duration of impacts to fishery and wildlife resources are defined as short-term-impacts of less than 10 years (approximately the life-of-mine for most expansion alternatives), and long-term impacts greater than 10 years.

Categorization of impact direction and levels for fisheries and wildlife are based on the following:

- NI - Negligible Impact

- Low - Exceeds criteria specifically established for low impacts; impact has more than negligible effects.

- Moderate - Exceeds criteria specifically established for moderate impacts; impact has less than high/significant effects.

- High - Exceeds significance criteria established for high impacts; is considered a significant impact.

- Beneficial - Impacts that improve the resource beyond 1979 baseline conditions

- Negative - Impacts that further reduce the value of the resource below 1979 baseline conditions or maintain conditions at less than baseline conditions

4.5.2 Impacts from Mining, 1979 to Present

The Zortman and Landusky mining sites in the Little Rocky Mountains contain seasonal and year long habitats for a number of wildlife species, particularly bighorn sheep, mule deer, various bats and upland game birds. Negative impacts to wildlife have occurred from habitat loss, human and mechanical harassment and wildlife mortality. The primary impact to wildlife from mining at the Zortman and Landusky Mines has been a loss of habitat. Total disturbance at the Zortman and Landusky Mines has been approximately 401 and 817 acres, respectively and 30 acres at clay pits for a total of 1,248 acres. This total includes 54 acres disturbed by historical mining activities.

Approximately 18,500 acres of crucial year-round bighorn sheep habitat is contained in the Little Rocky Mountains. Current mining activities in the Little Rocky Mountains have been estimated to have decreased year long crucial habitat for bighorn sheep by 4 percent (BLM 1992b), and overall wildlife habitat has been reduced 6 percent (Table 4.5-1). This habitat reduction is considered to be a low negative impact.

No federally listed threatened or endangered wildlife species have been documented on the project site prior to, or subsequent to, 1979. Additionally, no critical habitat for threatened or endangered species has been designated to occur within the Little Rocky Mountains by the USFWS. Thus, no threatened or endangered species have occurred or are expected to occur within the immediate vicinity of mining operations within the Little Rocky Mountains, and adverse impacts have not occurred.

Prior to mining at the Zortman and Landusky mines, the only fisheries in the vicinity of the project occurred in Lodgepole, Beaver, and Little Peoples Creek and Rock Creek below the town of Landusky (DSL 1979b). Beaver Creek is outside the area of influence of the Zortman and Landusky mines and has not been impacted by current mining, but some mine exploration has occurred. Lodgepole Creek has been impacted by the diversion of the recharge area since 1979; however, the resultant decrease in flow has been negligible (see Section 4.2.2). King Creek has also experienced a small amount of flow diversion since 1979.

Accidental spills of cyanide solution, which are described subsequently in Section 4.14.4, impacted surface waters in Alder, Ruby, Mill, and Montana Gulches at various times between 1982 and 1994. Cyanide levels in these streams exceeded the state chronic aquatic life standard as a result. No information on actual loss of aquatic or terrestrial wildlife that may have occurred due to these spills is available.

Rock Creek has been impacted at surface water station L-2 and has experienced a slight increase in sulfates and cyanide; however arsenic has decreased from pre-mine levels (Table 3.2-18). These chemical concentrations are not elevated above acute or chronic levels detrimental to aquatic life.

Mining activity can result in high sediment loads which can smother bottom dwelling aquatic macroinvertebrates and destroy their habitat. As described in Section 3.5.9, overall low total macroinvertebrate numbers, low diversity of taxa, and an abundance of pollution-tolerant organisms are reflective of natural perturbation and previous mining activity. Montana Gulch, which flows into Rock Creek, was heavily impacted prior to 1979. Changes in water flows, degraded water quality, and reduced availability of water sources within mined areas have impacted aquatic macroinvertebrates and water supplies for terrestrial wildlife, both within and downstream of existing mine operations.

Wildlife mortality from all mine-related activities (vehicle collision, cyanide poisoning) recorded by ZMI since 1979 has been relatively minor; however, concerted efforts to document mortality were not initiated until 1990. Wildlife mortality records from mine process ponds are summarized below:

YEAR	NUMBER	SPECIES
1982	1	Bighorn Sheep
1991	1	Mule Deer
	30	Sea Gulls
	4	Mallards
1992	2	Mule Deer
1993	0	—
1994	6	Eared Grebe

Mortality of migratory birds in process ponds and cyanide solutions can be a violation of the Migratory Bird Treaty Act and result in large fines and legal action. Bats and birds often die ¼-½ mile from the poisoning source; therefore, it is difficult to assess mortality of highly mobile species such as bats and birds that may be associated with process ponds.

As a result of the loss of 30 sea gulls in a barren solution pond at the Zortman plant site, bird netting was installed above all process ponds at both the Zortman and Landusky mines. Prior to 1991, avian mortality is reported to have not been a problem at either mine (Miller 1991).

Wildlife mortality from mine-related traffic has not been recorded at either the Zortman or Landusky mines; however, collisions with wildlife often go unreported. Wildlife may be fatally injured and crawl away from the road, large carnivores may drag carcasses away from roadsides, and roadkills may simply be tossed to the roadside without documentation. Although wildlife has undoubtedly been killed by mine-related vehicles, impacts are considered low negative.

A 1978 survey of Azure Cave found 530 hibernating bats (Chester et al. 1979). A survey of the cave in March

TABLE 4.5-1
SUMMARY AND COMPARISON OF IMPACTS
WILDLIFE AND FISHERIES

		IMPACTS								
		Special	Nesting	Habitat lost	Residual		Wildlife Mortality			Reclamation
Alternative	Duration[2]	Status spp.[1]	Raptors	or Disturbed	Water Quality	Sedimentation	Solution	Collisions	Noise	Effectiveness
1979 to Present		NI	NI	1,248 acres	H -	H -	L -	L-	NI	H -
	S-T	NI	NI		M -	H -	NI	L-	NI	L +
1	L-T	NI	NI	1,248 acres	M -	M -	NI	NI	NI	H -
	S-T	NI	NI		M -	H -	NI	L -	NI	L +
2	L-T	NI	NI	1,257 acres	M -	M -	NI	NI	NI	H-
	S-T	NI	NI		NI	H -	NI	M -	NI	M+
3	L-T	NI	NI	1,498 acres	NI	L -	NI	NI	NI	NI
	S-T	L-	NI		M -	H -	L-	M -	NI	M+
4	L-T	L-	NI	2,212 acres	M-	M -	NI	NI	NI	M -
	S-T	L-	NI		M -	H -	NI	M -	NI	M+
5	L-T	L-	NI	2,282 acres	M -	M-	NI	NI	NI	M -
	S-T	L-	NI		M -	H -	NI	M -	NI	M+
6	L-T	L-	NI	2,431 acres	M -	M-	NI	NI	NI	M -
	S-T	L-	NI		L -/NI	H -	NI	M -	NI	M+
7	L-T	L-	NI	2,064 acres	L -/NI	L -	NI	NI	NI	NI

[1] Threatened, endangered, federal candidate and special status species are combined into special status species for this summary table.

[2] S-T = Short-term; L-T = Long-term

NI = Negligible Impact (Adverse or Beneficial)

L = Low Impact

M = Moderate Impact

H = High (Significant) Impact

\+ = Beneficial Impact

\- = Negative Impact

1993 found approximately 250-300 hibernating bats (Butts 1993). This apparent decline in bat numbers could be related to discrepancies in counting methods, the extent of the cave area surveyed, or other factors; however, habitat loss or disturbance may be contributing to the actual decline (Taylor 1994). Similar declines in bat populations have been documented in a number of bat species nationwide. The most common reasons cited are loss of secure roosting sites through cave destruction, unplanned recreational use of caves, abandoned mine closures, loss of late seral stage forest as roosting sites, and loss of foraging habitat (Tuttle and Taylor in press).

4.5.3 Impacts from Alternative 1

Under the No Action Alternative, ZMI would continue activities already permitted at both the Zortman and Landusky mines with improved water capture and treatment measures. Over the short-term (i.e., over the life of the mine under this alternative), adverse impacts to fisheries and wildlife would be direct habitat loss and indirect impacts from traffic and noise. Evaluations of impacts for each alternative are presented in Table 4.5-1.

Habitat Loss

No direct loss of wildlife habitat beyond the existing permitted acreage at the Zortman Mine would occur under Alternative 1.

Soil at the current Carter Butte land application area has been loaded to nearly maximum metal contents from past emergency land application disposal. A 205 acre emergency land application area (LAD) has been proposed for the Goslin Flats. Thus, Alternative 1 has the potential to temporarily disturb an additional 205 acres of wildlife habitat (primarily grassland) in addition to the 401 acres previously disturbed by the existing Zortman mining operations. Disturbance at the LAD area would be of short duration during emergency disposal operations and would not preclude wildlife use or result in any significant short-term or long-term habitat loss. A 200 foot buffer would be maintained around any drainages or wetlands. Thus, short-term loss of habitat would remain at 1,248 acres or 6 percent from pre-1979 conditions (Table 4.5-2). This would result in a low negative impact. Long-term impacts based on the success of reclamation at re-establishing wildlife habitat are discussed under reclamation. Long-term habitat loss would not be significant.

No habitat disturbance beyond currently permitted activities would occur at the Landusky Mine.

Wildlife Mortality

Wildlife mortality from process ponds would be negligible under Alternative 1. All process ponds at the Zortman and Landusky mines have been covered with bird netting and are enclosed by fencing, effectively eliminating wildlife mortality.

Water catchment ponds at Ruby, Alder and Carter Gulches currently catch seepage and capture water and pump it to the Zortman water treatment plant. Capture ponds at the Landusky Mine include Sullivan Park, Mill Gulch, and the 85/86 contingency pond. Water temporarily stored in these ponds contains acid rock drainage with high metals concentrations that could adversely affect wildlife drinking from these ponds. Capture ponds would remain unfenced under Alternative 1 and potentially attract wildlife.

Collisions with trucks would be a potential source of wildlife mortality. Current levels of wildlife mortality from vehicle collisions are considered low negative. Approximately 275 truck haul trips per year would occur at the Zortman Mine under Alternative 1 and between 400 and 1,775 round trips by trucks per year would occur at the Landusky Mine. Based on these estimates of traffic, wildlife mortality would initially remain at current levels, then decrease below current levels through the year 2000. Haul traffic would occur for approximately 5 years, resulting in short-term low negative impacts.

Long-term impacts from wildlife-vehicle collisions would decrease to pre-mine levels, because haul truck traffic would diminish and virtually cease after completion of final reclamation, as no mining would occur in the foreseeable future.

Noise

No haul trucks would be needed to haul clay from the Seaford clay pit to the Zortman Mine under Alternative 1, and noise impacts to bats hibernating in Azure Cave would not occur. Mine and reclamation activities under this alternative (including Goslin Flats land application) would be more than one mile from Azure Cave, and cumulative noise would be 55 dBA or roughly the noise produced in a low density urban residential area (Table 4.9-2). Considering that the bats are inside a cave which further attenuates sound and greatly reduces noise levels, this level of noise would not likely impact bats at Azure Cave (Taylor 1994).

TABLE 4.5-2
WILDLIFE HABITAT LOSS BY ALTERNATIVE
Short-Term (Life of Mine) Habitat Loss in Acres

	Zortman			Landusky			Total			Acres	% Habitat Loss		
Alternative	Existing	New	Total	Existing	New	Total	Existing	New	Total	Available *	Existing	New	Total
1	405	0	405	843	0	843	1248	0	1248	20480	6%	0%	6%
2	405	3	408	843	6	849	1248	9	1257	20480	6%	0%	6%
3	405	250	655	843	0	843	1248	250	1498	20480	6%	1%	7%
4	405	891	1296	843	73	916	1248	964	2212	20480	6%	5%	11%
5	405	952	1357	843	82	925	1248	1034	2282	20480	6%	5%	11%
6	405	1101	1506	843	82	925	1248	1183	2431	20480	6%	6%	12%
7	405	753	1158	843	63	906	1248	816	2064	20480	6%	4%	10%

* = Total Acres of Habitat in the Little Rocky Mountains Evaluated by Scow (1979)

Nesting Raptors

Raptor surveys were conducted in all permitted areas prior to initiation of mining activity in 1978 and prior to subsequent amendments to mining permits (Farmer 1994). The most recent survey for nesting raptors was conducted in spring 1990. No breeding raptors or potential habitat have been located in or near existing permitted areas, and impacts to raptors would be negligible (Table 4.5-1).

Special Status Species

There are no known occurrences of, or potential habitat for bald eagle, peregrine falcon, piping plover, or black-footed ferret in the project vicinity under Alternative 1. Most federal candidate species and state species of special interest or concern including Mountain Plover, would not be impacted by any alternative, because many of these species inhabit open grassland prairie and would not be expected to occur at the mine sites.

The northern goshawk could occur in forested areas in the Little Rocky Mountains; however, nesting raptor surveys conducted prior to mining found no raptor nests of any kind. One adult goshawk was observed in Mill Gulch in October 1985, but the bird was probably a non-resident or migrant, because surveys in the same vicinity during the breeding season did not locate any nests or breeding goshawks (Farmer 1994). A single goshawk nest has been recorded approximately 1.5 miles north of the project site.

Several candidate bat species (western big-eared bat, long-eared myotis, western small-footed myotis, and the long-legged myotis) are known to hibernate in Azure Cave. Hibernating bats would not be impacted by Alterative 1; however, some or all of these species would likely occur in the Little Rocky Mountains during summer breeding or migration. Important known habitats for bats include caves, cliffs, crevasses, riparian areas, late seral forest, and abandoned mines (Taylor 1994). Alternative 1 would not impact any important bat habitat and would have negligible impacts to bats.

Residual Water Quality

Most streams in the vicinity of the Zortman and Landusky mines are ephemeral and do not support fisheries. The only streams to support fish previous to mining were Lodgepole, Beaver, Little Peoples Creek, and Rock Creek (below Landusky). Indirect impacts of residual water quality and sedimentation on downstream biota or on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Tables 4.2-1 and 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered moderate negative under Alternative 1, and sedimentation impacts are considered high negative in the short-term to moderate or high negative in the longer term. This is primarily due to the limited new disturbance and use of the water capture and treatment measures but with expected continued ARD generation, seepage, and sedimentation from failed reclamation activities. (See Table 4.4-5 for more details.)

Bats potentially occurring in the area could ingest large quantities of water contaminated by acid rock drainage containing elevated metals. Bats must drink every night during the breeding season and may drink up to a third of their weight in water. Reclamation under Alternative 1 would not adequately control acid rock drainage, and this alternative would continue to produce water in seepage and catchment ponds that could be detrimental to bats and other wildlife. Impacts of residual water quality on bats are rated moderate (Table 4.5-1).

Reclamation

Based on analysis of vegetation impacts presented in Section 4.4.3, no new direct impacts to vegetation or wildlife habitat would occur under Alternative 1. However, indirect impacts to vegetation and subsequently wildlife habitat would result from inadequate reclamation of existing disturbance. Over the short-term, wildlife forage would become established and habitat would begin to develop in most areas, particularly as pre-mine lodgepole pine forests are replaced with reclamation seed mixes containing forage species for wildlife. Over the long-term, low revegetation success would result in a lack of cover from steep slopes, erosion, inadequate plant growth media, and acid rock drainage. This failed revegetation would result in high negative long-term impacts on the re-establishment of wildlife habitat.

4.5.3.1 Cumulative Impacts

Cumulative impacts from Alternative 1 include:

- 54 acres of disturbance from historical mining activities prior to 1978.
- 1,194 acres of habitat removed due to mining activities between 1979 and the present.
- Continued acid rock drainage and degraded water quality above the water capture and treatment facilities.
- No new disturbance.
- No foreseeable future actions.

Past and present mining activities have directly impacted approximately 1,248 acres of wildlife foraging, breeding, resting and hiding areas, resulting in a 6 percent loss in overall wildlife habitat in the Little Rocky Mountains. Assuming short-term success of revegetation efforts, short term impacts would be minimized as wildlife forage becomes established. However, assuming long-term failure of reclamation would have high negative impacts due to lack of adequate cover, cumulative impacts to wildlife, downstream fisheries, and aquatic macroinvertebrates would continue from acid rock drainage. Long-term cumulative impacts to aquatics and wildlife are rated high negative because of revegetation failure and continued acid rock drainage exposure to wildlife, and aquatic macroinvertebrates.

4.5.3.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts to aquatics and wildlife under Alternative 1 would be long-term and consist of habitat lost from existing mining plus reduced quality of habitat from failed revegetation over time. Continued acid rock drainage to seepage and catchment ponds could be detrimental to bats, macroinvertebrates and other wildlife that inhabit or drink from these ponds.

4.5.3.3 Short-term Use/Long-term Productivity

Short-term use and long-term productivity of aquatic macroinvertebrates and wildlife would be impacted under this alternative. Establishment of vegetation would be less effective because of shallow soil depths and steep, long slopes. Degradation of vegetation and habitat from acid rock drainage would continue into the foreseeable future. Current reclamation has not been effective at controlling acid rock drainage. Reclamation under this alternative would not be protective of the environment and would not be effective at controlling acid rock drainage and subsequent impacts to aquatic macroinvertebrates and wildlife. Comparable stability and utility in the reclaimed landscape would not be achieved.

4.5.3.4 Irreversible or Irretrievable Resource Commitments

The majority of the 1,248 acres of wildlife habitat that has been lost would be at risk of not being reclaimed adequately under this alternative. This would result in a long-term loss of habitat and is considered irretrievable and irreversible for any area that does not regain adequate cover (see Section 4.4). Under Alternative 1, lack of adequate reclamation is expected to have high negative effects on revegetation success and, therefore, wildlife habitat.

4.5.4 Impacts from Alternative 2

Under this alternative, ZMI would continue already permitted activities at both the Zortman and Landusky mines. The reclamation plans would be revised, as proposed by ZMI, to better control sources of contamination and treatment of acid rock drainage. The water capture and treatment measures would continue, as required for all alternatives.

4.5.4.1 Impacts

Impacts to aquatics and wildlife under Alternative 2 would generally be similar to impacts under Alternative 1. Impacts to wildlife habitat, noise, nesting raptors and special status species would be the same as Alternative 1. Major differences in impacts between Alternatives 1 and 2 would be associated with a slight increase in reclamation activities, which would lower impacts from revegetation failure, and increased truck traffic hauling reclamation materials. Evaluation of impacts for each alternative is presented in Table 4.5-1.

Negative impacts to wildlife and aquatics related to Alternative 2 would include increased wildlife disturbance and mortality from traffic associated with the Williams and Seaford clay pits.

Wildlife Mortality

Based on traffic estimates presented in Section 4.11, between 1,600-2,000 haul truck round trips (both reclamation and hazardous materials) per year would be needed at the Zortman Mine, and between 2,500 and 5,500 haul truck round trips per year would be needed at the Landusky Mine. Clay would be hauled approximately 7 miles through grassland and disturbed habitat along Ruby Gulch. The haul routes would travel through summer and year-round habitat for mule deer and antelope. Clay would be hauled to the Landusky Mine approximately 2 miles from the Williams clay pit and travel through grassland and forest habitats that support mule deer and bighorn sheep. Increased traffic increases the potential of wildlife mortality caused by vehicle collision. Traffic and associated wildlife mortality would increase during the first 5 years, then decrease in the final 3 years of implementation of Alternative 2. Haul traffic would occur for approximately 3 years at the Zortman Mine and 8 years at the Landusky Mine. Considering the low levels of existing wildlife mortality, a potential short-term increase in mortality would be a low negative impact to wildlife populations.

Wildlife mortality from vehicle collisions under this alternative would decrease over the long-term as mine operations and closure activities end, eventually reaching levels comparable to pre-mining conditions.

Residual Water Quality
Residual water quality impacts would be similar to those described for Alternative 1. Most streams in the vicinity of the Zortman and Landusky mines are ephemeral and do not support a fishery. Indirect impacts of residual water quality and sedimentation on downstream biota or on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Tables 4.2-1 and 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered moderate negative under Alternative 2, and sedimentation impacts are ranked high negative in the short-term to moderate negative, in the longer term. This is primarily due to the limited disturbance and use of the water capture and treatment measures, but with expected continued ARD generation, seepage, and sedimentation from failed reclamation activities.

Reclamation
Based on analysis of vegetation impacts presented in Section 4.4.4, no new direct impacts to vegetation or wildlife habitat would occur.

Indirect impacts to wildlife aquatics associated with reclamation success would be similar under Alternatives 1 and 2. Reclamation slopes would continue to be 1H:1V at mine pits. Other facilities (i.e. heap leach pads) would be graded to 2.5H:1V or 3H:1V where possible, resulting in improved potential for establishment of wildlife forage over the short-term. However, over the long-term, as discussed in Section 4.3.3, the clay cover is not expected to withstand weathering and erosion, and vegetation would penetrate the clay and be exposed to the acidified substrate. The relatively high level of revegetation failure expected (see Section 4.4.4) would result in limited success of re-establishing bighorn sheep and other wildlife habitat. Reclamation under Alternative 2 would not adequately control acid rock drainage, which would continue to produce water in seepage and catchment ponds that could be detrimental to bats and other wildlife. Because of long-term continued acid rock drainage and reclamation failure, long-term impact to wildlife and aquatics associated with reclamation success is rated high negative.

4.5.4.2 Cumulative Impacts

Cumulative impacts under Alternative 2 from past and present mining and RFDs would be the same as those described for Alternative 1 in Section 4.5.3.1, but would include increased mine-related traffic and potential wildlife-vehicle collisions. Potential wildlife mortality, while increased, would result in negligible impacts. The level of reclamation failure expected over the long-term would result in high negative cumulative impacts to wildlife and aquatics. Nine additional acres would be disturbed at the clay pits for a total of 1,257 acres.

4.5.4.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as discussed in Alternative 1.

4.5.4.4 Short-term Use/Long-term Productivity

Short-term use of reclaimed areas by wildlife would improve over Alternative 1. Long-term productivity of wildlife and aquatics under this alternative would be about the same as discussed for Alternative 1.

4.5.4.5 Irreversible or Irretrievable Resource Commitments

A large percentage of the 1,257 acres of wildlife habitat that have been disturbed from pre-1979 conditions would be at risk of not being reclaimed adequately under Alternative 2. This would result in a long-term loss of habitat and is considered irretrievable and irreversible for any area that fails to regain adequate vegetative cover. Under Alternative 2, lack of adequate reclamation is expected to have high negative impacts on revegetation success and, therefore, wildlife habitat.

4.5.5 Impacts from Alternative 3

Under this alternative, ZMI would continue already permitted activities at both the Zortman and Landusky mines. Additionally, more rigorous reclamation plans would be implemented to control acid rock drainage, and water capture and treatment measures would be implemented. The emphasis of reclamation in Alternative 3, as opposed to the previous "No Expansion" Alternatives 1 and 2, is on source control of ARD. Reclamation covers under this alternative are expected to be more effective than the reclamation covers used for Alternatives 1 and 2. Existing facilities would also be reclaimed to a 3H:1V slope, with constructed benches for erosion control. Cover soil material for reclamation would come from a 250 acre soil borrow area at Goslin Flats.

4.5.5.1 Impacts

Impacts to nesting raptors and special status species would generally be the same as Alternatives 1 and 2. Major difference in impacts from Alternative 3 would be associated with the increased level of reclamation and, as a result, increased haul traffic. Long-term adverse impacts to aquatic macroinvertebrates and wildlife habitat would be reduced under Alternative 3 because of the expected reclamation success (Table 4.5-1). These reduced impacts would result from a further reduction in the potential for from:

- Use of the water balance reclamation cover that would inhibit acidic materials from contacting the cover soil, impacting vegetative growth, and damaging wildlife forage and habitat.

- Improved potential for the establishment of vegetation and wildlife forage on reduced slopes.

Potential negative impacts to wildlife could result from:

- Indirect wildlife mortality from increased reclamation haul traffic.

- Water catchment facilities containing high metals and acid rock drainage concentrations that could attract and potentially contaminate wildlife. (However, given the improved reclamation, the potential for this impact to occur is much less under Alternative 3.)

- Use of Goslin Flats as a soil borrow area, resulting in habitat loss and short-term water quality impacts.

Habitat Loss

Alternative 3 would result in loss of wildlife habitat from 1979 conditions of 659 acres at Zortman Mine and 843 acres at Landusky Mine (Table 4.5-2). Total new disturbance to wildlife habitat would be approximately 250 acres, and would account for an additional 1 percent decrease in overall wildlife habitat. Total loss of wildlife habitat from 1979 baseline conditions would be 1,498 acres, or approximately 7 percent of overall habitat. This level results in a low negative impact.

Wildlife Mortality

Based on traffic estimates provided in Section 4.11, between 7,200 and 9,400 round trips by haul trucks per year would be needed to haul reclamation and hazardous materials to the Zortman Mine.

Reclamation at the Landusky Mine would require an estimated 4,700 to 8,500 round trips by haul trucks per year. This amount of traffic would increase the potential of wildlife mortality caused by vehicle collision during the first 6 years of reclamation and would be a short-term moderate negative impact. Long-term wildlife mortality would return to pre-mine, negligible levels following completion of final reclamation.

Noise

The noise heard at the Azure Cave would increase above background levels due to the activities on Goslin Flats to mine reclamation materials. Cumulative noise impacts at Azure Cave are estimated to be 59 dBA. This level is less than an older urban residential area and about 14 dBA above background. Literature reviews and consultation with BCI found no available information on noise impacts to bats. However, bats are commonly found in urban residential areas, and it is assumed that impacts to Azure Cave bats from noise would be negligible under this alternative.

Residual Water Quality

Most streams in the vicinity of the Zortman and Landusky mines are ephemeral and do not support a fishery. Indirect impacts of residual water quality and sedimentation on downstream biota and on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Tables 4.2-1 and 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered negligible under Alternative 3 and sedimentation impacts are ranked high negative (short-term) to low negative (long-term). These impacts are less than those described for Alternatives 1 and 2. This reflects the improvements in the reclamation cover, plus the benefits of water capture and treatment measures, the limited new disturbance, but also the negative impacts (primarily sedimentation) related to the use of Goslin Flats as a soil borrow area. (See Table 4.4-5 for more details.)

Reclamation

Based on analysis of vegetation impacts presented in Section 4.4.5, direct impacts to vegetation and wildlife habitat would consist of 250 acres of new disturbance at the Goslin Flats borrow area to provide additional reclamation materials. This area would be reclaimed using a topsoil cover and seeding. However, the enhanced water balance and water barrier reclamation covers proposed for the areas previously disturbed at the mines would reduce adverse impacts to vegetation and wildlife habitat in these areas. Reclamation slopes would be lower, resulting in improved forage, vegetation cover and greater success in re-establishing habitat for bighorn sheep and other grassland species of wildlife. This would result in a short-term moderate positive impact over 1979 conditions based on the establishment of forage beneficial to valued wildlife species. Over the long-term, vegetation success is expected to be relatively high, given the expected effectiveness of the reclamation covers. Long-term impacts of reclamation effectiveness on wildlife and aquatic resources are ranked negligible. Taller fencing would be installed around ponds to prevent big game species from accessing contaminated water or process solutions.

4.5.5.2 Cumulative Impacts

Cumulative impacts from Alternative 3 would be less than those described for Alternatives 1 and 2, because enhanced reclamation and restoration reduces long-term impacts to wildlife habitat. Two-hundred fifty acres of existing wildlife habitat would be disturbed at the Goslin Flats soil borrow area. Cumulative impacts are rated negligible overall, since the disturbance at the Goslin Flats soil borrow area would be offset by improved reclamation.

4.5.5.3 Unavoidable Adverse Impacts

The potential for wildlife mortality from haul truck collisions would increase over Alternatives 1 and 2. Over the long-term, wildlife populations would recover and big game would likely increase after final reclamation, assuming a high level of revegetation success, and depending on management of wildlife populations. Impacts to wildlife from ponds containing contaminated water would be reduced over Alternatives 1 and 2, as less seepage would be expected and capture and treatment ponds would be fenced and covered. The Goslin Flats area would be disturbed for use as a soil borrow site.

4.5.5.4 Short-term Use/Long-term Productivity

Short-term use of the reclamation area by wildlife would be greater than under Alternatives 1 or 2. Long-term productivity of wildlife and aquatic resources under this alternative would be greater than under Alternatives 1 and 2. Potential impacts to wildlife and aquatic macroinvertebrates from acid rock drainage and contaminated water would be reduced at the source and by active water treatment. The predicted level of reclamation success significantly increases wildlife forage and habitat reestablishment at the mine sites.Water capture and treatment facilities serve to improve water-related resources in both the short- and long-term.

4.5.5.5 Irreversible or Irretrievable Resource Commitments

There are limited irreversible or irretrievable wildlife or aquatic resource commitments under Alternative 3, less than expected under Alternatives 1 and 2. The relatively high level of reclamation success would result in a small amount of irreversible and irretrievable habitat loss, mostly on mine pit benches. The area in Goslin Flats that is excavated and reclaimed would represent a long-term change in topography in the disturbed areas.

4.5.6 Impacts from Alternative 4

This alternative consists of the Company Proposed Action (CPA) for mine expansion at both the Zortman and Landusky mines, including corrective reclamation measures on existing disturbance. Major activities that impact wildlife and fisheries include: construction of a heap leach pad at Goslin Flats; use of a conveyor for ore transport; removal of some acid generating waste rock dumps and heap leach pads and disposed in the pits; construction of a waste rock repository in Carter Gulch; and developing a limestone source south of Green Mountain. A barrier-type reclamation cover would be used.

4.5.6.1 Impacts

Direct and indirect impacts to wildlife and aquatic resources would occur, including direct loss of habitat, increased wildlife mortality, noise disturbance to hibernating bats, disturbance to nesting raptors and special status species, restricted wildlife movement as a result of the construction of the conveyor, alteration of surface water quality, and limited restoration of wildlife habitat (Table 4.5-1).

Habitat Loss

Alternative 4 would result in loss of wildlife habitat from 1979 conditions of 1,296 acres at the Zortman Mine and 916 acres at the Landusky Mine (Table 4.5-2). Total new disturbance to wildlife habitat would be approximately 891 acres at the Zortman Mine and 73 acres at the Landusky Mine (Table 4.5-2). Total direct removal of vegetation and wildlife habitat from previously undisturbed areas under Alternative 4 would be 964 acres and account for an additional 5 percent decrease in overall wildlife habitat. Total loss of wildlife habitat from 1979 baseline conditions would be 2,212 acres or approximately 11 percent of overall habitat. This level exceeds 10 percent habitat loss and would therefore be a moderate negative impact.

Except for Goslin Flats, most of the vegetation removed would be in lodgepole pine forest, with minor disturbance occurring in ponderosa pine and Douglas fir forest. Forested areas provide thermal and escape cover for big game species, and potential habitat for northern goshawk, but contain little understory or food for foraging wildlife. At Goslin Flats, vegetation that would be removed includes shrub and grassland habitats occasionally used by pronghorn antelope, and vegetated wetlands. Some riparian habitat would also be disturbed where roads, conveyor and power corridors, and other facilities cross or are constructed in riparian areas along drainages. Riparian areas with open water are important summer bat habitat, especially within one mile of roost sites. This would be a low negative impact to bats.

Construction of the conveyor would cause increased short-term disturbance to big game and upland game bird habitats, particularly along Alder Gulch. Use of Carter Gulch as a waste rock repository would disturb high-value white-tailed deer habitat.

At Goslin Flats, a land application area of 285 acres would be used during closure and possibly in emergency situations, resulting in potential periodic disturbance and minor short-term loss of available habitat. A 200 foot buffer would be maintained around any wetlands or drainages.

Restricted Access

Construction of the conveyor from the Zortman Mine to Goslin Flats would result in restricted wildlife access along the proposed route. The conveyor is approximately 12,000 feet long with an elevation drop of about 1,000 feet. The conveyor would originate near the 84 leach pad, travel southeast through Alder Gulch and enter Goslin Flats through the gap just west of Whitcomb Butte (Figure 2.8-1). The abundance of wildlife in general and big game animals is particular is low in this area because of the close proximity of the town of Zortman. A few mule deer occur year round and an occasional white-tailed deer is observed in drainage bottoms. Bighorn sheep in the Little Rocky Mountains are non-migratory; seasonal, short-distance (3-4 miles) movements may occur, primarily west of the proposed conveyor route (Grensten, pers. comm. 1995). These movements occur in a north-south direction. Wildlife studies conducted by WESTECH (1991) found no bighorn sheep in the area of the proposed conveyor. Densities of large ungulates and other wildlife that may be impeded by the conveyor and four-strand fencing are generally low in the area of the proposed conveyor. Specifically, bighorn sheep in the Little Rocky Mountains have acclimated to mining operations and have adopted the existing mine sites as "safe havens" from hunting and poaching. It is estimated that 90+ percent of observations of bighorn sheep occurs west of the proposed conveyor route. Small amounts of bighorn sheep habitat would be fragmented and no corridors would be blocked (Grensten, pers. comm. 1995). Overhead spans of Pony and Alder Gulches by the conveyor would not restrict wildlife access in these two major drainages. However, the constant noise and psychological barrier of crossing open areas would likely restrict movement and access of some individual animals. This would result in a moderate negative impact in that some big game home ranges could become restricted, the effective habitat of the area reduced, and the overall carrying capacity within and near the study site decreased.

Bighorn Sheep

Seasonal observations mapped by WESTECH (1991) indicate that bighorn winter on the southern fringe of the mountain range in an area bounded by Gold Bug Butte, south to Sugar Loaf Butte and east to Saddle Butte. No sheep have been observed, either in summer or winter, east of the proposed conveyor route during wildlife studies from 1977 to 1987 and 1990. Bighorn sheep of the Little Rocky Mountains do not occupy distinct home ranges during any given season. Rather, it appears the sheep move randomly back and forth throughout the entire range with little or no use of habitat west of Montana Gulch or east of Saddle Butte. Because there are no distinct seasonal ranges, sheep have no need to establish distinct travel corridors. Based on information obtained from baseline wildlife studies (WESTECH 1991) and consultation with the BLM biologist for the area, the conveyor belt does not disrupt a bighorn sheep home range, migratory path or travel corridor and results in little to no fragmentation of the habitat.

Wildlife Mortality

Wildlife mortality from process ponds would be low under Alternative 4. All process ponds at the Zortman and Landusky mines would be covered with bird netting (mesh size 1" or less) and enclosed by fencing. These wildlife control methods would effectively preclude most bird and mammal (including bat) mortality at process ponds.

Wildlife mortality from mine-related traffic has not been recorded at either the Zortman or Landusky mines; however, collisions with wildlife often go unreported. Between 4,000 to 11,500 round trips by haul trucks per year would be made at the Zortman and Landusky mines under Alternative 4. These haul trips would traverse year-round mule deer and bighorn sheep habitat. Based on traffic projections provided in Section 4.11, haul traffic would increase significantly above recent levels through year 2003, then decrease to around current levels in years 2004 through 2006. Haul traffic would occur for approximately 12 years.

Wildlife mortality from vehicle collisions have not been a problem at the Zortman/Landusky mines, and big game and other wildlife seem to have acclimated to traffic and mining operations. Potential wildlife mortality under this alternative could occur over the mine life of 12 years. Based on the minimal vehicle-wildlife collisions from existing operations, this is rated a moderate negative short-term impact. Long-term impacts would be negligible as final reclamation is completed and traffic returns to pre-mine levels.

Noise

The conveyor proposed under Alternative 4 would not be expected to directly disturb hibernating bats (Taylor 1994). There may be some indirect effects during sustaining (buildup of fat and energy reserves prior to hibernating), foraging, or fall arrival of bats. Attenuation with distance at Azure Cave yields noise levels from the conveyor well below background levels, effectively eliminating audible sound from the conveyor at the cave. Noise impacts at Azure Cave from mining and reclamation activities (including blasting) would be 66 dBA, or roughly the noise produced in an older to dense urban residential area. This noise level would be further attenuated and greatly reduced by the structure of the cave. Noise from mining and reclamation would be constant and short-term in nature (i.e., life of mine) and is rated as a negligible impact to hibernating bats. No long-term impacts would occur, because noise would virtually cease upon final reclamation.

Nesting Raptors

Based on the results of nesting raptor surveys and element occurrence searches conducted by Montana National Heritage Program, Alternative 4 would not significantly impact nesting raptors.

Special Status Species

There are no known federally listed threatened or endangered wildlife species in the areas proposed for disturbance; however, potential nesting habitat for peregrine falcons exists approximately 2 miles west of the proposed Goslin Flats leach pad. Consultation with the Montana Natural Heritage Program (1992) and Montana Fish, Wildlife, and Parks (Flath, Pers. Comm. w/R. Beane) revealed that the closest occurrence of piping plover is more than 50 miles away at Fort Bowdoin National Wildlife Refuge.

There are no known occurrences of, or potential habitat for bald eagle, peregrine falcon, piping plover, or black-footed ferret in the project vicinity under Alternative 4; therefore, there would be no impacts to endangered species.

The northern goshawk could occur in forested areas in the Little Rocky Mountains; however, nesting raptor surveys conducted prior to mining found no raptor nests of any kind. One adult goshawk was observed in Mill Gulch in October 1985, but the bird was probably a non-resident or migrant because surveys in the same vicinity during the breeding season did not locate any nests or breeding goshawks (Farmer 1994). A single goshawk nest has been recorded approximately 1.5 miles north of the project site. No northern goshawks would be impacted by Alternative 4.

Several candidate bat species (Townsend's big-eared bat, long-eared myotis, western small-footed myotis, and the long-legged myotis) are known to hibernate in Azure Cave. Hibernating bats would not be directly impacted by Alternative 4 through either habitat disturbance or noise from crushing and conveyor activities. Little specific information is known regarding the summer ranges and foraging habitat of the bat species hibernating in Azure Cave. However, some or all of these bat species would likely occur in the Little Rocky Mountains during summer breeding or migration. Important habitats for bats include riparian areas, late seral forest, and abandoned mines (Taylor 1994). This alternative would impact approximately 10 acres of aspen riparian habitat along the conveyor route that likely supports bats. Because of the small area of disturbance, few bats would be impacted by disturbance to riparian habitat under Alternative 4. However, it should be noted that one aspen snag can house 75 or more bats in summer. No baseline data are currently available on the occurrence and distribution of breeding bats within the project area outside of Azure Cave. Impacts to sensitive bat species under Alternative 4 are rated as low negative, based on the conservative assumption that the 10 acres of disturbed riparian habitat contains at least one snag potentially providing habitat for 75 or more bats in summer.

This alternative places a large number of lights along the conveyor route and near the ore processing facilities that would attract insects and subsequently breeding bats. This could provide beneficial feeding conditions for the bats, assuming process ponds are adequately netted to prevent bats from drinking contaminated water.

The two bodies of standing water closest to Azure Cave would be removed under Alternative 4. A field reconnaissance conducted in December 1995, of potential water sources for bats and other wildlife in the vicinity of Azure Cave found a minimum of four other stock ponds within 2 miles of the cave (Grensten Pers. Comm. 1995). Additionally, running water was found in at least three stretches of Grouse Creek that would likely be available throughout the summer. Most of the bat species known to hibernate at Azure Cave typically glean their prey from vegetation or forage within tree canopies and do not require open water for foraging.

Loss of these stock ponds would be mitigated by creating a new pond located in Upper Goslin Gulch north of the cave. This pond would be closer to Azure Cave, would be totally or partially inundated from February through November (ZMI 1996) and further from mining operations and process ponds. Although the pond in Upper Goslin Gulch is smaller than the original two stock ponds (0.39 acres compared to .75 acres) the long term reliability of water in Goslin Gulch would benefit breeding bats. Additional open water and wetland areas will be created in Ruby Creek Tributary (ZMI 1996 - 404 permit). Although these wetland areas are not direct mitigation for bats, any open water would be beneficial to breeding bats in the area. Consultation with a bat expert from Bat Conservation International, indicates that newly constructed water ponds can provide a suitable water source for breeding bats (Taylor, Nov. 28, 1995). In fact, by providing a more consistent source of drinking water and designing the pond to benefit all bats (i.e., Townsend's big-eared bat requires relatively large areas of open water), the result of this mitigation could be very beneficial to bats and all wildlife. Information on the size, water source, and permanence of water is provided in the Zortman-Landusky 404 permit application (ZMI 1995; see also Appendix B). Based on the proposed mitigation pond and presence of other stock ponds in the area, the loss of the two stock ponds is not considered a significant impact.

The overall short-term and long-term impact rating of Alternative 4 on special status species is low negative.

Reptiles and Amphibians

Very few reptiles and amphibians have been observed within the study area, both prior to mining and in wildlife monitoring studies since 1977. This indicates a general low abundance of reptiles and amphibians in the study area. The EIS prepared for the original proposed plan of operations for the Landusky and Zortman mine (DSL 1979) postulated that species with low mobility or small home ranges, such as reptiles and amphibians would decline because of habitat loss and direct or indirect mortality (e.g., degraded water quality). Because these species are common to the Little Rocky Mountains, and because so little of their total habitat would be disturbed, the overall loss to the population in the Little Rocky Mountains would be insignificant. The 1979 analysis is relevant to the present analysis of impacts to reptiles and amphibians, since the species are the same and no threatened, endangered or other special status species are known to occur.

Residual Water Quality

Most streams in the vicinity of the Zortman and Landusky mines are ephemeral and do not support a fishery. Indirect impacts of residual water quality and sedimentation on downstream biota or on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Tables 4.2-1 and 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered moderate negative short-term and long-term, however, water quality would improve some over the long-term due to water capture and treatment and moderate reclamation success. Sedimentation impacts are ranked high negative for the short-term, and moderate negative over the long-term. This reflects impacts related to the increased disturbance of land, the moderate success predicted for the reclamation cover, coupled with the beneficial effects of the water capture and treatment measures (see Table 4.4-5 for more details).

Reclamation

The ability of reclamation to provide wildlife forage would improve in the short-term. Reclamation slopes of 2H:1V would be reduced to 3H:1V where topography will allow. This would result in improved vegetation cover and greater success in re-establishing bighorn sheep and other valued wildlife habitat.

Limiting habitat for bighorn sheep and other wildlife such as sage grouse in the Little Rocky Mountains is open grassy areas on south facing slopes. Removal of lodgepole pine forest through mining and reclamation of mine facilities and the conveyor corridors to produce open grassy areas would benefit grassland or edge species of wildlife. The ability of reclamation under Alternative 4 to provide wildlife forage would be moderate positive.

As discussed in the analysis of vegetation impacts presented in Section 4.4.6, over the long-term reclamation success is expected to be relatively moderate. Infiltration and eventual acid rock drainage could continue to create moderate negative long-term impacts on the reestablishment of aquatic macroinvertebrate and wildlife habitat. Succession and forest regeneration would revert to the original habitat. Seepage and catchment ponds under this alternative would continue to be unfenced and could be detrimental to bats and other wildlife.

4.5.6.2 Cumulative Impacts

Cumulative impacts from Alternative 4 include:

- 54 acres of disturbance from historical mining activities prior to 1978.
- 1,194 acres of habitat removed due to mining activities between 1979 and the present.
- 964 acres of new disturbance to wildlife habitat.
- Restricted access and reduced effective wildlife habitat caused by the conveyor in the short-term.
- Continued acid rock drainage and continued water treatment associated with a moderate level of long-term reclamation failure.
- Degradation of water and reduced flows due to mining activities, coupled with improvement of water quality due to the Water Quality Improvement Plan and other actions.
- A proposed 69 kv powerline from Malta would run parallel to Highway 191 and end at Goslin Flats.
- Reasonably foreseeable mining at the Pony Gulch deposit in the future, 128 acres of potential exploration disturbance and potential use of the LS-2 and Montana Gulch limestone quarry.

Additional direct and indirect disturbance of potential aquatic macroinvertebrates, and wildlife would occur from reasonably foreseeable developments under Alternative 4. Impacts associated with exploration, such as additional roads, would likely be minor; however, loss of habitat and short-term disturbance would occur, primarily from the roads. Total cumulative acres of habitat disturbed would include the 2,212 acres disturbed by Alternative 4, 128 acres of potential exploration disturbance, 13.5 acres of Pony Gulch development and approximately 24 acres of limestone quarries, for a total of 2,378 acres of disturbance or 11.5 percent of habitat available in the Little Rocky Mountains. Primary impacts of exploration may be disturbance to hibernating bats at Azure Cave and aspen riparian habitats along Pony and Alder Gulches.

Potential impacts would be greatest from future mining in Pony Gulch (new expansion needed for 2 million tons). The 2 million ton, Pony Gulch deposit is located approximately ½ mile from Azure Cave. Under the reasonably foreseeable development scenarios for Alternatives 4, 6, and 7, blasting could occur at Pony Gulch, approximately 4,000 feet from Azure Cave. Evaluation of mine blasting using Particle Velocity versus Square Root Scale Distance equations indicated that blasting associated with alternatives 4 through 7 would not create noticeable vibration at Azure Cave (W-C 1995). Blasting would produce vibration barely perceptible by humans. Variables used in calculations included:

Average number of holes per blast - 500
Average number of shots per week - 2.5
Number of holes shot per delay - 20
Pounds of explosives shot per delay - 5,000 lbs ANFO
Delay period - 100 msec between delays

Based on these calculations, vibration from blasting under all alternatives would be too low to cause any disturbance to hibernating bats.

Mining activity that includes blasting, large machinery and ore crushing operations within ½ mile could create a noise impact on bats hibernating in Azure Cave (Taylor 1994). However, analysis of noise impacts estimate a level of 66 dBA at Azure Cave from mining operations in Pony Gulch not accounting for screening and attenuation by vegetation and topography. Literature reviews and consultation with BCI found no available information on noise impacts to bats. The 66 dBA (cumulative noise) compares to noise levels of an older to dense urban residential area where bats are commonly found and no significant impact is anticipated. Noise would be further attenuated by an intervening hill and Lodgepole pine forest. This deposit in Pony Gulch would be mined and reclaimed within an approximately 2 year time frame, further reducing the chances of long-term impacts to bats in Azure Cave. However, once disturbed, bat populations may not return to the cave as individuals would forced into other areas in the 2-year period which may be less suitable habitat and would result in death due to exposure or other causes. The intervening mortality may prevent recolonization of the cave completely or reduce the population to such low levels that they cannot recover due to loss of genetic variation, inbreeding, susceptibility to environmental stochasticity or inability to find suitable mates.

Past and present mining activities have directly impacted 1,248 acres of wildlife foraging, breeding, resting and hiding areas. Proposed disturbance under Alternative 4 would impact 964 acres of wildlife habitat for a total disturbance of about 2,212 acres or 11 percent of available habitat in the Little Rocky Mountains. Assuming a moderate level of reclamation success and the establishment of grassland areas beneficial to wildlife, cumulative impacts to wildlife habitat are rated low negative. The powerline would be located in grassland habitat and be designed according to industry standards to avoid raptor electrocution. This powerline would create only a negligible disturbance to wildlife habitat during construction.

Cumulative impacts of residual water quality on aquatic macroinvertebrates, post reclamation, are rated moderate negative, based on predicted metals concentrations in downstream waters (see Table 4.2-1). After water capture and treatment, metals concentrations in Montana Gulch would be greatly reduced from existing conditions. This would result in improvements in aquatic macroinvertebrate habitat and create conditions conducive to the recovery of populations of macroinvertebrates in Montana Gulch, which is currently nearly devoid of organisms (WESTECH 1991).

The cumulative effects of noise, vibration, and habitat loss, particularly in riparian and mature Douglas fir along Alder, Carter, and Pony Gulches combined with habitat previously lost due to historic and existing mining could adversely impact summer breeding bats by directly removing breeding and foraging habitat or causing bats to avoid the area.

Cumulative impacts of past and present mining and reasonably feasible developments on increased mortality to wildlife would be short-term and considered low negative. Mortality from process facilities and vehicle collisions have been minor in the past and are expected to remain minor or have been mitigated with netting and fencing of process ponds (would be changed into grassy slopes planted with trees that would benefit bighorn sheep and other wildlife (BLM 1992a). Impacts from Alternative 4 would be greater than impacts from Alternatives 1-3, because of the additional acres of disturbance. However, assuming a moderate reclamation success, comparable stability and utility of wildlife resources would be achieved in the post-mine landscape. Water capture and treatment would reduce metals concentrations in Montana Gulch and create conditions conducive to macroinvertebrate recovery. Decreased flows in numerous gulches and tributaries would be offset by increased flows in Montana and Ruby Gulches.

4.5.6.5 Irreversible or Irretrievable Resource Commitments

There are limited irreversible or irretrievable wildlife or aquatic resource commitments under Alternative 4. Habitat lost during mining activities can be reclaimed and replaced during reclamation activities. Displaced wildlife populations would recolonize reclaimed areas and creation of open grassy habitats would benefit big game, grouse and other wildlife that may be limited by the lack of open meadows and grassland forage in the Little Rocky Mountains in the short-term. As planted trees grow, habitat would return to forested canopy in 70-80 years. The areas not successfully reclaimed would be mostly mine pit benches and some steep, long slopes.

4.5.7 Impacts from Alternative 5

Alternative 5 includes expansion of both the Zortman and Landusky mines, with agency-developed mitigation on expansion and reclamation activities and water capture and treatment measures. The major modification under this alternative is the relocation of the Goslin Flats heap leach facility within upper Alder Gulch.

4.5.7.1 Impacts

Impacts to wildlife and aquatic resources under this alternative would be similar to that described for Alternative 4, although somewhat less in magnitude since disturbance would shift from Goslin Flats to lodgepole pine habitat in Alder and Carter Gulches. Impacts would be similar under Alternatives 4 and 5 for nesting raptors, reptiles and amphibians, and special status species. However, disturbance would be greater in riparian areas along Alder Gulch that potentially provide foraging areas for sensitive wildlife species, including bats. Wildlife mortality from process ponds would be reduced from that described for Alternative 4. However, the conveyor would not be constructed, and loss of potential breeding bat habitat in riparian areas would not occur.

Habitat Loss

Alternative 5 would result in loss of wildlife habitat from 1979 conditions of approximately 1,357 acres at the Zortman Mine and 925 acres at the Landusky Mine. Total new disturbance to wildlife habitat would be approximately 952 acres at the Zortman Mine and 82 acres at the Landusky Mine. Total direct removal of vegetation and wildlife habitat from previously undisturbed areas under Alternative 5 would be approximately 1,034 acres.

Habitat loss at the Zortman Mine would occur primarily in forested areas and some riparian habitat in Alder and Carter Gulches. The 1,034 acres occur in year-round deer habitat and account for an additional wildlife habitat loss of 5 percent of available habitat in the Little Rocky Mountains. Total habitat loss from both mines since 1979 would be approximately 2,282 acres and would account for a 11 percent decrease from 1979 conditions. This loss of habitat acreage would be a moderate negative impact to wildlife (Table 4.5-2).

Because no facilities would be located on Goslin Flats, the wetlands and grassland and shrub habitats located there would not be directly disturbed; however, emergency land application could periodically disturb 285 acres at Goslin Flats, and land application would occur at closure, resulting in a short-term loss of available habitat. A 200 foot buffer would be maintained around any drainages or wetlands. However, impacts to high-value white-tailed deer habitat would occur in Alder Gulch from the leach pad and waste rock repository.

Wildlife Mortality

Based on traffic projections provided in Section 4.11, the number of round trips by haul trucks per year would be about the same under Alternatives 4 and 5. These haul trips would traverse year-round mule deer and bighorn sheep habitat. Wildlife mortality from vehicle collisions would be short-term and would increase slightly through year 2007 and essentially cease thereafter. Haul traffic would occur for approximately 12 years. Short-term impacts from wildlife-vehicle collisions are rated moderate negative. Wildlife mortality rates under this alternative would be a negligible long-term impact.

Impacts to wildlife from exposure to process solutions or contaminated capture water would be reduced from that described in Alternative 4. This reduction in impact results from the use of 8-foot high fencing around solution ponds.

Noise

Noise impacts to Azure Cave from mining and reclamation activities under Alternative 5 would be about 56 dBA (Table 4.9-4). This noise level is less than an urban residential area and 11 dBA above background levels of 45 dBA, not accounting for screening and attenuation by vegetation and topography. Literature reviews and consultation with BCI found no available information on noise impacts to bats. The 56 dBA compares to noise levels of an urban residential area where bats are commonly found. Therefore, impacts to Azure Cave bats from noise are rated as negligible.

Residual Water Quality

Most streams in the vicinity of the Zortman and Landusky mines are ephemeral and do not support a fishery. Indirect impacts of residual water quality and sedimentation on downstream biota or on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Table 4.2-1 and Table 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered moderate negative both short-term and long-term. Sedimentation impacts are rated high negative (short-term) to moderate negative (long-term), similar to Alternative 4. This reflects the impacts related to new disturbance (particularly sedimentation), the moderate success predicted for reclamation, coupled with the beneficial effects of the water capture and treatment measures (with some concern about the steepness of the areas and effectiveness of capture). (See Table 4.4-5 for more details.)

Reclamation

The ability of reclamation to provide wildlife forage and habitat would be similar to Alternative 4 with improved short term success of revegetation. Reduced slopes would increase vegetation cover and reduce potential erosion problems. Almost all of the south-facing slopes in the Little Rocky Mountains are covered with lodgepole pine. Through mining and proper reclamation, many of the currently wooded, south facing slopes would be changed into open grassy slopes with small planted trees that would benefit bighorn sheep and other wildlife (BLM 1992a). Over 70-80 years the trees would mature, and forested habitat would return.

As discussed in the analysis of vegetation impacts presented in Section 4.4.7, over the long-term vegetation success is expected to be moderate. Reclamation would fail on long steep slopes over 200 feet in length and mine pit benches. This loss of soil and habitat would create moderate negative long-term impacts on the reestablishment of wildlife and aquatic resources.

4.5.7.2 Cumulative Impacts

Cumulative impacts for wildlife and fisheries would be similar to Alternative 4. Major differences under Alternative 5 include:

- 1,034 acres of new disturbance to wildlife habitat.
- Wildlife access and effective habitat not restricted by the conveyor.
- Past and present mining activities have directly impacted 1,248 acres of wildlife foraging, breeding, resting and hiding areas. Proposed disturbance under Alternative 5 would impact 1,034 acres of wildlife habitat for a total disturbance of about 2,282 acres or 11 percent of available habitat in the Little Rocky Mountains.
- Exploration activities would target mineralized areas near the upper Alder Gulch leach pad impacting primarily lodgepole pine habitats. Pony Gulch potential mining would be limited. Total cumulative acres of habitat disturbed including historical, proposed mining and RFDs would be 2,434 acres or 12 percent of habitat available.
- A proposed 69 kv powerline from Malta would run parallel to Highway 191 and end at Goslin Flats. The powerline would be designed according to industry standards to avoid raptor electrocution and would be located in grassland habitat. The powerline would create only a negligible disturbance to wildlife habitat during construction.
- Overall cumulative impacts rating for Alternative 5 is moderate negative because of water quality impacts to macroinvertebrates, a moderate level of reclamation success, and the total amount for disturbance to wildlife habitat.

4.5.7.3 Unavoidable Adverse Impacts

The potential for wildlife mortality from vehicle collisions would increase 3-4 fold over the life of the mine. Over the long-term wildlife populations would recover and big game populations would recover after mine closure and final reclamation. Assuming a moderate level of reclamation and revegetation success, a small amount of wildlife habitat would not be reclaimed in the long term, especially long steep slopes and mine pit benches.

4.5.7.4 Short-term Use/Long-term Productivity

The short-term use/long-term productivity of Alternative 5 would be similar to Alterative 4 except 1,034 acres rather than 964 acres would be disturbed.

4.5.7.5 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments under Alternative 5 would be similar to those described for Alternative 4. In addition, a relatively large amount of high value riparian habitat would be lost by filling for the leach pad in Alder Gulch.

4.5.8 Impacts from Alternative 6

Alternative 6 includes expansion of both the Zortman and Landusky mines, but with agency-developed mitigations on expansion and reclamation activities and water capture and treatment measures. The major modification to the company proposed mine expansion would relocate the waste rock repository to Ruby Flats, instead of in Carter Gulch. The conveyor used for waste rock and ore transport would be enclosed.

4.5.8.1 Impacts

Impacts to wildlife and aquatic resources under Alternative 6 would be similar to impacts described for Alternative 4. Impacts would be the same under Alternatives 4 and 6 for nesting raptors, bighorn sheep, reptiles and amphibians, and special status species. Wildlife mortality from process ponds would be reduced. Impacts for each alternative are presented in Table 4.5-1.

Habitat Loss

Alternative 6 would result in loss of wildlife habitat from 1979 conditions of approximately 1,506 acres at the Zortman Mine and 925 acres at the Landusky Mine. Total new disturbance to wildlife habitat would be approximately 1,101 acres at the Zortman Mine and 82 acres at the Landusky Mine. Total direct removal of vegetation and wildlife habitat from previously undisturbed areas under Alternative 6 would be approximately 1,183 acres.

Habitat loss at the Zortman Mine would occur primarily in grassland habitat at Goslin Flats and Ruby Flats. The 1,183 acres occur in year-round mule deer/pronghorn habitat and account for an additional wildlife habitat loss of 6 percent of available habitat in the Little Rocky Mountains. Total habitat loss from both mines since 1979 would be approximately 2,431 acres and would account for a 12 percent decrease from 1979 conditions. This loss of habitat exceeds the criterion of 10 percent loss of habitat and would be a moderate negative impact to wildlife. The level of impact from Alternative 6 is approximately the same as Alternative 4; however impacts to deer habitat in Carter Gulch would be less and impacts to grassland wildlife species such as pronghorn would be greater under Alternative 6.

Impacts related to the use of the LAD area in Goslin Flats would be the same as described in Alternative 4.

Wildlife Mortality

Based on traffic projections provided in Section 4.11, approximately 6,000 to 12,100 total round trips by haul trucks per year would be made at the Zortman and Landusky mines under Alternative 6. These haul trips would traverse year-round mule deer and bighorn sheep habitat. Wildlife mortality from vehicle collisions would be short-term and would increase relative to the period of recent mining activity through year 2006. Haul traffic would occur for approximately 12 years then essentially cease thereafter. Long-term wildlife mortality under this alternative would be negligible.

Impacts to wildlife from exposure to process solutions or contaminated capture water would be reduced from that described in Alternative 4. This reduction in impact results from the use of 8-foot high fencing around solution ponds.

Noise

Noise impacts from the conveyor would be similar to Alternative 4. Duration of use of the conveyor would increase because ore and waste rock would be conveyed from the Zortman Mine to Goslin and Ruby Flats.

Noise impacts to Azure Cave from mining and reclamation activities would be 66 dBA, or roughly the noise produced in an older to dense urban residential area (Table 4.9-3). This noise level would be further attenuated by the cave structure and would be a negligible impact to hibernating bats (Taylor 1994).

Residual Water Quality

Most streams in the vicinity of the Zortman and Landusky mines are ephemeral and do not support a fishery. Indirect impacts of residual water quality and sedimentation on downstream biota or on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Tables 4.2-1 and 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered moderate negative both short-term and long-term. Sedimentation impacts are ranked high negative (short-term) to moderate negative (long term), similar to Alternative 4 and 5. This reflects the impacts related to new disturbance (especially sedimentation), the moderate success predicted for the reclamation cover, coupled with the positive effects of the Water Quality Improvement Plan and other actions (see Table 4.4-5 for more details).

Reclamation

The ability of reclamation to provide short-term wildlife forage and long-term wildlife habitat diversity would be similar for Alternatives 4 and 6. Reclamation would result in reduced adverse impacts over the short-term from lower slopes and increased success of vegetation cover. Short-term ability of reclamation to provide wildlife forage would be moderate positive relative to pre-1979 conditions based on the establishment of forage beneficial to valued wildlife species such as bighorn sheep, sage grouse and other grassland species. Over the long-term, vegetation success is expected to be moderate. Reclamation would fail in some areas initially revegetated, mainly on steep, long slopes over 200 feet in length. This failure and continued acid rock drainage results in long-term moderate negative impacts to wildlife and aquatic resources.

4.5.8.2 Cumulative Impacts

Cumulative impacts for wildlife and fisheries would be the same as Alternative 4, including construction of the conveyor and development of reasonably foreseeable ore deposits in Pony Gulch. Major differences would include:

- 1,183 acres of new disturbance to wildlife habitat.
- Increased disturbance to grassland habitat on Ruby Flats.
- No degradation of water quality in Alder Gulch.
- Past and present mining activities have directly impacted 1,248 acres of wildlife foraging, breeding, resting and hiding areas.
- Total cumulative acres of habitat disturbed including historical, proposed mining and RFDs would be 2,597 acres or 12.5 percent of habitat available.
- Overall cumulative impact rating for Alternative 6 is moderate negative because of potential mining in Pony Gulch, short-term restricted wildlife access due to the conveyor, short-term increased sedimentation, and a moderate level of reclamation success.
- A proposed 69 kv powerline from Malta would run parallel to Highway 191 and end at Goslin Flats. The powerline would be designed according to industry standards to avoid raptor electrocution and would be located in grassland habitat. The powerline would create only a negligible disturbance to wildlife habitat during construction.

4.5.8.3 Unavoidable Adverse Impacts

The potential for wildlife mortality from vehicle collisions would increase 3-4 fold over the life of the mine. Over the long-term wildlife populations would recover and big game populations would recover after mine closure and final reclamation. Assuming a moderate level of reclamation success, and dependent on management of wildlife populations, a small amount of wildlife habitat would not be reclaimed in the long term (primarily long,steep slopes and mine pit benches).

4.5.8.4 Short-term Use/Long-term Productivity

Short-term use/long-term productivity would be similar to Alternatives 4 and 5, except 1,183 acres rather than the 964 and 1,034 acres, respectively, are to be disturbed.

4.5.8.5 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable wildlife or aquatic resource commitments under Alternative 6 would be similar to Alternative 4.

4.5.9 Impacts from Alternative 7

Alternative 7 includes expansion of both the Zortman and Landusky mines, but with agency-developed mitigations on the expansion and reclamation activities and water capture and treatment measures. The major modifications to ZMI's expansion plans would be to locate the proposed waste rock repository on top of existing facilities at the Zortman Mine and to minimize tree planting in reclamation plans. In addition, water balance and water barrier reclamation covers would be used to maximize reclamation success. This alternative was developed as a way to reduce the amount of land disturbance, reduce impacts to water resources, and enhance reclamation; all of which have an effect on impacts to wildlife and fisheries.

4.5.9.1 Impacts

Impacts to wildlife and aquatic resources under Alternative 7 are similar to impacts described for Alternative 4 and 6, with major differences consisting of the amount of wildlife habitat lost, water quality impacts on aquatic macroinvertebrates and the ability of reclamation at establishing wildlife habitat. Impacts would be the same under Alternatives 4, 6, and 7 for nesting raptors, bighorn sheep, reptiles and amphibians, special status species and restricted access and wildlife movement. Wildlife mortality from process ponds would be reduced. Impacts for each alternative are presented in Table 4.5-1.

Habitat Loss

Alternative 7 would result in a total loss of wildlife habitat of approximately 1,158 acres at the Zortman Mine and 906 acres at Landusky Mine. Total new disturbance to wildlife habitat would be approximately 753 acres at Zortman Mine and 63 acres at Landusky Mine. Total direct removal of vegetation and wildlife habitat from previously undisturbed areas under Alternative 7 would be 816 acres. This results in an additional 4 percent loss of available wildlife habitat and a total loss of 10 percent of available habitat from pre-1979 conditions (Table 4.5-1). This loss of habitat exceeds the 10 percent criterion and would be a moderate negative impact.

Except for Goslin Flats, most of the vegetation removed would be in lodgepole pine forest, with minor disturbance occurring in ponderosa pine and Douglas fir forest. Forested areas provide thermal and escape cover for big game species, and potential habitat for northern goshawk, but contain little understory or food for foraging wildlife. At Goslin Flats, vegetation that would be removed includes shrub and grassland habitats occasionally used by pronghorn antelope, and vegetated wetlands. Some riparian habitat would also be disturbed where roads, conveyor and power corridors, and other facilities cross or are constructed in riparian areas along drainages. Riparian areas with open water are important summer bat habitat, especially within one mile of roost sites. This would be a low negative impact to bats.

Construction of the conveyor would cause increased short-term disturbance to big game and upland game bird habitats, particularly along Alder Gulch. Use of Carter Gulch as a waste rock repository would disturb high-value white-tailed deer habitat.

At Goslin Flats, a land application area of 285 acres would be used during closure and possibly in emergency situations, resulting in potential periodic disturbance and minor short-term loss of available habitat. A 200 foot buffer would be maintained around any wetlands or drainages.

Restricted Access

Construction of the conveyor from the Zortman Mine to Goslin Flats would result in restricted wildlife access along the proposed route. The conveyor is approximately 12,000 feet long with an elevation drop of about 1,000 feet. The conveyor would originate near the 84 leach pad, travel southeast through Alder Gulch and enter Goslin Flats through the gap just west of Whitcomb Butte (Figure 2.8-1). The abundance of wildlife in general and big game animals is particular is low in this area because of the close proximity of the town of Zortman. A few mule deer occur year round and an occasional white-tailed deer is observed in drainage bottoms. Bighorn sheep in the Little Rocky Mountains are non-migratory; seasonal, short-distance (3-4 miles) movements may occur, primarily west of the proposed conveyor route (Grensten, pers. comm. 1995). These movements occur in a north-south direction. Wildlife studies conducted by WESTECH (1991) found no bighorn sheep in the area of the proposed conveyor. Densities of large ungulates and other wildlife that may be impeded by the conveyor belt and four-strand fencing are generally low in the area of the proposed conveyor. Specifically, bighorn sheep in the Little Rocky Mountains have acclimated to mining operations and have adopted the existing mine sites as "safe havens" from hunting and poaching. It is estimated that 90+ percent of observations of bighorn sheep occurs west of the proposed conveyor route.Small amounts of bighorn sheep habitat would be fragmented and no corridors would be blocked (Grensten, pers. comm. 1995). Overhead spans of Pony and Alder Gulches by the conveyor would not restrict wildlife access in these two major drainages. However, the constant noise and psychological barrier of crossing open areas would likely restrict movement and access of some individual animals. This would result in a moderate negative impact in that some big game home ranges could become restricted, the effective habitat of the area reduced, and the overall carrying capacity within and near the study site decreased.

Bighorn Sheep

Seasonal observations mapped by WESTECH (1991) indicate that bighorn winter on the southern fringe of the mountain range in an area bounded by Gold Bug Butte, south to Sugar Loaf Butte and east to Saddle Butte. No sheep have been observed, either in summer or winter, east of the proposed conveyor route during wildlife studies from 1977 to 1987 and 1990. Bighorn sheep of the Little Rocky Mountains do not occupy distinct home ranges during any given season. Rather, it appears the sheep move randomly back and forth throughout the entire range with little or no use of habitat west of Montana Gulch or east of Saddle Butte. Because there are no distinct seasonal ranges, sheep have no need to establish distinct travel corridors. Based on information obtained from baseline wildlife studies (WESTECH 1991) and consultation with the BLM biologist for the area, the conveyor belt does not disrupt a bighorn sheep home range, migratory path or travel corridor and results in little to no fragmentation of the habitat.

Wildlife Mortality

Based on traffic projections provided in Section 4.11, between 3,500 and 10,800 total round trips by haul trucks per year would be made at the Zortman and Landusky mines under Alternative 7. These haul trips would traverse year-round mule deer and bighorn sheep habitat.

Haul traffic would occur for approximately 12 years. Over the short-term, mortality from vehicle collisions would likely increase through year 2007, resulting in a moderate negative impact. Over the long-term, wildlife collisions with mine-related vehicles would cease as mine closure and final reclamation is completed and wildlife mortality would return to pre-mine levels.

Reptiles and Amphibians

Very few reptiles and amphibians have been observed within the study area, both prior to mining and in wildlife monitoring studies since 1977. This indicates a general low abundance of reptiles and amphibians in the study area. The EIS prepared for the original proposed plan of operations for the Landusky and Zortman mine (DSL 1979) postulated that species with low mobility or small home ranges, such as reptiles and amphibians would decline because of habitat loss and direct or indirect mortality (e.g., degraded water quality). Because these species are common to the Little Rocky Mountains, and because so little of their total habitat would be disturbed, the overall loss to the population in the Little Rocky Mountains would be insignificant. The 1979 analysis is relevant to the present analysis of impacts to reptiles and amphibians, since the species are the same and no threatened, endangered or other special status species are known to occur.

Nesting Raptors

Based on the results of nesting raptor surveys and element occurrence searches conducted by Montana National Heritage Program, Alternative 7 would not significantly impact nesting raptors.

Special Status Species

There are no known federally listed threatened or endangered wildlife species in the areas proposed for disturbance; however, potential nesting habitat for peregrine falcons exists approximately 2 miles west of the proposed Goslin Flats leach pad. Consultation with the Montana Natural Heritage Program (1992) and Montana Fish, Wildlife, and Parks (Flath, Pers. Comm. w/R. Beane) revealed that the closest occurrence of piping plover is more than 50 miles away at Fort Bowdoin National Wildlife Refuge.

There are no known occurrences of, or potential habitat for bald eagle, peregrine falcon, piping plover, or black-footed ferret in the project vicinity under Alternative 7; therefore, there would be no impacts to endangered species.

The northern goshawk could occur in forested areas in the Little Rocky Mountains; however, nesting raptor surveys conducted prior to mining found no raptor nests of any kind. One adult goshawk was observed in Mill Gulch in October 1985, but the bird was probably a non-resident or migrant because surveys in the same vicinity during the breeding season did not locate any nests or breeding goshawks (Farmer 1994). A single goshawk nest has been recorded approximately 1.5 miles north of the project site. No northern goshawks would be impacted by Alternative 7.

Several candidate bat species (Townsend's big-eared bat, long-eared myotis, western small-footed myotis, and the long-legged myotis) are known to hibernate in Azure Cave. Hibernating bats would not be directly impacted by Alternative 7 through either habitat disturbance or noise from crushing and conveyor activities. Little specific information is known regarding the summer ranges and foraging habitat of the bat species hibernating in Azure Cave. However, some or all of these bat species would likely occur in the Little Rocky Mountains during summer breeding or migration. Important habitats for bats include riparian areas, late seral forest, and abandoned mines (Taylor 1994). This alternative would impact approximately 10 acres of aspen riparian habitat along the conveyor route that likely supports bats. Because of the small area of disturbance, few bats would be impacted by disturbance to riparian habitat under Alternative 7. However, it should be noted that one aspen snag can house 75 or more bats in summer. No baseline data are currently available on the occurrence and distribution of breeding bats within the project area outside of Azure Cave. Impacts to sensitive bat species under Alternative 7 are rated as low negative, based on the conservative assumption that the 10 acres of disturbed riparian habitat contains at least one snag potentially providing habitat for 75 or more bats in summer.

This alternative places a large number of lights along the conveyor route and near the ore processing facilities that would attract insects and subsequently breeding bats. This could provide beneficial feeding conditions for the bats, assuming process ponds are adequately netted to prevent bats from drinking contaminated water.

The two bodies of standing water closest to Azure Cave would be removed under Alternative 7. A field reconnaissance conducted in December 1995, of potential water sources for bats and other wildlife in the vicinity of Azure Cave found a minimum of four other stock ponds within 2 miles of the cave (Grensten Pers. Comm. 1995). Additionally, running water was found in at least three stretches of Grouse Creek that would likely be available throughout the summer. Most of the bat species known to hibernate at Azure Cave typically glean their prey from vegetation or forage within tree canopies and do not require open water for foraging.

Loss of these stock ponds would be mitigated by creating a new pond located in Upper Goslin Gulch north of the cave. This pond would be closer to Azure Cave, would be totally or partially inundated from February through November (ZMI 1996) and further from mining operations and process ponds. Although the pond in Upper Goslin Gulch is smaller than the original two stock ponds (0.39 acres compared to .75 acres) the long term reliability of water in Goslin Gulch would benefit breeding bats. Additional open water and wetland areas will be created in Ruby Creek Tributary (ZMI 1996 - 404 permit). Although these wetland areas are not direct mitigation for bats, any open water would be beneficial to breeding bats in the area. Consultation with a bat expert from Bat Conservation International, indicates that newly constructed water ponds can provide a suitable water source for breeding bats (Taylor, Nov. 28, 1995). In fact, by providing a more consistent source of drinking water and designing the pond to benefit all bats (i.e., Townsend's big-eared bat requires relatively large areas of open water), the result of this mitigation could be very beneficial to bats and all wildlife. Information on the size, water source, and permanence of water is provided in the Zortman-Landusky 404 permit application (ZMI 1996; see also Appendix B). Based on the proposed mitigation pond and presence of other stock ponds in the area, the loss of the two stock ponds is not considered a significant impact.

The overall short-term and long-term impact rating of Alternative 7 on special status species is low negative.

Noise

Cumulative noise levels at Azure Cave from mining and reclamation activities would be 60 dBA, or roughly the noise produced in an urban residential area not accounting for screening and attenuation by vegetation and topography. Literature reviews and consultation with BCI found no available information on noise impacts to bats. The 60 dBA compares to noise levels of an older urban residential area where bats are commonly found and would not present a significant adverse impact to hibernating bats (Taylor 1994). These noise levels would be further reduced and attenuated by vegetation, topography and the physical structure of the cave.

Residual Water Quality

Most streams in the vicinity of Zortman and Landusky mines are ephemeral and do not support a fishery. Indirect impacts of residual water quality and sedimentation on downstream biota or on limited macroinvertebrates in the project area drainages are summarized in Table 4.4-5 and are not repeated in detail here. (Tables 4.2-1 and 4.2-10 also address residual water quality for all alternatives.) Based on the information provided in these tables, water quality impacts to aquatic resources are considered low negative to negligible, and sedimentation impacts are ranked high negative (short-term) to low negative (long-term). This reflects the benefits expected from the success of the reclamation covers and the water capture and treatment measures in mitigating the impacts associated with the increased disturbance, the limiting of the disturbance to a smaller footprint, and the expected increased short-term sedimentation impacts. (See Table 4.4-5 for more details.)

Reclamation

The ability of reclamation to provide short-term wildlife forage and long-term diversity wildlife habitat would be similar to Alternatives 4 and 6, but with improved success of revegetation from increased soil depths and reduced slope lengths from reducing distance between erosion control benches. Additionally, improvements in the design of the reclamation covers would effectively limit acid rock drainage over the long term. Based on improved revegetation success, minimization of acid rock drainage and the establishment of forbs and grasslands as forage for valued wildlife would enhance long-term establishment of wildlife and aquatic macroinvertebrate habitat. Species diversity, particularly aquatic macroinvertebrate diversity, may take decades to recover. Impacts of reclamation effectiveness on fishery and wildlife resources is rated as negligible. Assuming a relatively high level of reclamation success over time, most of the disturbed area would be reclaimed over the long term, except on mine pit benches.

4.5.9.2 Cumulative Impacts

Cumulative impacts for wildlife and aquatic macroinvertebrates would be similar but lower in magnitude, to Alternatives 4, 5 and 6.

Cumulative impacts from Alternative 7 include:

- Restricted access and reduced effective habitat caused by the conveyor in the short term.
- Improved reclamation and establishment of wildlife habitat.
- Improved water quality and macroinvertebrate habitat due to enhanced reclamation and restoration activities.
- Total cumulative acres of habitat disturbed, including historical, proposed mining and RFDs would be 2,230 acres or 11 percent of habitat available in the Little Rocky Mountains.
- A proposed 69 kv powerline from Malta would run parallel to Highway 191 and end at Goslin Flats. The powerline would be designed according to industry standards to avoid raptor electrocution and would be located in grassland habitat. The powerline would create only a negligible disturbance to wildlife habitat during construction.
- Reasonably foreseeable mining at the Pony Gulch deposit in the future, 128 acres of potential exploration disturbance and potential use of the LS-2 and Montana Gulch limestone quarry.
- Overall rating of cumulative impacts of Alternative 7 to wildlife and aquatic resources is low negative based on the acres of habitat disturbed, a high level of revegetation success, increased short-term sedimentation, controlled acid rock drainage, conveyor impacts, potential mining in Pony Gulch and decreased impacts to water quality and macroinvertebrate habitat.

4.5.9.3 Unavoidable Adverse Impacts

The potential for wildlife mortality from vehicle collisions would increase 3-4 fold over the life of the mine. Over the long-term wildlife populations would recover and big game populations would reestablish after mine closure and final reclamation. Construction of the conveyor would disrupt home ranges and travel corridors for a few individual big game animals during mine life.

4.5.9.4 Short-term Use/Long-term Productivity

Short-term use/long-term productivity would be similar to Alternatives 4 and 6. The total new disturbance of 816 acres is less than either Alternative 4 or 6. The short-term extraction of mineral resources would not impact the long-term productivity of the disturbed area to support healthy and productive populations of endemic wildlife, assuming reclamation is successful. One of the limiting factors for bighorn sheep in the Little Rocky Mountains is open, grassy, south facing slopes interspersed with forest. Almost all of the south facing slopes in the Little Rocky Mountains are covered with lodgepole pine. Through mining and proper reclamation, many of the currently wooded south facing slopes would be changed into grassy slopes that would benefit bighorn sheep and other wildlife (BLM 1992a). Assuming a high reclamation success, comparable stability and utility of wildlife resources would be achieved in the post-mine landscape.

4.5.9.5 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable wildlife or aquatic resource commitments under Alternative 7 would be similar to Alternative 4, but less in magnitude, due to the smaller footprint of disturbance. Habitat lost during mining activities can be reclaimed and replaced during reclamation activities. Displaced wildlife populations would recolonize reclaimed areas and creation of open grassy habitats would benefit big game, grouse, and other wildlife that may be limited by the lack of open meadows and grassland forage in the Little Rocky Mountains in the short-term. Therefore, the short-term extraction of mineral resources would not impact the long-term productivity of the disturbed area to support health and productive populations of endemic wildlife and aquatic resources. Through mining and proper reclamation, many of the currently wooded, south facing slopes would be changed into grassy slopes that would benefit bighorn sheep and other valued wildlife (BLM

1992a). Water capture and treatment would improve downstream water quality and reduce metals in Montana Gulch and long-term reduced sedimentation impacts would create conditions conducive to macroinvertebrate recovery.

4.6 AIR QUALITY

4.6.1 Methodology

Air quality impacts were assessed for each alternative by comparing modeled impacts of air pollutants resulting from mining activities with National Ambient Air Quality Standards (NAAQS). NAAQS were selected as criteria for these assessments because they represent enforceable standards under State of Montana and federal regulations. The impacts are compared to the Average 24-Hour (150 $\mu g/m^3$) and Average Annual (50 $\mu g/m^3$) standards for respirable particulate matter less than 10 microns in size (known as "PM_{10}"), the pollutant of most concern from the Zortman and Landusky mines because of dust generated by blasting, truck traffic, construction, reclamation, and other mining activities.

PM_{10} emissions associated with the alternative actions for mining operations were taken from the Air Quality Permit Application submitted to the Air Quality Division of the Montana Department of Environmental Quality (Gelhaus 1992). These emissions were supplemented with PM_{10} emissions from reclamation activities. Emissions due to reclamation were calculated using the estimated number of haul trips and emission factors from the Compilation of Air Pollutant Emission Factors, AP-42 (EPA 1995). Emission control measures were applied to the estimated emissions whenever appropriate. The control measures used for the mining activities are described in the Air Quality Permit Application (Gelhaus 1992). Control measures for reclamation material hauling included watering and chemical treatment of roads. A control efficiency of 90 percent was used for the reclamation hauling emissions.

Particulates were selected as the indicator compound for air impact modeling, although other pollutants are and would be generated at the mines. These compounds were not modeled for the non-expansion alternatives (1, 2, and 3) because they are dependant on mine operations under the existing permit. Air pollutants including carbon monoxide, nitrogen oxide, sulfur dioxide, and volatile organics were assessed for the mine expansion alternatives. Results of these analyses are described in Section 4.6.6.1. None of the alternatives would significantly increase lead emissions or the manner in which hydrogen cyanide is used. Therefore, these compounds were not evaluated for impacts to air quality.

The reader should note that the methodology used herein is highly conservative. Therefore, the analysis predicts the worst possible impacts from mining operations, where actual impacts would likely be lower. Worst-case emissions for each mining activity were modeled as though they occur simultaneously; though some most likely would occur during different years of the life-of-mine.

The methods used for impact analysis are dependent on assumptions about equipment use, climate, road conditions and operational techniques, all of which could be modified to some extent to further reduce emissions. For example, reducing haul trucks to even slower speeds would result in a decrease of particulate emissions, while limiting further the number of trucks per day would decrease the average daily emissions. A paved road surface would significantly decrease particulate emissions. However, unless specifically noted and to reduce emissions to below permit thresholds, these added mitigations have not been incorporated into the alternatives. The dispersion models described in the next section rely on standardized assumptions for all of the alternatives so that results are consistent and comparable between the non-expansion alternatives, and between the expansion alternatives.

4.6.1.1 Dispersion Models

Two different dispersion models were used in this impact analysis. A relatively unsophisticated model called SCREEN was used to calculate impacts associated with the non-expansion alternatives at both mines. SCREEN was also used to calculate emissions for the Landusky Mine extension alternatives since mining facilities and reclamation equipment for Alternatives 4 through 7, and therefore emissions rates, would be very similar. A more sophisticated model known as the Fugitive Dust Model (FDM) was used to estimate concentrations for the Zortman Mine extension alternatives. This model is designed to specifically evaluate impacts from fugitive dust, the air pollutant of specific concern to this project. In addition, FDM contains a line source algorithm which allows for the estimation of impacts stemming from road traffic. A brief description of each model follows.

SCREEN is an EPA-approved screening-level model. SCREEN uses the distance between the source and receptor, the emission rate from the source, worst-case meteorological conditions (stable atmosphere and light winds blowing directly from the source to the receptor), and the Gaussian dispersion equation to estimate the ambient concentrations of the pollutant. The model incorporates a relatively large degree of conservatism to provide reasonable assurance that maximum concentrations are not underestimated. In other words, the model would be expected to overestimate impacts.

The Fugitive Dust Model (FDM) was used to estimate PM_{10} impacts resulting from mining and reclamation activities associated with the Zortman Mine Alternatives 4 through 7. FDM is an hourly, steady-state Gaussian model designed for estimation of concentration and deposition impacts from fugitive dust sources (EPA 1980). The sources may be point, line, or area sources. Area sources were used to model impacts from mining activities, and line sources were used to model impacts from haul road emissions.

FDM has been designed to eliminate hours with wind speeds less than 1.0 meter per second from the analysis. Meteorological data collected at the Zortman site during 1993 were used in the FDM analysis. FDM accounts for deposition through two parameters: the gravitational settling velocity and the deposition velocity. Three particle sizes of 10, 5, and 2.5 were distributed as 65, 27, and 8 percent of the emissions, respectively. Additional key inputs to the model are the roughness height and friction velocity. Friction velocities are calculated internally in the FDM from the wind speed and the reference height of the meteorological data. A roughness height of 15 cm was used in this analysis as suggested by EPA's FDM User's Guide (EPA 1992).

4.6.1.2 Allocation of Air Emissions

As indicated in 4.6.1.1, FDM can simulate emissions from point, line and area sources. In the analysis of each alternative, PM_{10} air emissions were allocated into a number of line and area sources. More specifically, these sources can be categorized into six mining activity areas (see bullet list below). These areas were selected because they would be responsible for almost the entire contribution of PM_{10} emissions resulting from mining and reclamation activities. Five of these areas (mine pit, waste rock repository, primary crusher, ore transfer points, and the heap leach pad) were modeled as area sources using the FDM, while reclamation materials hauling was modeled as line sources. Impacts from small sources such as the limestone quarry operations are not included in the emissions estimates, but are accounted for in the overall conservatism of the modeling analysis. The SCREEN model combines all sources into one source, but does not account for emissions from reclamation haul trucks in transit through the towns. The allocated emissions to the FDM area sources at the Zortman Mine is described below.

- Mine Pits Emissions resulting from drilling, blasting, ore/waste removal and hauling activities were incorporated into a total mine pit emission rate which varied by alternative.

- Waste Rock Repository Emissions from the waste rock repository consisted of waste rock hauling, waste rock dumping, and topsoil dumping. Emissions varied by alternative.

- Primary Crusher The total emissions at the primary crusher included emissions from ore dumping, waste rock dumping, primary crushing, and primary screening.

- Transfer Points Five transfer points along the conveyor line from the mine pit to the Goslin Flats leach pad were modeled using ore and waste rock emissions due to material transfer operations. Emissions varied by alternative.

- Heap Leach Pad: Emissions from the heap leach pad consist of secondary and tertiary crushing, ore dumping from the conveyor, and waste rock or reclamation material dumping.

- Reclamation Hauling Clay hauling to the leach pads for liner material and various facilities for reclamation covers, as well as hauling of topsoil, subsoils and gravels from the borrow areas to the various facilities for reclamation covers, were modeled as numerous separate line sources. Emission rates depended on the alternative considered.

4.6.1.3 Sensitive Receptors

Estimated emission rates for the various sources are supplied as input parameters to the dispersion models. The models are used to calculate the projected PM_{10} concentrations at the receptor locations. The towns of Zortman and Landusky were selected as the sensitive receptor locations for this analysis. They were chosen because of their proximity to the mining activities, population potentially affected, and location on routes used by haul trucks to deliver reclamation and construction materials.

4.6.1.4 Impact Significance

All air quality impacts projected under this analysis, for all alternatives, would cause negative impacts since baseline air quality could only be reached when all mine activity ceases. Tables 3.6-1 through 3.6-6 provided average PM_{10} concentrations for the study area. As discussed in Section 3.6, the data in Tables 3.6-1 through 3.6-6 was analyzed to select the most representative background concentrations. Data from monitoring Site 7 at 7 Mile Road for 1994 was selected to represent background concentrations because it is the closest monitoring location not in the mine area or affected by mining activities. The 24-hour and annual average concentrations at this site were 30 and 9 $\mu g/m^3$, respectively.

For each alternative, the estimated impacts have been rated as low, moderate, or high magnitude, using the Annual and 24-Hour PM_{10} Primary standards for rating criteria (See Table 4.6-1). Low air quality impacts are those that are less than the standards. Moderate air quality impacts are those that are equal to or near the standards, and a high air quality impact rating was assigned to alternatives for which exceedances of the standards were estimated. Impacts are considered to be significant if they exceed one or both of the air quality standards.

The frequency and duration of impacts are also evaluated. Duration of air emissions caused by certain mining activities could be short-term, and as such the air quality could degrade for short, possibly intense periods then quickly improve. Long-term emissions, such as the relatively constant emissions from ore removed and processing which would extend until mine closure, could result in degraded air quality for longer periods. The frequency of air emissions also varies. In particular, air emissions from most mining activities would be constant. The air emissions resulting from reclamation haul trucks passing through Zortman and Landusky would occur on an intermittent and short-duration basis.

The importance of duration and frequency of emissions is particularly evident in the fugitive dust models conducted for Zortman Mine activities, especially the impacts resulting from haul truck traffic through the town of Zortman. However, the truck convoys would typically pass through town in a matter of minutes and the air would usually clear relatively soon after. Therefore, the duration of the impact would be very short term, and occur only when the convoys pass through town.

4.6.1.5 Cumulative Impacts

Air emissions resulting from historic and recent mine activities is not relevant to a cumulative impacts analysis, since air quality would usually improve very quickly after emissions cease. Therefore, the cumulative impacts analysis for this resource relies on background air concentrations measured at Monitoring Site 7, combined with ongoing and/or projected mine activities, plus reasonably foreseeable developments if the applicable emissions would occur concurrent with the other air emissions sources. Exploration activities are not factored into the cumulative effects analysis for air emissions because of the dispersed nature of drilling and short duration of emissions.

4.6.2 Impacts from Mining, 1979 to Present

Air quality impacts from mining for the years 1979 to present, based on the limited data available and summarized in Section 3.6.1, have not exceeded applicable air quality standards. No air quality monitoring data were available to determine baseline (pre-1979) conditions.

Other air quality sources and emissions exist in the vicinity of the mines. These include gold processing emissions such as lead emissions from the assay lab located in Zortman, emissions from the refinery at the Zortman Mine process plant, and hydrogen cyanide gas emissions from the various Zortman and Landusky leach pads. Additional particulate emissions occur in the area from wood burning and private vehicle traffic. Each of these sources and their nature were discussed in Section 3.6 A summary of emissions from each is repeated below.

Lead air emissions from the assay lab have been estimated by the Montana Air Quality Division at approximately 504 pounds per year (0.25 tons per year) based on the current lab operating schedule of 8 hours per day. The maximum lead concentration measured at a nearby monitoring location 0.03 $\mu g/m^3$. Based on these emission estimates and ambient air monitoring results, the assay lab is in compliance with applicable lead ambient air quality standards. Lead emissions from the assay lab would be expected to drop to zero under a non-expansion alternative (Alternatives 1 through 3). Current emission rates would be expected to continue for the expansion alternatives. Under either scenario, the emissions would not constitute a significant impact. Because the emissions would cease for the no-action alternatives and remain constant for the mine extension alternatives, lead emissions are not discussed under each alternative's impact analysis.

Stack testing of emissions from the refinery indicate a total particulate emission rate of 2.42 tons per year (MDHES AQD 1994a). Modeling results indicate a 24-hour and annual PM_{10} concentration of 1.4 $\mu g/m^3$ and 0.3 $\mu g/m^3$, respectively. These concentrations are well below applicable Montana and federal ambient PM_{10} standards. Emissions from the refinery would

TABLE 4.6-1
SUMMARY OF AMBIENT AIR QUALITY STANDARDS FOR CRITERIA POLLUTANTS
(micrograms per cubic meter, $\mu g/m^3$)

Pollutant[(1)]	Averaging Period	State and Federal Standards[(2)]	
		Primary	Secondary
Particulate Matter (PM_{10})	Annual	50	NA
	24-Hour	150	NA
Sulfur Dioxide (SO_2)	Annual	80	NA
	24-Hour	365	NA
	3-Hour	1,300	NA
	1-Hour	1,310	NA
Carbon Monoxide (CO)	8-Hour	10,000	10,000
	1-Hour	40,000	40,000
Nitrogen Dioxide (NO_2)	Annual	100	NA
Lead (Pb)	3-Month 90 days[(3)]	1.5	NA
Ozone (O_3)	1-Hour	235	NA

(1) Gaseous concentrations are corrected to a reference temperature of 25°C and to a reference pressure of 760 millimeters of mercury.

(2) All maximum values are not to be exceeded more than one time per year except lead which may not be exceeded. The ozone standard is not to be exceeded more than one day per year.

(3) In Montana

NA Not applicable

Source: Montana Air Quality Regulations, December 1993.

cease under a no-action alternative and be expected to continue at similar rates for the mine extension alternatives. Under either scenario, the emissions would not constitute a significant impact. Refinery emissions are not discussed under each alternative's impact analysis.

Emissions of hydrogen cyanide from the leach pads at the Zortman and Landusky mines have been measured by ZMI personnel in the early 1990s (DSL/BLM 1993). Hydrogen cyanide concentrations did not exceed 1 ppm. The Threshold Limit Value (a concentration established for the protection of human health, particularly worker safety) for hydrogen cyanide is 10 ppm (ACGIH 1993). When compared to the TLV, hydrogen cyanide concentrations emanating from the leach pads do not represent a significant impact.

Particulate air emissions in the project area also occur from the operation of private vehicles and wood burning, and wood burning in particular can contribute significant quantities of particulate emissions. Impacts from these sources are included in the monitoring data presented in Tables 3.6-1 through 3.6-6.

4.6.3 Impacts from Alternative 1

The no action alternative limits activities at the Zortman and Landusky mines to already permitted actions. Air emissions would originate from the limited ore processing operations at the Zortman Mine, continued mining at the Landusky Mine until approximately early 1996, and reclamation activities at both mines to be completed in 1996.

4.6.3.1 Impacts

Projected air quality concentrations for mining and reclamation activities at both mines were estimated using the SCREEN model and the appropriate emissions sources for the activities. No operational calculations were conducted for the Zortman Mine since there is no additional permitted mining. The 24-hour and annual PM_{10} impacts resulting from Landusky Mine operations are estimated to be 85 $\mu g/m^3$ and 1 $\mu g/m^3$, respectively, at Landusky Mine. Table 4.6-2 summarizes the estimated PM_{10} concentrations for each alternative.

The reclamation activities for which impacts were assessed included material handling, such as truck loading and dumping, grading and dozer activities, and material transport, which involves emissions from haul roads. The 24-hour and annual PM_{10} impacts at the towns of Zortman and Landusky associated with reclamation activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	32 $\mu g/m^3$	8 $\mu g/m^3$
Landusky	14 $\mu g/m^3$	4 $\mu g/m^3$

For this alternative, no clay or cover soil would be hauled through either Zortman or Landusky for reclamation covers. There would be no significant impact at the sensitive receptor locations associated with reclamation materials transport.

4.6.3.2 Cumulative Impacts

There are no reasonably foreseeable developments for this alternative. Therefore, cumulative air quality impacts are estimated by adding the modeled impacts at the mine sites to representative background, measured PM_{10} concentrations. The maximum 24-hour and annual average concentrations measured at Monitoring Site 7 are 30 $\mu g/m^3$ and 9 $\mu g/m^3$, respectively (see Section 3.6). Adding these background concentrations to the estimated impacts results in the following impacts:

Receptor	24-Hour	Annual
Zortman	62 $\mu g/m^3$	17 $\mu g/m^3$
Landusky	129 $\mu g/m^3$	14 $\mu g/m^3$

These concentrations are below the applicable federal and state ambient air quality standards and not significant.

4.6.3.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the limited remaining mine operations and reclamation activities. These impacts are not significant. It should be noted this is based on a conservative modeling analysis. Therefore, additional mitigation should not be needed to further reduce the magnitude of the impacts.

4.6.3.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts under this alternative would last until the year 2000. After reclamation is completed, air quality concentrations would return to background levels.

TABLE 4.6-2
SUMMARY OF 24-HOUR AND ANNUAL PM_{10} IMPACTS ($\mu g/m^3$) AT SENSITIVE RECEPTOR LOCATIONS

	Alt. 1		Alt. 2		Alt. 3		Alt. 4		Alt. 5		Alt 6		Alt. 7[6]	
	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual	24-hr	Annual
PM_{10} Standard	150	50	150	50	150	50	150	50	150	50	150	50	150	50
Zortman[2]														
Mining	n/a	n/a	n/a	n/a	n/a	n/a	76	4	**158**	6	59	5	118	5
Reclamation	32	8	57	14	100	4	n/a[3]	n/a[3]	n/a[3]	n/a[3]	n/a[3]	n/a[3]	n/a[3]	n/a[3]
RFD[4]	0	0	0	0	0	0	**189**	48	0	0	**189**	48	**189**	48
Background	30	9	30	9	30	9	30	9	30	9	30	9	30	9
Cumulative[5]	62	17	87	23	130	13	**295**	**61**	**188**	15	**278**	**62**	**148[6]**	**14[6]**
Landusky[2]														
Mining	85	1	85	1	85	1	85	1	85	1	85	1	85	1
Reclamation	14	4	25	6	31	8	31	8	32	8	32	8	32	8
RFD[4]	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Background	30	9	30	9	30	9	30	9	30	9	30	9	30	9
Cumulative[5]	129	14	140	16	146	18	146	18	147	18	147	18	147	18

n/a - not applicable.

1 Concentrations shown are for the maximum impact from any facility modeled. Concentrations above standards are highlighted in **bold**.
2 Concentrations shown are estimated for the applicable townsite, Zortman or Landusky.
3 Reclamation estimates for Zortman Mine expansion alternatives are incorporated in the values presented for mining.
4 RFD = Reasonably Foreseeable Development Activity (for example, Pony Gulch Mine development)
5 Values shown are the summation of mining, reclamation, and background concentrations.
6 Alternative 7 precludes mining of the Pony Gulch deposit concurrent with mining and reclamation at the Zortman Mine. This mitigation prevents exceedance of the air quality standards which would otherwise occur.

4.6.3.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality would return to background levels after reclamation is completed.

4.6.4 Impacts from Alternative 2

This non expansion alternative limits activities at the Zortman and Landusky mines to already permitted actions, with some enhanced reclamation as proposed by ZMI. Air emissions would originate from the limited ore processing operations at the Zortman Mine, continued mining at the Landusky Mine until approximately early 1996, and reclamation until complete in 1998 for the Zortman Mine and 2000 for the Landusky Mine.

4.6.4.1 Impacts

Operational impacts for Alternative 2 would be the same as projected for Alternative 1. No mining related emissions would come from the Zortman Mine, while the 24-hour and annual PM_{10} emissions from the Landusky Mine would be 85 $\mu g/m^3$ and 1 $\mu g/m^3$.

Clay would be hauled through Zortman and Landusky for use in reclamation covers. Topsoil would come from existing facilities and not require transport through either town. The 24-hour and annual PM_{10} impacts associated with reclamation activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	57 $\mu g/m^3$	14 $\mu g/m^3$
Landusky	25 $\mu g/m^3$	6 $\mu g/m^3$

These concentrations are below the applicable federal and state ambient air quality standards and not significant.

4.6.4.2 Cumulative Impacts

There are no reasonably foreseeable developments for Alternative 2, so cumulative air quality impacts were estimated by adding the modeled impacts to representative background, measured PM_{10} concentrations. Cumulative impacts are:

Receptor	24-Hour	Annual
Zortman	87 $\mu g/m^3$	23 $\mu g/m^3$
Landusky	140 $\mu g/m^3$	16 $\mu g/m^3$

These concentrations are below the applicable federal and state ambient air quality standards and not significant. The impacts at Zortman are of low magnitude, while the impacts at Landusky are of moderate magnitude.

4.6.4.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the limited mining and reclamation activities. It should be noted that this is based on a conservative modeling analysis. Additional mitigation would not be necessary to meet permit standards.

4.6.4.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts under this alternative would last until 1998 for the Zortman Mine; and until 2000 for the Landusky Mine. After reclamation is completed, air quality concentrations would return to background levels.

4.6.4.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality would return to background levels after reclamation is completed.

4.6.5 Impacts from Alternative 3

This non-expansion alternative limits activities at the Zortman and Landusky mines to already permitted actions, with agency-mitigated reclamation imposed. Impacts to air quality would result from the limited ore processing operations at the Zortman Mine, continued mining at the Landusky Mine until approximately early 1996, and enhanced reclamation activities to be complete in 1999 at the Zortman Mine and 2001 at the Landusky Mine.

4.6.5.1 Impacts

Operational impacts for Alternative 3 would be the same as projected for Alternative 1. No mining related emissions would come from the Zortman Mine, while the 24-hour and annual PM_{10} emissions from the Landusky Mine would be 85 $\mu g/m^3$ and 1 $\mu g/m^3$.

Topsoil, subsoils, gravels, or other non-acid generating rock would be hauled through Zortman for use in reclamation covers. Topsoil would come from existing facilities at the Landusky Mine and not require transport through town. Limestone may also be used in reclamation covers but would not require transport through either town.

The 24-hour and annual PM_{10} impacts from reclamation activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	100 $\mu g/m^3$	4 $\mu g/m^3$
Landusky	31 $\mu g/m^3$	8 $\mu g/m^3$

These concentrations are below the applicable federal and state ambient air quality standards. The impacts are of low magnitude and not significant.

4.6.5.2 Cumulative Impacts

There are no reasonably foreseeable developments for Alternative 3. Adding background concentrations to the estimated impacts results in the following impacts:

Receptor	24-Hour	Annual
Zortman	130 $\mu g/m^3$	13 $\mu g/m^3$
Landusky	146 $\mu g/m^3$	18 $\mu g/m^3$

The concentrations at Zortman and Landusky are below the applicable federal and state ambient air quality standards and not significant, but represent a moderate impact at both locations.

4.6.5.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the limited mining and enhanced reclamation activities. It should be noted that this is based on a conservative modeling analysis. Additional mitigation would not be necessary to meet permit standards.

4.6.5.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts under this alternative would last until 1999 for the Zortman Mine and until 2001 for the Landusky Mine. After reclamation is completed, air quality concentrations would return to background levels.

4.6.5.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality impacts would return to background levels after reclamation is completed.

4.6.6 Impacts from Alternative 4

Alternative 4 includes extension of mine activities at both the Zortman and Landusky mines. Increased reclamation would be implemented at both mines as well. Air emissions would emanate from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities. Additional exploration and development actions are reasonably foreseeable.

4.6.6.1 Impacts

Projected air quality concentrations for mining and reclamation activities were estimated using the FDM model at the Zortman Mine, and the SCREEN model for the Landusky Mine. The maximum predicted 24-hour and annual PM_{10} impacts at Zortman and Landusky from activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	76 $\mu g/m^3$	4 $\mu g/m^3$
Landusky	116 $\mu g/m^3$	9 $\mu g/m^3$

These estimates include impacts from reclamation activities and haul trucks carrying reclamation materials, as these activities would take place concurrent with mining. The frequency of the emissions from materials hauling is variable, while mining and reclamation activities would be continuous until complete. Impacts from hauling reclamation materials through town would be frequent but of short duration. The frequency of impact can be related to the schedule for haul truck traffic, as shown on Table 4.11-2, which lists projected annual haul trips for reclamation materials for each alternative.

Other air pollutants predicted to be generated by the mining activities at the Zortman Mine include carbon monoxide (335 tons per year), nitrogen oxides (430 tons per year), sulfur dioxide (47 tons per year), and volatile organic compounds (28 tons per year). Air pollutants generated by the mining activities at Landusky include PM_{10} (872 tons per year), carbon monoxide (264 tons per year), nitrogen oxides (404 tons per year), sulfur dioxide (44 tons per year), and volatile organic compounds (28 tons per year).

Ambient air quality impacts from these pollutants were modeled using SCREEN. SCREEN predicted ambient air quality impacts for each of the pollutants listed above at the towns of Zortman and Landusky (the nearest sensitive receptors) are as follows:

Compound	Zortman	Landusky
Carbon Monoxide		
1-hour	274 $\mu g/m^3$	263 $\mu g/m^3$
8-hour	192 $\mu g/m^3$	184 $\mu g/m^3$
Nitrogen Oxides		
Annual	35 $\mu g/m^3$	40 $\mu g/m^3$
Sulfur Dioxide		
3-hour	35 $\mu g/m^3$	44 $\mu g/m^3$
24-hour	15 $\mu g/m^3$	40 $\mu g/m^3$
Annual	4 $\mu g/m^3$	4 $\mu g/m^3$
Volatile Organics		
Annual	23 $\mu g/m^3$	26 $\mu g/m^3$

The volatile organic compounds impacts can be compared to the federal and state ozone standard, since volatile organic compounds are a precursor to the formation of ozone. These impacts are all well below the corresponding federal and state ambient air quality standards (see Table 4.6-1), and would result in no significant impact. These calculations also apply to the air quality impacts analyses for the remaining mine extension alternatives.

4.6.6.2 Cumulative Impacts

Cumulative air quality impacts were estimated by adding the modeled impacts to representative measured background PM_{10} concentrations in the area and to emissions predicted for reasonably foreseeable development activities.The reasonably foreseeable developments under Alternative 4 include mining extension into Pony Gulch. The Pony Gulch area is approximately 4000 feet from Zortman. Air emissions would result from haul roads traffic and be a function of the amount of ore and waste rock handled per day. The SCREEN model predicts 24-hour and annual PM_{10} impacts of 189 $\mu g/m^3$ and 48 $\mu g/m^3$, respectively. If this development occurs, an air quality permit modification would be required, but mitigations would have to be applied to bring the emissions below standard.

Impacts from the Pony Gulch mine added to the background concentrations and impacts from Alternative 4 implementation would result in cumulative emissions of 295$\mu g/m^3$ and 61 $\mu g/m^3$, respectively, emissions which represent high, significant impacts above air quality standards.

The reasonably foreseeable development for the Landusky Mine is to extend mining for approximately one year. Therefore, impacts estimated for mining and reclamation in the previous section would merely extend longer. Cumulative impacts from Landusky mining added to background concentrations results in 24-hour and annual PM_{10} impacts of 146 $\mu g/m^3$ and 18 $\mu g/m^3$, respectively. These concentrations are below the applicable federal and state ambient air quality standards but represent a moderate impact.

4.6.6.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the expanded mining operations and reclamation activities. It should be noted that this is based on a conservative modeling analysis. Additional mitigation would be required should the reasonably foreseeable development of the Pony Gulch ore body occur.

4.6.6.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts under this alternative would last until 2007, for the Zortman Mine and until 2002 for the Landusky Mine. After reclamation is completed, air quality concentrations would return to pre-mining levels.

4.6.6.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality impacts would return to pre-mining levels after reclamation is completed.

4.6.7 Impacts from Alternative 5

This alternative includes extension of mine activities at both the Zortman and Landusky mines. A major operational modification affecting air quality impacts would place the Zortman Mine heap leach pad in Upper Alder Gulch. Agency mitigated reclamation would be implemented at both mines. Air quality impacts would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities.

4.6.7.1 Impacts

Air quality impacts under this alternative would be similar to those in Alternative 4. The differences in air quality impacts from Alternative 4 would result from the relocation of the proposed Goslin Flats Leach Pad relocated to Upper Alder Gulch. The ore would be transported to the leach pad using haul trucks. Other air pollutants associated with the mining activities would be estimated to have similar emissions as described in Section 4.6.6.1.

The maximum predicted 24-hour and annual PM_{10} impacts at Zortman and Landusky from activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	158 $\mu g/m^3$	6 $\mu g/m^3$
Landusky	117 $\mu g/m^3$	9 $\mu g/m^3$

These estimates include impacts from mining, reclamation activities and haul trucks carrying reclamation materials. The 24-hour impacts at Zortman are in exceedance of the 24-hour average PM_{10} standard and result in a high, significant impact. Concentrations estimated for the Landusky Mine are below standards. As described in Section 4.6.6.1, the frequency of these impacts would be variable, but the impacts would continue for the duration of the mining and reclamation activities.

4.6.7.2 Cumulative Impacts

The reasonably foreseeable development for the Landusky Mine is to extend mining for approximately one year. Therefore, impacts estimated for mining and reclamation in the previous section would merely extend longer. Cumulative impacts from Landusky mining added to background concentrations results in 24-hour and annual PM_{10} impacts of 147 $\mu g/m^3$ and 18 $\mu g/m^3$, respectively. These concentrations are below the applicable federal and state ambient air quality standards but represent a moderate impact.

Because Pony Gulch mining is not reasonably foreseeable under this alternative, there are no applicable reasonably foreseeable development activities for the Zortman Mine. Addition of background concentrations to the FDM estimated emissions for the Zortman Mine results in 24-hour and annual average PM_{10} impacts of 188 $\mu g/m^3$ and 15 $\mu g/m^3$, respectively. The 24-hour concentrations are above the applicable standards and result in a high, significant impact.

4.6.7.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the expanded mining operations and reclamation activities. It should be noted that this is based on a conservative modeling analysis.

4.6.7.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts would last until 2007 for the Zortman Mine and until 2002 for the Landusky Mine. After reclamation is completed, air quality impacts would return to background levels.

4.6.7.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality impacts would return to background levels after reclamation is completed.

4.6.8 Impacts from Alternative 6

This alternative includes extension of mine activities at both the Zortman and Landusky mines. A major operational modification affecting the air impacts analysis would place the Zortman Mine waste rock repository on Ruby Flats. Agency mitigated reclamation would be implemented at both mines. Air emissions would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities. Additional exploration and development activities are reasonably foreseeable.

4.6.8.1 Impacts

Air quality impacts under this alternative would be similar to Alternative 4. The differences in air quality impacts from Alternative 4 would result from the relocation of the Carter Gulch waste rock repository to Ruby Flats just east of the Goslin Flats leach lad. A conveyor system would be used to transport the ore and waste rock from the Zortman Mine to the Goslin Flats area. A haul road would be needed to transport the waste rock from the conveyor terminus to Ruby Flats. Other air pollutants associated with the mining activities would be estimated to have similar emissions as described in Section 4.6.6.1.

The maximum predicted 24-hour and annual PM_{10} impacts at Zortman and Landusky from activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	59 $\mu g/m^3$	5 $\mu g/m^3$
Landusky	117 $\mu g/m^3$	9 $\mu g/m^3$

These estimates include impacts from mining, reclamation activities and haul trucks carrying reclamation materials. Estimated concentrations at both Zortman and Landusky would be below emissions standards and not significant. As described in Section 4.6.6.1, the frequency of these impacts would be variable, but the impacts would continue for the duration of mining and reclamation.

4.6.8.2 Cumulative Impacts

Cumulative air quality impacts were assessed by adding the impacts to representative background, measured PM_{10} concentrations in the area, and to emissions predicted for reasonably foreseeable development activities. Reasonably foreseeable developments under Alternative 6 would be as described for Alternative 4 in Section 4.6.6.2.

The 24-hour and annual PM_{10} air emissions from a Pony Gulch mine would be 189 $\mu g/m^3$ and 48 $\mu g/m^3$, respectively. These emissions represent a high, significant impact. An air quality permit modification would be required for such a development, but mitigations would have to be applied to bring the emissions below standard.

Addition of background concentrations and emissions from the Pony Gulch reasonably foreseeable development to the FDM estimated emissions for the Zortman Mine results in 24-hour and annual PM_{10} emission concentrations of 278 $\mu g/m^3$ and 62 $\mu g/m^3$, respectively. These concentrations are well above the applicable standards and result in a high, significant impact.

The reasonably foreseeable development for the Landusky Mine is to extend mining for approximately one year. Therefore, impacts estimated for mining and reclamation in the previous section would merely extend longer. Cumulative impacts from Landusky mining added to background concentrations results in 24-hour and annual PM_{10} impacts of 146 $\mu g/m^3$ and 18 $\mu g/m^3$, respectively. These concentrations are below the applicable federal and state ambient air quality standards but represent a moderate impact.

4.6.8.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the expanded mining operations and reclamation activities. It should be noted that this is based on a conservative modeling analysis. Additional mitigation would be required should the reasonably foreseeable development of the Pony Gulch ore body occur.

4.6.8.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts would last until 2006 for the Zortman Mine and until 2002 for the Landusky Mine. After reclamation is completed, air quality impacts would return to baseline levels.

4.6.8.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality impacts would return to background levels after reclamation is completed.

4.6.9 Impacts from Alternative 7

This alternative includes extension of mine activities at both the Zortman and Landusky mines. A major operational modification which would affect air emissions would place the Zortman Mine waste rock repository on top of existing disturbances and undisturbed areas around the mine site. Agency mitigated reclamation would be implemented at both mines. Air quality impacts would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities. Additional exploration and development activities are reasonably foreseeable.

4.6.9.1 Impacts

The air emissions levels for this alternative were estimated using the FDM model at the Zortman Mine and the SCREEN model for the Landusky Mine. Air quality impact analyses for this alternative are based on a worst-case scenario that all mining equipment listed in Table 4.9-1 would be operating at the same time.

The maximum predicted 24-hour and annual PM_{10} impacts at Zortman and Landusky from activities at the two mines are:

Receptor	24-Hour	Annual
Zortman	118 $\mu g/m^3$	5 $\mu g/m^3$
Landusky	117 $\mu g/m^3$	9 $\mu g/m^3$

This estimate includes impacts from reclamation activities and haul trucks carrying reclamation materials. The 24-hour impacts at both mines are in below air quality standards and represent a moderate, but not significant impact. The frequency of the emissions from materials hauling is variable, while mining and reclamation activities would be continuous until complete. Impacts from hauling reclamation materials through town would be frequent but of short duration. The frequency of impact can be related to the schedule for haul truck traffic, as shown on Table 4.11-2, which lists projected annual haul trips for reclamation materials for each alternative.

To keep emissions levels below the 24-hour standard, this alternative limits to 120 (from about 150 in the Company Proposed Action) or less the number of reclamation materials haul trucks passing through the town of Zortman in a single day. The frequency of days on which truck convoys would operate would correspondingly increase, from about 30 to 40 days in the peak year.

Other air pollutants predicted to be generated by the mining activities at the Zortman Mine include carbon monoxide (335 tons per year), nitrogen oxides (430 tons per year), sulfur dioxide (47 tons per year), and volatile organic compounds (28 tons per year). Air pollutants generated by the mining activities at Landusky include PM_{10} (872 tons per year), carbon monoxide (264 tons per year), nitrogen oxides (404 tons per year), sulfur dioxide (44 tons per year), and volatile organic compounds (28 tons per year).

Ambient air quality impacts from these pollutants were modeled using SCREEN. SCREEN predicted ambient air quality impacts for each of the pollutants listed above at the towns of Zortman and Landusky (the nearest sensitive receptors) are as follows:

Compound	Zortman	Landusky
Carbon Monoxide		
1-hour	274 $\mu g/m^3$	263 $\mu g/m^3$
8-hour	192 $\mu g/m^3$	184 $\mu g/m^3$
Nitrogen Oxides		
Annual	35 $\mu g/m^3$	40 $\mu g/m^3$
Sulfur Dioxide		
3-hour	35 $\mu g/m^3$	44 $\mu g/m^3$
24-hour	15 $\mu g/m^3$	40 $\mu g/m^3$
Annual	4 $\mu g/m^3$	4 $\mu g/m^3$
Volatile Organics		
Annual	23 $\mu g/m^3$	26 $\mu g/m^3$

The volatile organic compounds impacts can be compared to the federal and state ozone standard, since volatile organic compounds are a precursor to the formation of ozone. These impacts are all well below the corresponding federal and state ambient air quality standards (see Table 4.6-1), and would result in no significant impact.

4.6.9.2 Cumulative Impacts

Cumulative air quality impacts were assessed by adding the impacts to representative background, measured PM_{10} concentrations in the area and to emissions predicted for reasonably foreseeable development activities.

The reasonably foreseeable developments under Alternative 7 include mining extension into Pony Gulch. The Pony Gulch area is approximately 4000 feet from Zortman. Air emissions would result from haul roads traffic and be a function of the amount of ore and waste rock handled per day. The SCREEN model predicts 24-hour and annual PM_{10} impacts of 189 $\mu g/m^3$ and 48 $\mu g/m^3$, respectively. If this development occurs, an air quality permit modification would be required, but mitigations would have to be applied to bring the emissions below standard. Because emissions from the Pony Gulch development would cause cumulative emissions concentrations to exceed air quality standards, Alternative 7 precludes mining of the Pony Gulch deposit while mining and reclamation is underway at the Zortman Mine site.

Because the Pony Gulch project emissions would not be occurring during reclamation or mining at the Zortman Mine facilities, cumulative emissions for Alternative 7 are restricted to the summation of background levels plus emissions from mine expansion project. Addition of background concentrations to the FDM estimated emissions for the Zortman Mine results in 24-hour and annual average PM_{10} impacts of 148 $\mu g/m^3$ and 14 $\mu g/m^3$, respectively. The 24-hour concentrations are below the applicable standards and result in a moderate but not significant impact.

The reasonably foreseeable development for the Landusky Mine is to extend mining for approximately one year. Therefore, impacts estimated for mining and reclamation in the previous section would merely extend longer. Cumulative impacts from Landusky mining added to background concentrations results in 24-hour and annual PM_{10} impacts of 147 $\mu g/m^3$ and 18 $\mu g/m^3$, respectively. These concentrations are below the applicable federal and state ambient air quality standards but represent a moderate impact.

4.6.9.3 Unavoidable Adverse Impacts

The impacts described are considered unavoidable and adverse, resulting from the expanded mining operations and enhanced reclamation activities. It should be noted that this is based on a conservative modeling analysis. Additional mitigations have been incorporated into Alternative 7 to reduce impacts from a high level to moderate, and to keep the particulate emissions below the 24-hour and annual ambient air quality standards. These mitigations include a reduction in the number of reclamation vehicles traveling through the town of Zortman on any given day, and a prohibition on initiation of a mining operation in Pony Gulch until reclamation at the Zortman Mine site is complete.

4.6.9.4 Short-term Use/Long-term Productivity

Mining and reclamation air quality impacts would last until 2007 for the Zortman Mine and until 2002 for the Landusky Mine. After reclamation is completed, air quality impacts would return to baseline levels.

4.6.9.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for air quality for this alternative. Air quality impacts would return to background levels after reclamation is completed.

4.7 RECREATION AND LAND USE

4.7.1 Methodology

Mining activities could effect recreation and land use resources both directly and indirectly by exerting a physical and/or a visual influence. Direct impacts to recreational or land use resources would occur if construction or operation of the project resulted in the termination of use or modification of the resources within the study area. Indirect impacts would occur if construction or operation activities altered recreation use patterns, recreation demand, access, or the quality of the recreational experience.

Impacts to recreation and land use were considered significant if: (1) project-related changes would alter or otherwise physically affect established, designated, or planned recreation areas or activities; (2) project-related changes would conflict with officially adopted polices or goals for land management; (3) project-related changes would effect accessibility to areas established, designated or planned for recreational use; (4) project-related changes would terminate or have a major affect on existing land uses; (5) project-related changes would have a major effect on the duration or quality of recreational environments and experiences.

Impacts may be locally or regionally significant. For the recreation and land use resources, local is defined as those areas within 0-5 miles of current or proposed mine activities. The regional area includes recreation and land use resources in north central Montana, including the many recreational opportunities and facilities found along the Missouri River. Short-term impacts are defined as those occurring during the life of mine operations. Long term impacts are defined as those occurring after reclamation and revegetation.

4.7.2 Impacts from Mining, 1979 to Present

As described in the affected environment chapter (Section 3.7), recreation activities in 1979 centered around the two campgrounds (Montana Gulch campground near Landusky and the Camp Creek campground near Zortman), picnicking in Mission Canyon, and the hiking, hunting, picnicking, and sightseeing opportunities available throughout the Little Rocky Mountains. Prior to 1979, recreationists could drive the Zortman/Landusky county road and use that road to access hunting and hiking areas, and for sightseeing (including viewing historic mining structures). BLM lands were managed for multiple use including wildlife habitat, forestry, mining and recreation. Agriculture was the dominant use on private lands surrounding the Little Rocky Mountains.

Impacts to recreation resources due to mining activities can be generally characterized as a loss of access to dispersed use areas that were previously accessed by the Zortman/Landusky county road over Antoine Butte; a reduction in the aesthetic quality of surrounding recreational use areas due to an increase in the amount of visible land disturbances; and noise from mining operations.

The recreation environment today still includes the two campgrounds, picnic spots and Pow Wow grounds in Mission Canyon, and the dispersed activities available in 1979. However, the Zortman/Landusky county road over Antoine Butte is closed to non-mine business which has caused some loss of access to hunting areas and sightseeing opportunities. ZMI reportedly no longer offers mine tours of their operations.

Although visitor use data for the campgrounds is not available for 1979, overall recreational visits to the Little Rocky Mountain Recreation Management Area has been declining in the last decade (Whitehead 1995). The water well at the Montana Gulch campground, found to be producing arsenic contaminated water prior to 1979 and which was capped soon after drilling, was plugged and abandoned in 1991. Since 1979 there have been periods of surface water degradation at the campground due to overtopping of upstream capture systems at the Landusky Mine. Noise from blasting can occasionally be heard at the Pow Wow grounds in Mission Canyon on the Fort Belknap Indian Reservation.

There has been a substantial increase in the amount of visible land disturbance since 1979. Recreationists hiking up several of the peaks and buttes near the Zortman and Landusky mines now have extensive views of mine disturbance which can reduce the quality of the recreational environment and reduce scenic viewing opportunities. Portions of the Landusky Mine have now become visible to recreation areas as far south as the Missouri Breaks Backcountry Byway, located over 20 miles south of the mines, as well as to viewers at the Pow Wow grounds in Mission Canyon. Light sources at the mines are particularly visible at night, from both nearby and distant viewpoints. (Visual impacts are further evaluated in Section 4.8.)

Lands used for mine operations have precluded other land uses in the immediate area of mine operations.

Table 4.7-1 displays the total acres of existing disturbance and proposed additional disturbance by alternative for both public (BLM) and private lands. Figure 4.7-1 graphically displays the additional disturbance to public and private lands from the four expansion alternatives. BLM lands in the surrounding area still provide for other uses such as wildlife habitat and recreation. Native Americans use many of the areas in the Little Rocky Mountains for cultural purposes, including vision quests. Since 1979 there have been indirect impacts to several of these sites from the visual and noise impacts caused by mine operations.

4.7.3 Impacts From Alternative 1

Under Alternative 1, mine expansion plans would not be approved. Mining activities previously permitted would continue, and reclamation procedures would proceed as approved. Previously permitted activities at the Zortman Mine include continued leaching at the 89 pad and reclamation and closure activities. At the Landusky Mine ore is still being leached at the 87/91 and 91 heap leach pads. These activities would have no appreciable effect on recreation resources. Existing impacts to recreation, as described in the previous section, would remain the same until reclamation and revegetation activities reduced the indirect visual impacts caused by land disturbance, and the Zortman/Landusky road is available for use by the public.

Reclamation generally includes regrading of facilities to slopes no steeper than 2:1 and a soil cover of eight inches. The existing reclamation plan under Alternative 1 would not be successful in most areas because of problems with steep slopes and potential acidification of soils in those areas where the cover soil is overlain on acid producing material (Plantenberg 1994). In those areas of reclamation failure, there would be long-term significant impacts to land use and recreation. Water quality may remain poor in some drainages where the 8 inches of cover soil is not adequate to prevent acid rock drainage. If this occurs, water quality at the Montana Gulch campground may remain poor.

Mining is an approved use of BLM lands in the Little Rocky Mountains (BLM 1994). Denial of mine extension plans would end this land use after the currently permitted operations have ended, having a significant impact on future mining within the Little Rocky Mountains.

4.7.3.1 Cumulative Impacts

Mining operations at both the Zortman and Landusky mines have created significant short-term impacts to the recreational environment in the local area. These impacts are caused by access restrictions and the degradation of the scenic quality of the area, which can affect the quality of the recreational experience. The reclamation plan is not adequate to return the land to productive uses which would continue impacts to recreation and land use.

Under Alternative 1, future mining activities would be limited. Further reclamation and remediation measures would be required in the future to correct problems with reclamation failure and acid rock drainage. Exploration activities are not anticipated with Alternative 1, however, it is foreseeable that some exploration may occur at some point in the future which would involve road building and exploratory drilling. Continued building of exploration roads would add to the visible disturbance in the area, and lower the scenic quality of the landscape. This would continue the impacts to recreationists expecting to view natural appearing mountain scenery while recreating in areas within the viewshed of mining activities.

4.7.3.2 Unavoidable Adverse Impacts

Indirect visual impacts would occur to recreationists who would view the mine area with disturbed areas unreclaimed. Reclamation would not entirely remove visual impacts as the reclaimed surfaces would still be noticeable because of their unnatural topography and differences in vegetation pattern. Reclamation failure would continue long-term impacts to both recreation and land use.

4.7.3.3 Short-term Use/Long-term Productivity

Access to lands currently within the mine operational areas continue to be restricted until reclamation activities are complete. The reclamation plan under Alternative 1 would not be successful in a majority of areas, which would continue significant long-term impacts to future productive uses of the affected lands such as wildlife habitat and hunting.

TABLE 4.7-1
ACREAGE OF LAND AFFECTED

	Existing			Additional[2]			Total
Alternatives	Public[3]	Private	Total	Public	Private	Total	(EXISTING + ADDITIONAL)
1) No Action (Permitted Operations and Reclamation)							
- Zortman	122	284	406	0	0	0	406
- Landusky	472	311	783	0	0	0	783
- Total	594	595	1189	0	0	0	1189
2) Mine Expansion Not Approved and Company Proposed Reclamation							
- Zortman	122	284	406	0	0	0	406
- Landusky	472	311	783	0	0	0	783
- Total	594	595	1189	0	0	0	1189
3) Mine Expansion Not Approved and Agency Mitigated Reclamation							
- Zortman	122	284	406	21	257	278	684
- Landusky	472	311	783	22	23	45	828
- Total	594	595	1189	43	280	323	1512

TABLE 4.7-1
ACREAGE OF LAND AFFECTED
(Continued)

Alternatives	Existing			Additional[2]			Total
	Public[3]	Private	Total	Public	Private	Total	(EXISTING + ADDITIONAL)
4) Company Proposed Expansion and Reclamation (Company Proposed Action or CPA)[4]							
- Zortman	122	284	406	186	693	879	1285
- Landusky	472	311	783	56	37	93	876
- Total	594	595	1189	242	730	972	2161
5) Agency Mitigated Expansion and Reclamation with Leach Pad in Upper Alder Gulch[5]							
- Zortman	122	284	406	477	351	828	1234
- Landusky	472	311	783	58	37	95	878
- Total	594	595	1189	535	388	923	2112
6) Agency Mitigated Expansion and Reclamation with Waste Rock Facility on Ruby Flats[4]							
- Zortman	122	284	406	51	805	856	1262
- Landusky	472	311	783	58	37	95	878
- Total	594	595	1189	109	842	951	2140

TABLE 4.7-1
ACREAGE OF LAND AFFECTED BY ZORTMAN-LANDUSKY EIS ALTERNATIVES[1]
(Concluded)

Alternatives	Existing			Additional[2]			Total
	Public[3]	Private	Total	Public	Private	Total	(EXISTING + ADDITIONAL)
7) Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located in Existing Mine Facilities (Preferred)[4]							
- Zortman	122	284	406	69	675	744	1150
- Landusky	472	311	783	13	15	28	811
- Total	594	595	1189	82	690	772	1961

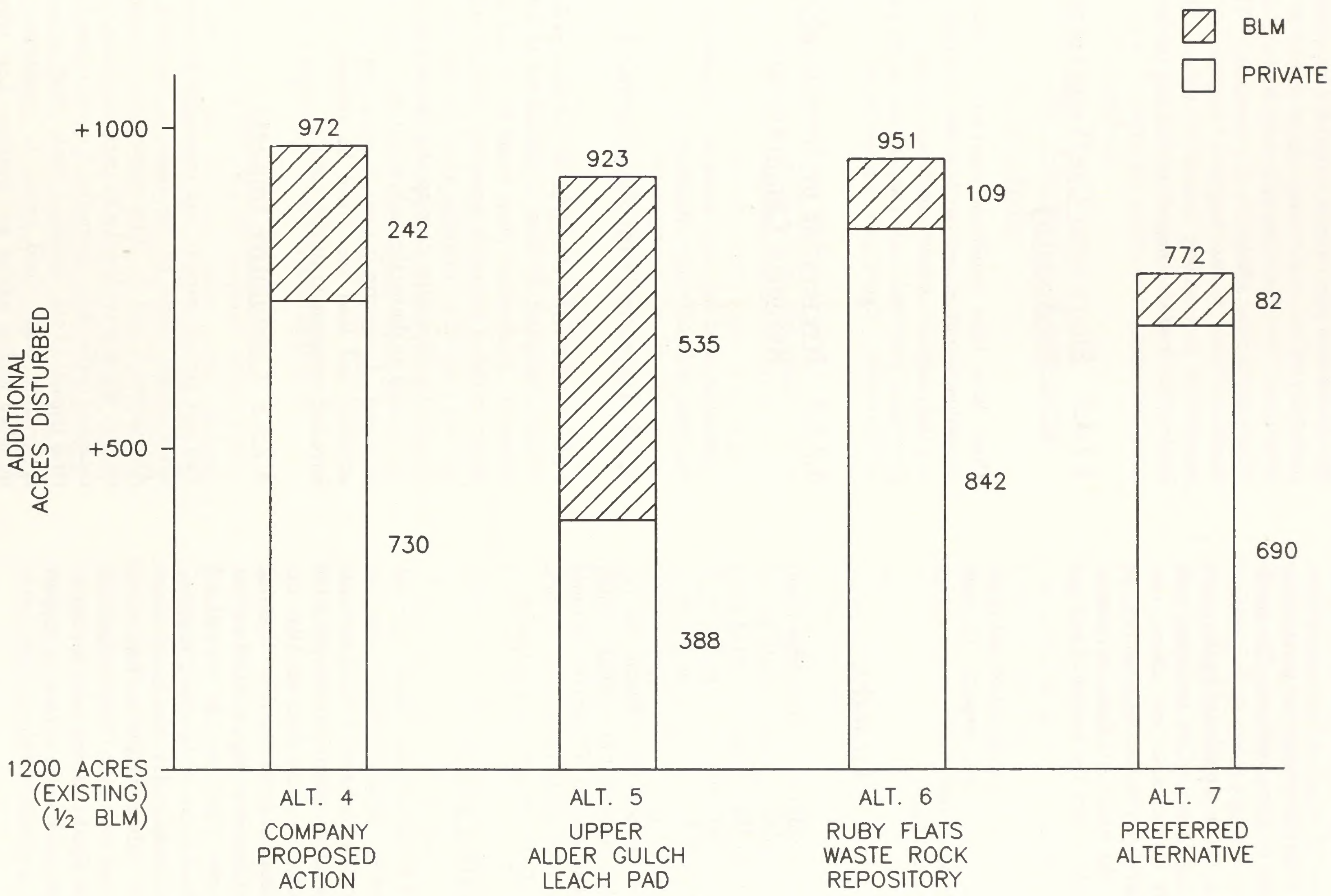
1 Reasonably foreseeable actions and the acreage potentially affected by them are not included in this analysis. Acres of disturbance reported in this table may differ from those reported in other sections of the document due to variances in how different resources define the study area, ancillary facilities included or not included in the calculations, and differences in map sources.

2 "Additional" disturbance refers to total additional disturbance from proposed operations.

3 Public lands managed or controlled by the BLM.

4 Includes the proposed Land Application Disposal Area (approximately 285 acres) around the proposed Goslin Flats heap leach pad.

5 Includes the proposed Land Application Disposal Area at Goslin Flats (currently pending permit review).



MINE EXPANSION ALTERNATIVES
ADDITIONAL DISTURBANCE
BY OWNERSHIP

FIG. 4.7–1

173E0025

4.7.3.4 Irreversible or Irretrievable Resource Commitments

Mining in the Little Rocky Mountains has permanently altered the topography in some locations. The scenic quality of some lands would not return to their original condition. For land uses that are affected by the scenic quality and natural appearance of the landscape, such as scenic viewing by recreationists and cultural uses (vision quests) by Native Americans, there has been an irretrievable loss in the quality of their experiences. This impact has already occurred as a result of past and ongoing mining activities.

With reclamation failure because of limited soil depth and soil acidification problems, impacts to both recreation and land use resources would remain at high levels into the foreseeable future.

4.7.4 Impacts from Alternative 2

Under this alternative, already permitted activities would continue, but plans for mine expansion would not be approved. Impacts from the already permitted mine activities would be as described for Alternative 1. Reclamation plans would be revised as proposed by ZMI. The Seaford clay pit, located approximately 7 miles south of Zortman and the Williams clay pit, located approximately 2 miles west of Landusky, would be used for reclamation material. Disturbance at those sites would not impact recreational facilities or activities. Impacts would generally be the same as Alternative 1.

4.7.4.1 Cumulative Impacts

As in Alternative 1, future mining activities are not reasonably foreseeable with implementation of Alternative 2. It is possible that a few exploration roads may be built, but exploration activities are also predicted to be limited since this alternative does not allow for mining of already delineated ore reserves. Existing impacts from past and current mining activities have had a significant short-term effect on the recreational environment in the local area. Alternative 2 improves the probability of successful reclamation in the short-term. It does not reduce long-term impacts to recreation and land use resources. With reclamation failure there would be significant long-term impacts to recreation, and to the ability of the land to support other land uses such as wildlife habitat.

4.7.4.2 Unavoidable Adverse Impacts

The reclamation plan under Alternative 2 improves the probability of successful revegetation slightly in the short-term. However, there still would be large areas where reclamation efforts are not successful. There would continue to be long-term impacts to the recreational environment caused by indirect visual impacts, and long-term impacts to returning the land to other land uses.

4.7.4.3 Short-term Use/Long-term Productivity

There have been significant short-term impacts to recreation resources surrounding the Zortman and Landusky mines. Lands would not return to other productive land uses and recreational opportunities would remain at significantly reduced levels.

4.7.4.4 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments are the same as described for Alternative 1.

4.7.5 Impacts from Alternative 3

Under this alternative, already permitted activities would continue, but plans for mine expansion would not be approved. Reclamation plans would be revised using agency modified corrective measures. Effects to land use and recreation resources would be the same as described in Alternative 2, except that the probability of reclamation producing the desired post-mine land use is increased. Long-term impacts to recreation sites and activities, and land use would be reduced by the increased revegetation success rate.

4.7.5.1 Cumulative Impacts

Past and present impacts, and reasonably foreseeable developments would be the same as described for Alternatives 1 and 2. Improvement in reclamation success, which is predicted with implementation of the measures outlined for Alternative 3, would reduce long-term impacts to non-significant levels. With successful reclamation lands could return to productive use, including wildlife habitat and hunting. Less reliance would be required on active water treatment.

4.7.5.2 Unavoidable Adverse Impacts

Impacts would generally be as described for Alternatives 1 and 2. However, reclamation measures included in this alternative would improve the potential for reclamation success. The large improvement in the general success of reclamation would reduce long-term impacts to the recreational environment, and increase the availability and productivity of the land for other land uses. Topographic modifications in the landscape will still be significant.

4.7.5.3 Short-term Use/Long-term Productivity

Short-term use would be the same as for Alternatives 1 and 2. The increase in the effectiveness of reclamation would increase the long-term productivity of the affected area for other land uses.

This alternative assumes the use of Goslin Flats as a borrow source for topsoil, subsoil, and possibly gravel for non-acid generating layers in reclamation covers. This disturbance would temporarily (about 3 to 5 years) restrict access to Goslin Flats, used by recreationists, and Saddle Butte, used by biologists for access to Azure Cave. This is an unavoidable impact associated with enhancing long-term productivity of the site.

4.7.5.4 Irreversible or Irretrievable Resource Commitments

Irretrievable resources commitments would be the same as described for Alternatives 1 and 2 for land uses affected by scenic quality and natural appearance of the landscape. Successful reclamation would limit other long-term losses to recreation and other land uses.

4.7.6 Impacts from Alternative 4

Alternative 4 is the company proposed action (CPA). Activities at the Zortman Mine would include: expansion of existing pits; a waste rock repository in Carter Gulch; an overland conveyor for ore transport; a heap leach pad and other processing facilities in Goslin Flats; rerouting of the Zortman to Landusky access road, power line, and pipeline; upgrading of haul roads; and development of a limestone quarry, LS-1, south of Green Mountain. No direct impacts to recreation facilities or activities would occur to areas in, or immediately adjacent to, existing mining operations. However, the overland conveyor, which would carry ore from the mine to the heap leach pad in Goslin Flats, and the Goslin Flats heap leach pad, would restrict access to Goslin Gulch, which is occasionally used by recreationists and biologists to access Saddle Butte and Azure Cave. Access would be maintained into Pony Gulch. Hunters may encounter access restrictions along the length of the conveyor. The Camp Creek Campground and Buffington day use area would not be directly impacted by the proposed mine expansion.

Indirect impacts would be significant, primarily as a result of an increase in visual, noise and traffic impacts. Sightseeing, which includes walking, biking, horseback riding or driving along roads and trails, is a high use activity in the Little Rocky Mountains. Recreationists driving up the county road (7-mile Road) to the town of Zortman would drive by the heap leach pad and processing facilities in Goslin Flats. Facilities at Goslin Flats would require night lighting, creating a noticeable light source for miles around. Trail users on Old Scraggy Peak and Saddle Butte would also be exposed to the new facilities in Goslin Flats as well as expansion of facilities at the mine site (mine pits and the waste rock dump). The increase in industrial activity in the area would affect the natural appearance of the landscape and decrease the quality of the recreational environment. This would cause significant short-term impacts until the area is reclaimed. For users requiring scenic quality and natural appearing landscapes, impacts would be significant regardless of reclamation strategy. Mine life would be extended by approximately five to eight years after project startup.

Proposed activities at the Landusky Mine include expansion of the existing pits and heap leach pads, and development of a limestone quarry at Kings Creek. None of these proposed facilities would directly impact developed recreation facilities. The Montana Gulch campground is not within view of mining areas. Indirect impacts would be the same as those caused by expansion of the Zortman Mine - primarily visual impacts caused by an increase in the amount of visible mine disturbance. The expanded mine pits and/or heap leach pads would be seen from several of the higher peaks in the area including Mission, Indian and Silver Peaks, Thornhill Butte, and from sections of U.S. Highway 191 and State Highway 66. Expansion of the heap leach pads would be visible from the Pow Wow grounds in Mission Canyon. This would cause a small incremental increase in visual impacts to the Pow Wow grounds, but would not be expected to cause any reduction in the recreational use of the area.

Continued disturbance at the Landusky Mine would increase the area of visible contrast to viewers on both the auto tour route on the Charles M. Russell National Wildlife Refuge (CMR) and the Missouri Backcountry Byway south of the Missouri River. Recreation facilities or activities within the CMR would not be directly impacted by the proposed mine expansion.

Continued mining in the Little Rocky Mountains would not be inconsistent with federal land use plans. Private land in Goslin Gulch, used for the heap leach pad and ancillary facilities, would no longer be used for livestock grazing. This would have a minor effect on the total amount of grazing land in the region. Phillips County would require the rezoning of the Goslin Gulch land from agriculture to industrial. After reclamation, grazing could be an appropriate use on reclaimed lands.

4.7.6.1 Cumulative Impacts

Reasonably foreseeable future developments at the Zortman Mine include mining in the Pony Gulch area, expansion of the Goslin Gulch leach pad, additional limestone quarry development, and a transmission line which may be built between Malta, Montana and the mine site. At the Landusky Mine foreseeable future actions include continued mining of ore and waste rock at existing pits and the South Gold Bug pit, additional heap leach capacity, and additional limestone mining at the King Creek quarry and an additional quarry in Montana Gulch. Exploration activities could occur over a ten year period and disturb up to 155 acres throughout that portion of the Little Rocky Mountains outside of the Fort Belknap Indian Reservation. This additional disturbance would be from road and trench construction and drill sites.

Mine development in the Pony Gulch area would have a significant, direct impact on recreationists who may use the area for hiking, hunting or Christmas tree cutting. Disturbance from additional ore and waste rock mining and exploration activities would increase the amount of industrial activity occurring in the area and decrease the amount of land in the Little Rocky Mountains that provide undisturbed, intact landscapes and environments. Future mine development would prolong the use of facilities in Goslin Flats, increasing the duration of visual impacts in that area. Operation of a limestone quarry at the Montana Gulch site would cause substantial visual and noise impacts to recreationists at the Montana Gulch campground.

A transmission line from Malta to the mine site would likely have no direct effects to recreation. Indirect impacts may result in a few areas due to negative effects to scenic quality, but impacts would again likely be minor. Private lands may be effected by a new right-of-way; however, most lands in this area are used for livestock grazing and this land use would not be impacted by a transmission line.

In summary, there has been significant short-term impacts to the local recreational environment caused primarily by indirect visual impacts from existing mine developments, and from access restrictions. On a more regional level, impacts are not considered significant. Recreation activities outside of the Little Rocky Mountains, including prairie dog hunting and developed recreation sites along the Missouri River are unaffected. Visible contrasts in the landscape caused by mine disturbance are noticeable from very long distances, including viewers on the Missouri Breaks Backcountry Byway, but these impacts are not significant enough at those distances to cause a substantial reduction in the enjoyment of their activities.

The CPA would extend the mine life for approximately eight years, and create new areas of visible ground disturbance and industrial activity. Foreseeable mine development and exploration activities would extend those impacts for some years into the future and delay the final reclamation of some mine facilities/disturbance areas. Once final reclamation has occurred, the land could return to productive land uses including wildlife habitat and grazing. Access to reclaimed areas would allow recreationists to use the area again for hunting and other activities, and the indirect visual impacts would be reduced. Impacts to users requiring undisturbed scenic quality and natural appearing landscapes are significant and would be increased under Alternative 4 by 972 acres.

4.7.6.2 Unavoidable Adverse Impacts

Indirect visual impacts to recreationists, and other users would occur for the life of mine, until the area has been successfully reclaimed, and for some users forever. Access to mining areas for hunting or sightseeing would continue to be restricted as long as the mines are operational. Use of mined lands for other purposes such as wildlife habitat and recreation (hiking, gathering forest products) would be precluded until after final reclamation. Topographic modification and natural scenic quality would never be the same regardless of reclamation success. This is an unavoidable significant impact to Native Americans. For Native Americans and others who value natural conditions, impacts would be non-mitigatable.

4.7.6.3 Short-term Use/Long-term Productivity

Impacts to the productivity of disturbed lands to provide recreational opportunities would increase for the life of mine, projected to be around eight years. Foreseeable developments could extend impacts for several more years. However, the long-term productivity of disturbed areas for some users could be returned with successful reclamation. Reclaimed areas at both the Zortman and Landusky mines could, in the future, be used for wildlife habitat and for recreational use including hunting and hiking, although there would be some long-term reduction in the quality of the recreational environment due to residual visual impacts. Reclaimed land in Goslin Flats would be used for livestock grazing and wildlife habitat, which are the current land uses.

4.7.6.4 Irreversible or Irretrievable Resource Commitments

Mining expansion at the Zortman and Landusky mines would cause an increase in the irretrievable change in the scenery of the area. Mine pits, waste rock dumps/repositories, heap leach pads, roads, limestone quarries, and other facilities will increase the permanent changes to the topography in disturbed areas. Visual scars caused by the pit highwalls would not be corrected by reclamation, and those facilities that would be graded and revegetated would still look like unnatural landforms and would be noticeable as a human modified landscape. This is increased over Alternatives 1-3. For some recreationists, and for other users of the area including Native Americans using the surrounding peaks for vision quest sites, that has caused significant a permanent reduction in the quality of the environment. Revegetation of the reclaimed areas should reduce the impacts to acceptable levels for most users, but the area would not be returned to its original, pre-mining condition. As a result of the expansion, disturbance would be increased by 972 acres.

4.7.7 Impacts from Alternative 5

Under Alternative 5, the heap leach facility would be located in upper Alder Gulch. This would place all of the major new facilities at the Zortman Mine in the Alder Gulch drainage. Siting the facilities in these locations would have no direct impact on developed recreation. New facilities would have an additive visual impact to those already existing at the mine.

With this alternative there would be no major land disturbance in Goslin Flats. The land application area in Goslin Flats would be used, but this would not create any significant long-term impacts. The overland conveyor system would not be necessary, eliminating impacts caused by the visual disturbance and access considerations associated with the conveyor. Noise impacts from the facilities in Goslin Flats would also be eliminated. During reclamation, an increased amount of clay liner material would have to be transported to mine facilities through the town of Zortman, causing an increase in the traffic impacts to residents of Zortman.

Impacts to recreation and land use at the Landusky mine would generally be as described for Alternative 4.

4.7.7.1 Cumulative Impacts

Reasonably foreseeable actions are similar to those described in Alternative 4, except that the ore reserves in Pony Gulch would not be developed since there would be no heap leach pad in Goslin Flats nor a conveyor system to transport ore. Impacts from past, present and future actions would generally be as described in Alternative 4. This includes significant short-term impacts in the local area as a result of visual impacts and access restrictions. In Alternative 5 there would be an increase in disturbance to land in Alder Gulch which would be noticeable to recreationists hiking the higher peaks surrounding the mine. The Goslin Flats area would not be developed, which would eliminate impacts to sightseers along the roads leading into the town of Zortman and to the Camp Creek campground that would be caused by the proposed heap leach and related facilities in Goslin Flats. Reclamation would reduce impacts to most users except Native Americans and others that desire natural, undisturbed landscapes.

4.7.7.2 Unavoidable Adverse Impacts

Unavoidable impacts would be as described for Alternative 4. Those significant include indirect impacts caused by visual disturbance to the landscape which affects recreationists and other users of the area, including Native Americans, that expect to view undisturbed mountain scenery and whose enjoyment of their activities are reduced by the impacts to the scenic quality of the disturbed areas. Reclamation would not eliminate impacts to these users.

4.7.7.3 Short-term Use/Long-term Productivity

Short-term uses and long-term productivity would generally be as described in Alternative 4.

4.7.7.4 Irreversible or Irretrievable Resource Commitments

Irretrievable commitment of resources are generally the same as described for Alternative 4.

4.7.8 Impacts from Alternative 6

This alternative is the same as Alternative 4 except that the waste rock repository would be relocated from the proposed Carter Gulch site down to the Ruby Flats, northeast of the Goslin Flats heap leach pad. Impacts would be as described in Alternatives 4 and 5, except for those associated with the waste rock repository. The siting of the waste rock repository in the Ruby Flats location would result in no direct impacts to developed recreation facilities. There would be an increase in the visibility of the facility compared to the Carter Gulch location, which would cause a corresponding increase in indirect impacts to the quality of the recreation environment. Noise generated from the Goslin Flats and Ruby Flats facilities would increase, causing indirect impacts to users of the Camp Creek Campground and to dispersed recreation use areas in the surrounding lands.

Locating the waste rock facility on the Ruby Flats would increase the amount of land taken out of livestock production (approximately 200 acres), and would require the use of privately owned land other than that presently controlled by ZMI. Approximately 134 acres of land currently owned by the Square Butte Grazing Association would be affected by the waste rock repository. Industrial use of the area would require additional lands to be rezoned from agriculture to industrial use. With successful reclamation those lands could return to livestock use and wildlife habitat.

4.7.8.1 Cumulative Impacts

Reasonable foreseeable developments would be the same as Alternative 4. Cumulative impacts, based on the past, present and future developments would generally be the same as Alternatives 4 and 5, except for an increase in the magnitude and intensity of visual impacts in the Goslin Flats area, which would, under this alternative, contain both the Goslin Flats heap leach pad and the Ruby Flats waste rock repository.

4.7.8.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as in Alternative 4, except that with the relocation of the Carter Gulch waste rock repository to Ruby Flats, visual impacts would be reduced in the Alder Gulch drainage and increased in the Goslin Flats/Ruby Flats area.

4.7.8.3 Short-term Use/Long-term Productivity

Short-term uses and long-term productivity would generally be as described in Alternatives 4 and 5.

4.7.8.4 Irreversible or Irretrievable Resource Commitments

Irretrievable resource commitments would be as described in Alternative 4. The location of some of the irretrievable changes in topography and corresponding loss in the natural scenic condition of the landscape would be transferred from upper Alder Gulch to the Ruby Flats, where it would be noticeable to more people, as the Ruby Flats area is visible to recreationists and other people traveling to the town of Zortman and to the Camp Creek campground.

4.7.9 Impacts From Alternative 7

Most plans and facility designs under Alternative 7 are similar to Alternatives 4, 5 and 6 and impacts to recreation and land use would generally be the same as those described in Alternatives 4, 5 and 6. The major modification would be at the Zortman Mine where the waste rock repository would be constructed on top of existing facilities at the mine, instead of in Carter Gulch. Most importantly, reclamation covers would also be modified to enhance reclamation success.

As in Alternatives 4, 5 and 6 there would be no direct impacts to recreation facilities. However, the overland conveyor, which would carry ore from the mine to the heap leach pad in Goslin Flats, and the Goslin Flats heap leach pad, would restrict access to Goslin Gulch, which is occasionally used by recreationists and biologists to access Saddle Butte and Azure Cave. Access would be maintained into Pony Gulch. Hunters may encounter access restrictions along the length of the conveyor. The Camp Creek Campground and

Buffington day use area would not be directly impacted by the proposed mine expansion.

Indirect impacts would be significant, primarily as a result of an increase in visual, noise and traffic impacts. Sightseeing, which includes walking, biking, horseback riding or driving along roads and trails, is a high use activity in the Little Rocky Mountains. Recreationists driving up the county road (7-mile Road) to the town of Zortman would drive by the heap leach pad and processing facilities in Goslin Flats. Facilities at Goslin Flats would require night lighting, creating a noticeable light source for miles around. Trail users on Old Scraggy Peak and Saddle Butte would also be exposed to the new facilities in Goslin Flats as well as expansion of facilities at the mine site (mine pits and the waste rock dump). The increase in industrial activity in the area would affect the natural appearance of the landscape and decrease the quality of the recreational environment. This would cause significant short-term impacts until the area is reclaimed. For users requiring scenic quality and natural appearing landscapes, impacts would be significant regardless of reclamation strategy. Mine life would be extended by approximately five to eight years after project startup.

Proposed activities at the Landusky Mine include expansion of the existing pits and heap leach pads, and development of a limestone quarry at Kings Creek. None of these proposed facilities would directly impact developed recreation facilities. The Montana Gulch campground is not within view of mining areas. Indirect impacts would be the same as those caused by expansion of the Zortman Mine - primarily visual impacts caused by an increase in the amount of visible mine disturbance. The expanded mine pits and/or heap leach pads would be seen from several of the higher peaks in the area including Mission, Indian and Silver Peaks, Thornhill Butte, and from sections of U.S. Highway 191 and State Highway 66. Expansion of the heap leach pads would be visible from the Pow Wow grounds in Mission Canyon. This would cause a small incremental increase in visual impacts to the Pow Wow grounds, but would not be expected to cause any reduction in the recreational use of the area.

Continued disturbance at the Landusky Mine would increase the area of visible contrast to viewers on both the auto tour route on the Charles M. Russell National Wildlife Refuge (CMR) and the Missouri Backcountry Byway south of the Missouri River. Recreation facilities or activities within the CMR would not be directly impacted by the proposed mine expansion.

Continued mining in the Little Rocky Mountains would not be inconsistent with federal land use plans. Private land in Goslin Gulch, used for the heap leach pad and ancillary facilities, would no longer be used for livestock grazing. This would have a minor effect on the total amount of grazing land in the region. Phillips County would require the rezoning of the Goslin Gulch land from agriculture to industrial. After reclamation, grazing could be an appropriate use on reclaimed lands.

Indirect impacts to recreationists caused by visual impacts of a new waste rock repository on undisturbed land would be eliminated. Constructing the new waste rock repository on already disturbed land would not cause additional indirect visual impacts over those that currently exist. Other impacts to recreation and land use that would be caused by the Goslin Flats heap leach pad, conveyor system, development, access roads, and other ancillary facilities would remain the same as described for Alternatives 4 and 6.

Under this Alternative, no clay would be mined at the Seaford or Williams Clay pits. However, this change results in no effect to recreational use, simply a reduction in land disturbance at the two sites. In addition, limestone would be mined from the LS-2 and Montana Gulch sites rather than King Creek and LS-1. Limestone mining at LS-2 could result in some minor additional recreational access limitation from the town of Zortman to areas west.

4.7.9.1 Cumulative Impacts

Reasonable foreseeable mine activities at both the Zortman and Landusky mines would be the same as described under Alternatives 4 and 6. Reasonably foreseeable future developments at the Zortman Mine include mining in the Pony Gulch area, expansion of the Goslin Gulch leach pad and additional limestone quarry development. At the Landusky Mine foreseeable future actions include continued mining of ore and waste rock at existing pits and the South Gold Bug pit, additional heap leach capacity, and additional limestone mining at the King Creek quarry and an additional quarry in Montana Gulch. Exploration activities could occur over a ten year period and disturb up to 155 acres throughout that portion of the Little Rocky Mountains outside of the Fort Belknap Indian Reservation. This additional disturbance would be from road and trench construction and drill sites.

Mine development in the Pony Gulch area would have a significant, direct impact on recreationists who may use the area for hiking, hunting or Christmas tree cutting. Disturbance from additional ore and waste rock mining and exploration activities would increase the amount of industrial activity occurring in the area and decrease the amount of land in the Little Rocky Mountains that provide undisturbed, intact landscapes and environments. Future mine development would prolong the use of facilities in Goslin Flats, increasing the duration of visual impacts in that area. Operation of a limestone quarry at the Montana Gulch site would cause substantial visual and noise impacts to recreationists at the Montana Gulch campground.

A transmission line from Malta to the mine site would likely have no direct effects to recreation. Indirect impacts may result in a few areas due to negative effects to scenic quality, but impacts would again likely be minor. Private lands may be effected by a new right-of-way; however, most lands in this area are used for livestock grazing and this land use would not be impacted by a transmission line.

In summary, there has been significant short-term impacts to the local recreational environment caused primarily by indirect visual impacts from existing mine developments, and from access restrictions. On a more regional level, impacts are not considered significant. Recreation activities outside of the Little Rocky Mountains, including prairie dog hunting and developed recreation sites along the Missouri River are unaffected. Visible contrasts in the landscape caused by mine disturbance are noticeable from very long distances, including viewers on the Missouri Breaks Backcountry Byway, but these impacts are not significant enough at those distances to cause a substantial reduction in the enjoyment of their activities.

As described under Alternative 4, the mine life would be extended for approximately eight years, and create new areas of visible ground disturbance and industrial activity. Foreseeable mine development and exploration activities would extend those impacts for some years into the future and delay the final reclamation of some mine facilities/disturbance areas. Once final reclamation has occurred, the land could return to productive land uses including wildlife habitat and grazing. Access to reclaimed areas would allow recreationists to use the area again for hunting and other activities, and the indirect visual impacts would be reduced. Impacts to users requiring undisturbed scenic quality and natural appearing landscapes are significant and would be increased under Alternative 7 by 772 acres. Potential impacts to recreation and land use would also be the same.

4.7.9.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would generally be the same as in Alternatives 4, 5 and 6. Indirect visual impacts to recreationists, and other users would occur for the life of mine, until the area has been successfully reclaimed, and for some users forever. Access to mining areas for hunting or sightseeing would continue to be restricted as long as the mines are operational. Use of mined lands for other purposes such as wildlife habitat and recreation (hiking, gathering forest products) would be precluded until after final reclamation. Topographic modification and natural scenic quality would never be the same regardless of reclamation success. This is an unavoidable significant impact to Native Americans. For Native Americans and others who value natural conditions, impacts would be non-mitigatable.

4.7.9.3 Short-term Use/Long-term Productivity

The relationship between short-term use and the long-term productivity of the land to provide recreational opportunities and productive land uses would be the same as described in Alternatives 4, 5 and 6. Impacts to the productivity of disturbed lands to provide recreational opportunities would increase for the life of mine, projected to be around eight years. Foreseeable developments could extend impacts for several more years. However, the long-term productivity of disturbed areas for some users could be returned with successful reclamation. Reclaimed areas at both the Zortman and Landusky mines could, in the future, be used for wildlife habitat and for recreational use including hunting and hiking, although there would be some long-term reduction in the quality of the recreational environment due to residual visual impacts. Reclaimed land in Goslin Flats would be used for livestock grazing and wildlife habitat, which are the current land uses.

4.7.9.4 Irreversible or Irretrievable Resource Commitments

Irreversible and irretrievable resource commitments would be as described for Alternatives 4, 5 and 6. Mining expansion at the Zortman and Landusky mines would cause an increase in the irretrievable change in the scenery of the area. Mine pits, waste rock dumps/repositories, heap leach pads, roads, limestone quarries, and other facilities will increase the permanent changes to the topography in disturbed areas. Visual scars caused by the pit highwalls would not be corrected by reclamation, and those facilities that would be graded

and revegetated would still look like unnatural landforms and would be noticeable as a human modified landscape. This is increased over Alternatives 1-3. For some recreationists, and for other users of the area including Native Americans using the surrounding peaks for vision quest sites, that has caused significant a permanent reduction in the quality of the environment. Revegetation of the reclaimed areas should reduce the impacts to acceptable levels for most users, but the area would not be returned to its original, pre-mining condition. As a result of the expansion, disturbance would be increased by 772 acres.

4.8 VISUAL RESOURCES

4.8.1 Methodology

The assessment of visual impacts was based upon impact significance criteria and methodology developed in the BLM's visual contrast rating system. The degree to which project facilities would impact the scenic qualities of the landscape depends on the amount of visible contrast created by project facilities in relation to the existing landscape character. The amount of contrast between project facilities and the existing landscape features is defined by an analysis of each of the basic visual elements present in the landscape (line, form, color, and texture).

Two key issues were addressed in determining the level of visual contrast. These include the type and extent of actual physical contrast brought about by the project, and the visibility of the proposed project facilities to sensitive viewpoints within the study area. The type of physical contrast is determined by evaluating the following criteria: scale differential, spatial dominance, landforms, soil color, landscape diversity, structural compatibility, and vegetation patterns. Scale differential refers to the proportionate size of project components relative to the surroundings in which they are placed. Spatial dominance is related to scale and refers to the prominence of project components within the landscape. Variables considered in evaluating visibility of facilities included viewer orientation, view distance, duration of view, lighting conditions, topographic and/or vegetation screening, and viewer sensitivity.

The significance of impacts are evaluated by examining the visual contrasts brought about by project facilities, and how those contrasts affect the following: the quality of any scenic resource; scenic resources of rare or unique value; views from (or the visual setting of) parks, wilderness areas, natural areas or other sensitive land use; views from (or the visual setting of) travel routes, including roads and trails; and views from (or the visual setting of) established or planned recreational, educational, scientific or preservational facility or use area. For the non-expansion alternatives (1-3) long-term impacts are those lasting 5 years or more (USDI 1986b). For the expansion alternatives (4-7) short-term impacts would be those which end by the time mining stops. Long-term impacts would be those extending beyond mine life.

Sensitive viewpoints within the study area, termed Key Observation Points (KOPs), were selected as representative views from travel routes, recreational areas, residential areas, and views from several sites of significance to Native Americans. A total of 21 KOPs were mapped within the study area, as shown in Figure 4.8-1. Table 4.8-1 describes significant visibility characteristics of the KOPs and results of the visibility analysis from each KOP. Visibility of the proposed facilities from the KOPs were analyzed through the examination of aerial photographs, 7.5 min. topographic maps, site visits, photographs taken from the KOPs, and computer visibility models.

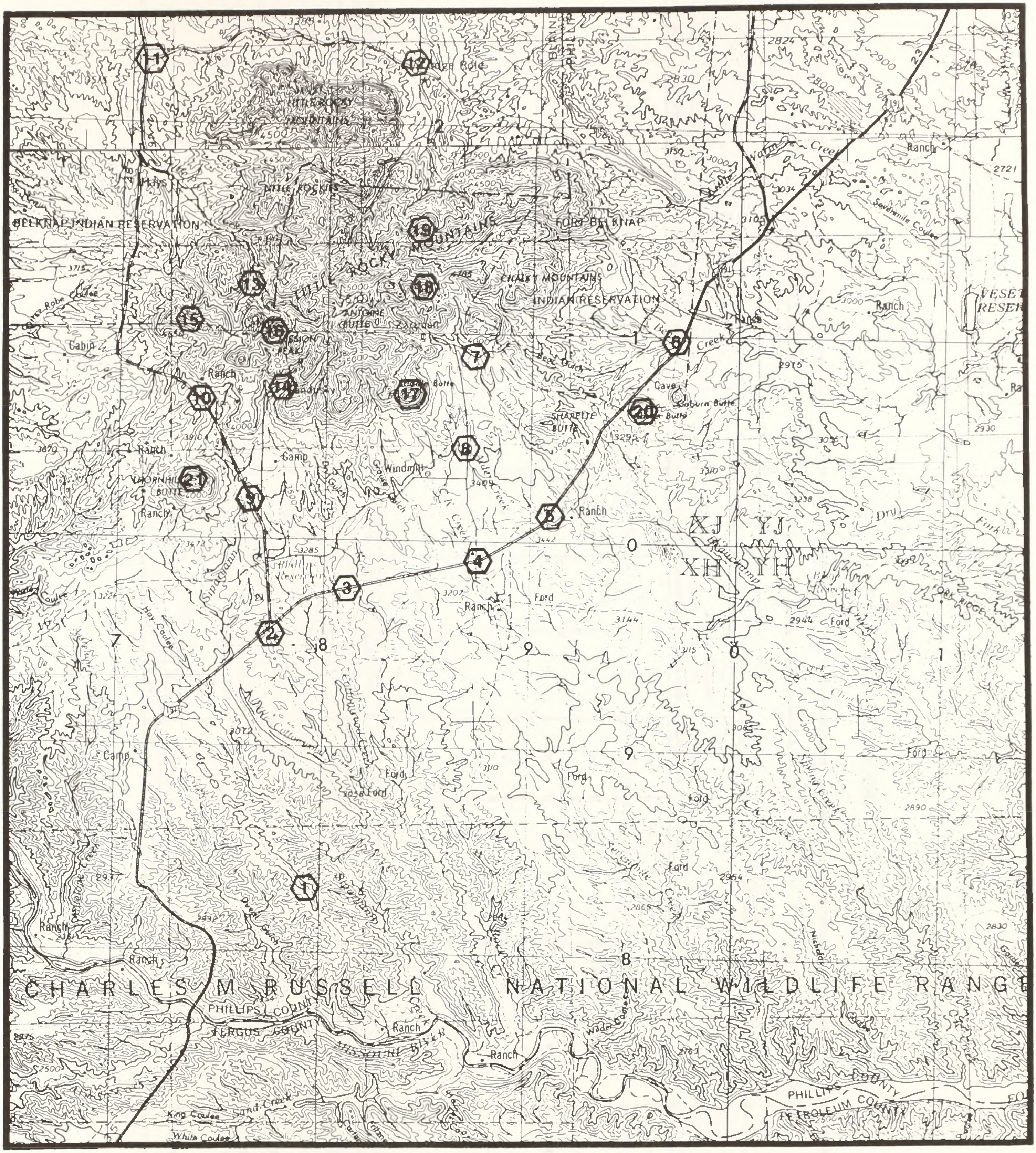
In addition to the visibility analysis, photographic simulations of the proposed action and alternative facilities were prepared from selected viewpoints. Simulations are from viewpoints with representative views from recreation areas, travel routes and areas traditionally used by Native Americans, and display the existing view and views with the proposed and/or alternative project facilities. Simulations were presented in Appendix D of the Draft EIS (1995).

4.8.2 Impacts from Mining, 1979 to Present

Modern mining began at the Zortman and Landusky mines in 1979. At that time, surface disturbance associated with historic mining activity was visible in Alder and Ruby Gulches near Zortman, and in the area surrounding Gold Bug Butte near Landusky. Visual contrasts were evident in the landscape, caused by road building, surface mining, adits, waste rock and tailing. However, these disturbances were on a relatively small scale and the area could still be characterized as being generally natural appearing, except in a few localized areas. Historic mining had disturbed approximately 54 acres in the vicinity of the Zortman and Landusky mines. Views of the disturbed areas were generally confined to a small local viewshed, and were not noticeable from the main roads surrounding the Little Rocky Mountains.

In 1979 the visual resources of the Little Rocky Mountains were evaluated by the BLM using the Visual Resource Management (VRM) methodology. The scenic quality of the area was classified as A scenery (the highest rating), and was given a VRM Class II rating. Objectives for Class II landscapes call for the retention of the existing character of the land. Changes in the landscape should be low and not attract attention.

Currently, 401 acres at the Zortman mine and 814 acres at the Landusky mine have been disturbed. This includes disturbance from open mine pits, heap leach



KEY OBSERVATION POINTS

FIG. 4.8-1

TABLE 4.8-1
KEY OBSERVATION POINTS

KOP No.[1]	Viewpoint	Jurisdiction[2]	Elevation (Feet)	View Distance (Miles)		Major Proposed and Alternative Project Facilities Seen[3]									
						Zortman							Landusky		
				Zortman Mine	Landusky Mine	Mine Pit Expansion	Carter Gulch Waste Rock Repository	Overland Conveyor	Goslin Flats Heap Leach	Limestone Quarry	Ruby Terrace Waste Rock Repository	Alder Gulch Heap Leach	Mine Pit Expansion	Heap Leach Pad Extension	Limestone Quarry King Creek
1	CMR-Auto Tour Route	USFW	2,953	17.6	16.3	N	N	N	N	N	N	N	Y	Y	N
2	DY Junction	BLM	3,220	10	8.4	N	N	N	N	N	N	N	Y	Y	N
3	U.S. Hwy. 191 ~3 mi. N of DY Junction	Private	3,120	8.4	7.4	N	N	N	N	N	N	N	Y	Y	N
4	U.S. Hwy. 191-Junction with Dry Fork Rd.	Private	3,220	8.1	8.3	N	N	N	Y	N	Y	N	N	N	N
5	U.S. Hwy. 191 ~3 mi. N of Dry Fork Rd.	State	3,380	8	8.9	Y	Y	N	Y	N	Y	N	N	N	N
6	Bear Gulch Road Junction w/U.S. Hwy. 191	FBIR	3,040	9.3	11.6	Y	N	N	N	N	N	N	N	N	N
7	Bear Gulch Road Landing Strip	Private	3,960	3	3.9	Y	N	Y	Y	N	Y	Y	N	N	N
8	7-Mile Road ~4 mi. N of U.S. Hwy. 191	Private	3,530	5.9	6.4	N	N	Y	Y	N	Y	N	N	N	N
9	State Hwy. 66-Junction w/Landusky Rd.	Private	3,500	6.7	4.5	N	N	N	N	N	N	N	Y	Y	N
10	State Hwy. 66 ~3.5 mi. N of Landusky Rd.	Private	3,880	5.9	3.2	N	N	N	N	N	N	N	Y	N	N
11	State Hwy. 66-Junction w/Lodge Pole Rd.	FBIR	3,280	10	9.5	N	N	N	N	N	N	N	Y	Y	N
12	Lodge Pole	FBIR	3,460	6.8	8.7	Y	N	N	N	N	N	N	N	N	N
13	Pow Wow Grounds-Mission Canyon	FBIR	4,040	3.5	2.1	N	N	N	N	N	N	N	N	Y	N

TABLE 4.8-1 - KEY OBSERVATION POINTS
(Concluded)

KOP No.[1]	Viewpoint	Jurisdiction[2]	Elevation (Feet)	View Distance (Miles)		Major Proposed and Alternative Project Facilities Seen[3]									
						Zortman							Landusky		
				Zortman Mine	Landusky Mine	Mine Pit Expansion	Carter Gulch Waste Rock Repository	Overland Conveyor	Goslin Flats Heap Leach	Limestone Quarry	Ruby Terrace Waste Rock Repository	Alder Gulch Heap Leach	Mine Pit Expansion	Heap Leach Pad Extension	Limestone Quarry King Creek
14	Landusky townsite	Private	4,000	3.6	1.1	N	N	N	N	N	N	N	Y	N	N
15	Eagle Child Mountain	FBIR	5,243	5.7	3.5	N	N	N	N	N	N	N	Y	N	N
16	Mission Peak	FBIR/BLM	5,480	3	.3	N	N	N	N	N	N	N	Y	Y	Y
17	Saddle Butte	BLM	5,192	2.9	3.7	Y	Y	Y	Y	N	Y	N	N	N	N
18	Old Scraggy Peak	BLM	5,708	1.6	4.6	Y	Y	N	Y	Y	N	Y	N	N	N
19	Beaver Mountain	BLM	5,542	2.4	5	Y	N	N	N	Y	Y	N	N	N	N
20	Ricker Butte	FBIR/ Private	3,977	8.6	10.5	Y	Y	Y	Y	N	Y	Y	N	N	N
21	Thornhill Butte	BLM	4,636	7.6	5.1	N	N	N	N	N	N	N	Y	Y	N

[1] KOP number corresponds to numbers shown on Figure 4-8.
[2] USFW = United States Fish and Wildlife Service
BLM = Bureau of Land Management
FBIR = Fort Belknap Indian Reservation
[3] Y = seen; N = not seen; - = no data

pads, waste rock storage, roads, topsoil stockpiles, processing areas and other ancillary facilities/ disturbance areas. Impacts to the scenic quality of the area have been significant.

Open pit mining has caused major changes in landforms, creating sharp contrasts in the line, form, color and textures visible in the landscape. Areas where rock and soil have been exposed contrast with color and texture of the surrounding natural vegetation. Unnatural looking landforms have been created by the excavation of the mine pits, and by the large heap leach pads and waste rock dumps. Roads, especially the downhill sidecast along the roads, create color and line contrasts visible for miles from the mine sites. Benches along the highwall create strong geometric lines and forms that contrast with the characteristic lines and shapes naturally occurring mountain landscapes. The scale of the disturbance dominates the viewers attention.

At the Zortman mine these visual contrasts are visible to many of the surrounding peaks and buttes, including Old Scraggy Peak and Saddle Butte, both of which are used by recreationists for hiking, picnicking and wildlife viewing, and by Native Americans for cultural purposes. Although portions of the disturbed areas at the Zortman mine can be seen from several high viewpoints surrounding the mine, much of the disturbance is topographically enclosed and not visible from lower vantage points. The Landusky mine has twice the amount of disturbed acres as the Zortman Mine, and is visible not only to high points surrounding the mine, but to viewpoints as far away as the Missouri Breaks Backcountry Byway, located over 20 miles south of the mine. Closer to the mine, mine facilities can be seen by travellers along U.S. Highway 191 and State Highway 66. The current disturbance at both the Zortman and Landusky mines is not compatible with the scenery management objectives of VRM Class II landscapes.

4.8.3 Impacts from Alternative 1

Under Alternative 1, permitted activities would continue, but mine extension plans would not be approved. Previously permitted activities at the Zortman mine include continued leaching at the 89 pad and reclamation and closure activities. There is approximately one year of leaching capacity at the 89 pad, final reclamation should be completed by 1997. At the Landusky mine, ore is still being removed at the Gold Bug pit and leaching operations are active at the 87/91 and 91 heap leach pads. Ore removal will likely continue through 1995. Heap leaching will continue for several years after the last of the ore has been mined - final reclamation would take 2-3 years after active leaching is complete. Permitted operational activities would have no appreciable effect on the existing visual quality at the mines. Existing disturbance has already caused significant long-term impacts to the scenic quality of the mined areas.

With successful reclamation, visual contrasts could be reduced. Revegetation of reclaimed facilities would mitigate much of the color contrasts caused by the exposed rock and soil. However, the reclamation measures outlined for Alternative 1 would fail in most areas - the result of steep slopes on reclaimed facilities and inadequate soil depth, failure of the reclamation covers to prevent erosion and acidification of soil. In areas where revegetation was not successful, bare soil would be exposed and would continue the visual contrasts that currently exist. The alteration of topography caused by mine pits and the large man-made landforms caused by the heap leach and waste rock facilities would be apparent, even after reclamation. Visual contrasts resulting from the failure of reclamation to establish ground cover in some areas, the contrasts in landforms, and the visual scar left by the pit highwalls would attract attention from several sensitive viewpoints, causing long-term significant impacts to the visual resources of the southern Little Rocky Mountains. These impacts would be especially evident at the Landusky mine, which is visible to a greater number of observers than the Zortman mine, including travellers along the two major highways in the area, U.S. 191 and State Highway 66.

4.8.3.1 <u>Cumulative Impacts</u>

Foreseeable future mine development or exploration activities in the Little Rocky Mountains are limited under Alternative 1 since mining delineated ore reserves would not be approved. Any road building associated with exploration activities would cause additional color and line contrasts.

In summary, mining activity from 1979 to present has caused significant long-term impacts to the visual resource. Alternative 1 would not allow further mining which would stop additional, additive impacts from occurring, but has a reclamation plan that would not be successful. Long-term significant impacts would not be reduced after implementation of the reclamation plan.

4.8.3.2 <u>Unavoidable Adverse Impacts</u>

Unavoidable adverse impacts include contrasts created by the exposed rock of the mine pit highwalls, contrasts caused by large man-made landforms (heap leach pads and waste rock stockpiles), and possible color contrasts created by the failure of reclamation to establish vegetative cover in most areas. Significant visual impacts would not be reduced.

4.8.3.3 Short-term Use/Long-term Productivity

Scenic resources of the area have been degraded in order for mine development to occur. The long-term productivity of the visual resource would not return to its original condition or quality after reclamation in Alternative 1..

4.8.3.4 Irreversible or Irretrievable Resource Commitments

Alteration of the topography has caused an irretrievable loss of the high scenic quality of the original landscape. Reclamation measures in this alternative would not correct or reduce significant visual contrasts present in the landscape today.

4.8.4 Impacts from Alternative 2

Under Alternative 2, already permitted activities would continue, but plans for mine extension would not be approved. Company-proposed corrective measures would be implemented. These corrective measures are primarily intended to control acid rock drainage.

Impacts would generally be as described for Alternative 1, even though the possibility for successful reclamation is increased. The Seaford Clay pit, located approximately 7 miles south of Zortman, and the Williams Clay pit, located approximately 2 miles west of Landusky, would be used for clay liner material. Disturbance at these sites would not be a significant visual impact to identified sensitive viewpoints, although they would be visible from nearby roadways.

Long-term impacts from both the Landusky and Zortman mines, caused primarily from the altered topography and vegetation patterns, would remain significant to close in viewpoints after mine closure and reclamation. Reclamation would not reduce most of the existing visual contrasts which would be noticeable from several sensitive viewpoints, especially from many of the surrounding peaks. Post-reclamation contrasts include form, line, color, and texture contrasts of the pit highwalls and landform contrasts caused by heap leach pads and waste rock dumps. Objectives for VRM Class II landscapes are for landscape modifications not to be noticeable to the casual observer, and to retain the character of the landscape. These objectives may be met from a few of the more long distance viewpoints but would not be met from close in viewpoints such as Mission Peak and Old Scraggy.

4.8.4.1 Cumulative Impacts

Cumulative impacts from past activities, current disturbance, and future activities would be as described for Alternative 1.

4.8.4.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts are generally the same as Alternative 1 and include contrasts created by the exposed rock of the mine pit highwalls, contrasts caused by large man-made landforms (heap leach pads and waste rock stockpiles), and differences in the vegetative patterns and textures of the reclaimed surfaces compared to those occurring naturally in the surrounding lands.

4.8.4.3 Short-term Use/Long-term Productivity

Short-term use/long-term productivity impacts are the same as Alternative 1.

4.8.4.4 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitment impacts are the same as Alternative 1.

4.8.5 Impacts from Alternative 3

Alternative 3 would continue already permitted activities but would not approve plans for mine extension. Agency-modified corrective actions would be implemented to effect source control of acid rock drainage. Part of those corrective actions could include using limestone as capillary break material in the reclamation covers. This may require the mining of limestone at the LS-2 quarry located northwest of the town of Zortman, (Zortman mine), and at the Montana Gulch site for the Landusky Mine. The LS-2 quarry is currently located on mostly undisturbed, tree covered land and would be seen from the town of Zortman and Alder Gulch. Gravel, topsoil, and subsoil would be obtained from a new disturbance on the Goslin Flats.

A borrow source would be developed on approximately 250 acres of what is now pasture land. This would result in a temporary (3 to 5 year) visual impact resulting from a lack of vegetation, exposed substrata, and contractor equipment and trucks. The long-term visual impact may be significant, as the relatively flat topography is changed and affects views from Scraggy Peak and Seven Mile Road. The Montana Gulch quarry site is located on lower ground with a generally southwest aspect, and would be visible from Mission Peak and other high mountain peaks in the vicinity of the Landusky Mine and possibly from the town of Landusky. Impacts from limestone mining would include line, form color and texture contrasts created by the exposed soil and rock, and clearing of vegetation.

Alternative 3 also calls for the Alder Gulch and OK waste rock dumps, the 85/86 leach pad and dike, to be moved from their present location and used as backfill in the mine pits. This would reduce existing landform contrasts caused by those facilities and would lessen the visual impact of the pits, as the surface depression caused by the pit would be partially filled in.

The reclamation covers used in Alternative 3 would produce successful reclamation and revegetation on all mine disturbances, except inaccessible mine benches. Some mine benches that are reclaimed would be reacidified by pitwall runoff, thereby reducing the color contrasts caused by exposed soil. Pit highwalls, landform contrasts, and contrasts in vegetation pattern and textures will still be evident in the landscape after reclamation, and would cause significant long-term impacts to close in viewpoints, especially at the Landusky mine. VRM Class II objectives would be met from the more long distant viewpoints, but would not be met from close in viewpoints, mostly the result of the color and form contrasts of pit highwalls, engineered benches used for drainage on waste rock dumps and heap leach pads and other topographic variations produced by man-made structures.

4.8.5.1 Cumulative Impacts

Reasonably foreseeable mine development and exploration activities are as described for Alternatives 1 and 2. Little additional visual impacts are expected. Past and present impacts to the scenic quality of the affected lands are significant. Post-reclamation impacts remain significant for sensitive viewpoints within close proximity to the mines, mostly from the surrounding peaks. Impacts to sensitive viewpoints located in the background distance zone (> 3-5 miles from the mines) would be reduced to non-significant levels. Reclamation measures used in Alternative 3 would reduce the impacts at both mines compared to alternative 1 and 2.

4.8.5.2 Unavoidable Adverse Impacts

Significant unavoidable adverse impacts include contrasts created by the exposed rock of the mine pit highwalls (including limestone quarries), contrasts caused by large man-made landforms (heap leach pads and waste rock dumps), and differences in the vegetative patterns and textures of the reclaimed surfaces compared to those occurring naturally in the surrounding lands.

4.8.5.3 Short-term Use/Long-term Productivity

Scenic resources of the area have been significantly degraded in order for mine development to occur. The long-term productivity of the visual resource will return to some degree with reclamation, but not return to its original condition or quality, especially from sensitive viewpoints in close proximity to the mines.

4.8.5.4 Irreversible or Irretrievable Resource Commitments

Alteration of the topography has caused an irretrievable loss of the original scenery found in the area. This includes the large depressions in the ground surface caused by the mine pits and the large man-made landforms created by the heap leach pads and the waste rock dumps. Reclamation success does not change this impact from close viewpoints.

4.8.6 Impacts from Alternative 4

Alternative 4 would approve company-proposed mine expansion. Activities at the Zortman Mine would include expansion of existing pits; a waste rock repository in Carter Gulch; removal of the existing Alder Gulch waste rock dump and Ruby Gulch sulfide stockpile for processing at the Goslin Flats heap leach pad; an overland conveyor for ore transport from the mine area to Goslin Flats; a heap leach pad and processing facilities in Goslin Flats; rerouting of the Zortman-to-Landusky access road, power line and pipeline; upgrading of haul roads; and development of a limestone quarry south of Green Mountain (LS-1 quarry). Visibility of the major proposed and alternative facilities is given in Table 4.8-1. Impacts to visual resources would continue to be significant during construction, operations, and from some vantage points, even after successful reclamation.

The vertical and lateral extension of the mine pit would bring the total pit disturbance to about 200 acres. Visual impacts of the pit expansion would include an increase in the alteration of existing topography, and exposure of soil and rock from the newly disturbed area, which would create color, form and texture contrasts. The impacts caused by pit extension would double the existing significant disturbance, and would change the magnitude of existing contrasts and draw additional visual attention to the site. The increased size of the disturbance would be most noticeable from viewpoints north of the Zortman Mine, including Beaver Mountain and the town of Lodge Pole. For Native Americans using these viewpoints, the change would be significant.

The waste rock repository in Carter Gulch would cover an additional 149 acres. This area is currently mostly covered in conifers, and has a dark green color and a generally natural appearance, although there are a few exploration/access roads in this area. Visual impacts would include color, form and texture contrasts created by the alteration of the natural drainage pattern, and the light color of exposed soil and waste rock, which contrasts with the color and texture of the surrounding conifers. Although additional visual impacts would occur from the waste rock repository in Carter Gulch, such impacts would be in an area adjacent to existing disturbance, thereby causing an incremental increase to significant visual effects that already exists in the area.

The overland conveyor for hauling ore from the mine area to the heap leach facility in Goslin Flats would be approximately 5.5 feet high, 4.5 feet wide, and 12,000 feet long. The conveyor corridor would be fenced for most of its length to limit public access; however, it would be engineered to maintain public access to Pony Gulch. A roadway, constructed along the conveyor route, would add additional disturbance, bringing the total width of visible ground disturbance to approximately 50 feet. The conveyor would pass through land which is generally undisturbed, mixed-forest/shrub land in the mountain section, and grassy pasture land in the Goslin Flats area. Construction of the conveyor would introduce a linear feature in the landscape, creating a line and color contrast noticeable from several roads the area (7-mile road and the Bear Gulch road), and from Saddle Butte and Old Scraggy Peak. Appendix D of the Draft EIS contains an artist's conception of the Goslin Flats heap leach pad and the conveyor system.

The heap leach pad and ancillary facilities in Goslin Flats would be located in what is now pasture land. Approximately 5,200 feet long by 1,800 feet wide, the facility would stack ore in 25-foot lifts up to a maximum depth of 200 feet. Other facilities include a soil stockpile on the east side of the leach pad, ore stockpiles and a building which would contain secondary and tertiary crushers, and solution ponds and a processing plant located on the south end of the facility. Construction of the leach pad and facilities would create a major new disturbance in the landscape, affecting approximately 250 acres of land. Visual impacts from the facilities would include strong form and color contrasts created by the introduction of a large geometric shape which would be incongruous with any natural features found in the surrounding landscape. Structures associated with the plant would also introduce line and form contrasts. Night lighting would be required at the mine pits, crusher facilities and at the new facilities in Goslin Flats, creating a visible light source for miles around.

The character of the land would be changed from agricultural to industrial. The leach pad and facilities would be most noticeable from the roads leading into the town of Zortman, and from several high peaks in the area including Saddle and Ricker Buttes. Travellers along U.S. Highway 191 would be able to see the leach pad from the section of highway near the junction with 7-mile Road. Users on 7-mile Road would have the longest duration of view of the leach pad, as the facility would be visible along the entire section of road from the junction with U.S. 191 to the junction with Bear Gulch road. Color contrasts would be the most evident in morning light, when sun illumination would brighten the facilities.

Rerouting of the Zortman to Landusky access road, transmission line and pipeline (the pipeline and transmission line are to be buried), and building new or upgrading existing access/haul roads, would have an additive effect on the overall amount of disturbance visible from viewpoints within the study area. Strong color and line contrasts are created by linear features like roads and cleared right-of-ways, and these contrasts can be visible from very long distances.

A limestone quarry is planned for an area south of Green Mountain in the upper reaches of Lodge Pole Creek. Approximately 13 acres would be disturbed by the quarry, creating color and texture contrasts with the surrounding landscape features. The quarry would be visible from Beaver Mountain and Old Scraggy Peak. An additional 4.2 acres of disturbance would occur at the Seaford clay pit - visual contrasts from that disturbance would be seen from U.S. Highway 191. Duration of view would be short and contrasts would not attract attention.

The photographic simulations, located in Appendix D of the Draft EIS, show examples of existing and future landscape conditions that would occur with implementation of the various alternatives. The following figures show facilities associated with Alternative 4 at the Zortman Mine. Figure D-2 shows the reclaimed Goslin Flats heap leach pad, as viewed from the junction of Highway 191 and Dry Fork Rd. Most color and texture contrasts have been reduced, however the shear size and scale of the landform and the geometric shape, still present a noticeable visual contrast. Figure D-5 shows the reclaimed Zortman facilities as viewed from Ricker Butte. Significant color contrasts are noticeable at the mine pit and surrounding area. Visual contrasts created by the reclaimed Goslin Flats heap leach have been reduced, however the straight edge of the top of the facility creates a unnatural looking line in the landscape. Figure D-13 shows the reclaimed Goslin Flats heap leach as viewed from Old Scraggy Peak. With successful revegetation, the color and texture contrasts are reduced, however the large geometric shape of the landform still presents noticeable line and form contrasts. Figure D-16 shows the mine pit area as viewed from Old Scraggy Peak. The pit highwalls retain significant visual contrasts, particularly the color contrast between the exposed rock of the highwall and the surrounding darker colored vegetation. Figure D-21 shows the reclaimed Zortman mine area as viewed from Saddle Butte. The mine pit highwalls display noticeable color, line, form and texture contrasts. Other reclaimed facilities, including the Carter Gulch waste rock repository, are less noticeable due to the revegetation, grading and scattered planting of trees. Figure D-26 shows the Goslin Flats heap leach pad at full buildout as viewed from Saddle Butte. The leach pad is a major change in the landscape. It's massive size and relative scale, the strong form and color contrasts, and close proximity to the viewpoint draws strong visual attention. Figure D-27 shows the same view after reclamation. Color and texture contrasts have been significantly reduced, however the strong form and line contrasts persist. Figure D-33 shows the view of the reclaimed Goslin Flats heap leach pad as viewed from Bear Gulch Road. Strong line and form contrasts remain, however revegetation has helped the color and texture of the leach pad blend in more with the surrounding landscape.

Activities at the Landusky Mine include extension of existing mine pits and leach pads, and development of a limestone quarry at King Creek. Mining at the Queen Rose and August pits (see Figure 2.8-1) would not involve new disturbances. Extension of the Gold Bug Pit (called the South Gold Bug Pit on Figure 2.8-1) would disturb approximately 20 acres of previously undisturbed ground. The area of the proposed extension is in a highly visible location on the south face of Gold Bug Peak. This area can be seen by travellers on U.S. Highway 191 and Montana Highway 66. Disturbance from the Landusky Mine, particularly the heap leach pads, is visible for long distances (30 to 40 highway miles) to the south of the Little Rocky Mountains, including U.S. Highway 191 and areas within the Charles M. Russell National Wildlife Refuge. The south side of Gold Bug Butte is visible from many locations, and existing exploration roads coming out of the Gold Bug Pit and running across portions of the south face of Gold Bug Peak can be seen. Extension of the pit onto the south face would create more visible disturbance from southerly viewpoints. Impacts would include line, form and color contrasts. The topographic changes in Gold Bug Peak would be silhouetted from some viewpoints, drawing visual attention. From viewpoints north of Gold Bug Peak, the extension of the Gold Bug Pit would not be as noticeable, as the new disturbance would blend in with the existing pit disturbance.

Additions to the existing 1987 and 1991 heap leach pads would create additional surface area of visible disturbance noticeable from several key viewpoints, including points along U.S. Highway 191, Montana Highway 66, the Pow Wow grounds in Mission Canyon, and several high points in the surrounding area, such as Mission Peak and Thornhill Butte.

Development of a limestone quarry at the King Creek location would disturb approximately 10 acres (including disturbance from pit, storage and haul roads) and produce approximately 50,000 tons of limestone. Located on high ground northwest of the existing Queen Rose Pit, a new quarry at the King Creek site would create visual impacts, including color, form and texture contrasts, noticeable from Mission Peak and other dispersed areas in the surrounding landscape. Approximately 7 acres of disturbance would occur at the Williams Clay pit - visual contrasts from that disturbance would be seen from Highway 66 and would attract the viewers attention.

The following figures (found in Appendix D of the Draft EIS) display Alternative 4 at the Landusky Mine. Figure D-36 shows a view of the Landusky Mine from Thornhill Butte. The mine pit highwalls retain noticeable color and texture contrasts. Other reclaimed facilities have been regraded and revegetated to blend in the surrounding landscape and do not draw visual attention. Figure D-38 shows the view of the Landusky Mine as viewed from the Pow Wow grounds in Mission Canyon. The top of the 1987/1991 leach pad is visible and draws visual attention due to form and texture contrasts. During the summer when the grass on the reclaimed facility is a green color the contrasts would be reduced. Figure D-40 shows the Landusky Mine as viewed from Highway 66 at the Landusky turnoff. Reclamation has reduced the visual impacts of most of the facilities to a point where they are not readily noticeable, except for the pit highwalls which retain strong line contrasts. Figure D-43 shows the Landusky Mine at full buildout as viewed from Mission Peak. This viewpoint looks directly down into the mine at very close range (~.3 mile). From this vantage point the mine presents very strong line, form, color and texture contrasts. Figure D-43 shows the reclaimed mine from the same viewpoint. Partial backfilling of the pit and revegetation on some of the facilities has reduced the contrasts, however the mined area, especially the pit highwalls, still presents a very strong visual contrast to viewers on Mission Peak.

4.8.6.1 Cumulative Impacts

Reasonable foreseeable developments at the Zortman Mine include mining activity in the Pony Gulch area south of the existing mine, extension of the Goslin Flats heap leach pad, additional limestone quarry development, construction of a transmission line from Malta, Montana to the heap leach pad in Goslin Flats, and continued exploration activities. At the Landusky mine foreseeable future actions include continued mining of ore and waste rock at existing pits, additional heap leach capacity, and additional limestone quarry operations at the King Creek quarry and a quarry in Montana Gulch.

Exploration activities could occur over a ten year period and disturb an additional 155 acres throughout that portion of the Little Rocky Mountains outside of the Fort Belknap Indian Reservation. This additional disturbance would be from road and trench construction and drill sites. Road construction creates strong line and color contrasts that can be seen for miles from the disturbance.

Mine development in the Pony Gulch area would disturb approximately 14 acres of land. This site is not in a prominent location, but can be seen from Old Scraggy Peak and would be seen by recreationists using the area for dispersed recreation. Disturbance from additional ore and waste rock mining and exploration activities would increase the amount of industrial activity occurring in the area and decrease the amount of land in the Little Rocky Mountains that provide undisturbed, intact landscapes and environments. Future mine development would prolong the use of facilities in Goslin Flats, increasing the duration of visual impacts in that area. These activities would add to the overall amount of visual contrasts present in the Little Rocky Mountains and cause further degradation of the scenic qualities of the high-value mountain landscapes.

A transmission line may be built from Malta, Montana to the heap leach pad in Goslin Flats. It would likely be a 69 kV line with single, wood poles. The transmission line would add a new linear disturbance in the landscape, and, depending on its alignment, impact views from primary travel routes, dispersed recreation areas, and Native American cultural sites.

In summary, past and present mining activities, and those activities proposed under this alternative would continue and enlarge significant long-term impacts to the scenic resources of the area. Reclamation would reduce many of the visual contrasts existing in the landscape, and those which would be created by the proposed expansion, but the residual impacts (impacts after reclamation) from sensitive viewpoints in close proximity to the mine would still draw attention, and would not be consistent with VRM Class II objectives, which calls for change in the landscape to be low and not attract attention.

4.8.6.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts include significant contrasts created by the exposed rock of the mine pit highwalls (including limestone quarries), contrasts caused by large man-made landforms (heap leach pads and waste rock dumps), and differences in the vegetative patterns and textures of the reclaimed surfaces compared to those occurring naturally in the surrounding lands. These types of impacts would nearly double over those occurring in Alternatives 1, 2, and 3.

4.8.6.3 Short-term Use/Long-term Productivity

Scenic resources of the area have been degraded in order for mine development to occur. The long-term productivity or quality of the visual resource will return to some degree with reclamation, but will not return to its original condition or quality. Under Alternative 4, this would include the area of current mine disturbance, and the proposed areas of new disturbance including the Carter Gulch waste rock repository, the limestone quarries at LS-1 and Montana Gulch, and the heap leach and other ancillary facilities in Goslin Flats. These types of impacts would nearly double over those occurring in Alternatives 1, 2, and 3.

4.8.6.4 Irreversible or Irretrievable Resource Commitments

Alteration of the topography has caused an irretrievable loss of the original scenery found in the area. This includes the large depressions in the ground surface caused by the mine pits and the large man-made landforms created by the heap leach pads and the waste rock dumps. Under Alternative 4, the area would increase over Alternatives 1, 2 and 3.

4.8.7 Impacts from Alternative 5

In Alternative 5, the heap leach pad would be relocated from Goslin Flats to upper Alder Gulch. With implementation of this alternative, there would be no large-scale development of mine facilities in Goslin Flats. The overland conveyor system would also not be part of this alternative mine development plan. Impacts to the visual resource would remain significant at both the Zortman and Landusky mines, although these impacts would not include Goslin Flats. Reclamation measures would reduce some of the long distance visual contrasts at the Zortman mine to non-significant levels but not visual contrasts from sensitive viewpoints immediately surrounding the mine, including Old Scraggy Peak and Saddle Butte. Visual contrasts remaining after reclamation at the Landusky mine would leave significant impacts to several sensitive viewpoints including Mission Peak, and from selected viewpoints along U.S. 191 and State Highway 66.

A heap leach in upper Alder Gulch would permanently change the topography of Alder Gulch, which would be filled in with ore. The surface of the leach pad would create substantial form and color contrasts in an area that is relatively undisturbed, except for a few access roads. The site for the leach pad is in an area that is visually contained by surrounding topography, causing visual impacts to be mostly localized to high peaks east of Alder Gulch, including Old Scraggy Peak and Ricker Butte. Portions of the upper end of Alder Gulch can also be seen from Bear Gulch Road in the vicinity of the landing strip, although the duration of view would be quite short and from Ricker Butte, approximately 7 miles east of the mine. Other impacts associated with mine development plans at both the Zortman and Landusky mines would remain generally the same as those described in Alternate 4.

The following figures (found in Appendix D of the Draft EIS) display examples of future landscape condition associated with Alternative 5. Figure D-6 shows the reclaimed Zortman Mine as viewed from Ricker Butte. Color contrasts at the mine pit are still strong and very apparent from this viewpoint - approximately 7.4 miles distant. The upper Alder Gulch heap leach pad is visible to the left of the mine pit area, but revegetation has reduced the visual contrasts and the facility does not strongly attract the viewers attention. Figure D-11 shows the Zortman Mine after reclamation. Only a portion of the mine pit is visible from this viewpoint. Pit highwalls retain very high color and line contrasts. Improvement in the appearance of other areas that had been impacted by mining and exploration roads can be noticed. Figure D-17 shows the Zortman Mine as viewed from Old Scraggy Peak. This viewpoint is in close proximity to the mine (~ 1.6 miles) and looks directly down into the mined area. Strong visual color, line and texture contrasts caused by the pit highwalls are very apparent. Other areas, including the Upper Alder gulch heap leach pad and the Carter Gulch waste rock repository have been regraded and revegetated, which will reduced the color contrast. Figure D-22 shows the reclaimed Zortman Mine as viewed from Saddle Butte. The appearance of the site is similar to Alternative 4 except that trees were limited in the revegetation plan and the Upper Alder Gulch heap leach pad is also visible at the far left of the photo. Figure D-23 shows the Zortman Mine as viewed from Bear Gulch Road. The Upper Alder Gulch waste rock repository is visible from this viewpoint, however it does not attract the attention of the casual viewer.

4.8.7.1 Cumulative Impacts

Mine development in Pony Gulch would not be a foreseeable development in Alternative 5. At the Zortman mine, enlargement of the LS-1 limestone quarry or a new limestone quarry on the ridge above Zortman is foreseeable. Foreseeable activities at the Landusky mine are as described for Alternative 4.

Disturbance from additional ore, limestone and waste rock mining and exploration activities would increase the amount of industrial activity occurring in the area and decrease the amount of land in the Little Rocky Mountains that provide undisturbed, intact landscapes and environments. The visual impacts resulting from a new powerline, described in Section 4.8.6.1, would apply to this alternative.

In summary, past and present mining activities, and those activities proposed under this alternative would increase significant long-term impacts to the scenic resource of the area. Reclamation would reduce many of the visual contrasts existing in the landscape, and those which would be created by the proposed expansion, but the residual impacts (impacts after reclamation) from sensitive viewpoints in close proximity to the mine would still draw attention, and would not be consistent with VRM Class II objectives, which calls for change in the landscape to be low and not attract attention. Alternative 5 would reduce the amount of land affected by visual impacts in some areas compared to Alternative 4 by not allowing development in the Goslin Flats or Ruby Flats area, and by not including the Pony Gulch mine as a reasonably foreseeable development.

4.8.7.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts include contrasts created by the exposed rock of the mine pit highwalls (including limestone quarries), contrasts caused by large man-made landforms (heap leach pads and waste rock dumps), and differences in the vegetative patterns and textures of the reclaimed surfaces compared to those occurring naturally in the surrounding lands.

4.8.7.3 Short-term Use/Long-term Productivity

Scenic resources of the area have been degraded in order for mine development to occur. The long-term productivity or quality of the visual resource would return to some degree with reclamation, but will not return to its original condition or quality. Under Alternative 5, this would include the area of current mine disturbance, and the proposed areas of new disturbance including the Carter Gulch waste rock repository, the limestone quarries at LS-1 and Montana Gulch, and the heap leach and other ancillary facilities in Goslin Flats. Impacts are significant to short-term use and long-term productivity of visual resources.

4.8.7.4 Irreversible or Irretrievable Resource Commitments

Alteration of the topography has caused an irretrievable loss of the original scenery found in the area. This includes the large depressions in the ground surface caused by the mine pits and the large man-made landforms created by the heap leach pads and the waste rock dumps. Impacts are significant now and after implementation of Alternative 5.

4.8.8 Impacts from Alternative 6

Under Alternative 6, the waste rock repository for the Zortman mine would be relocated from Carter Gulch to Ruby Flats, located northeast of the proposed heap leach pad in Goslin Flats. Visual impacts from this alternative would be significant at both the Zortman and Landusky mines.

Ruby Flats is grassy pasture land on a terrace, currently free from any major ground disturbance. Approximately 200 acres would be affected by the construction and operation of the waste rock repository. This disturbance would create additional visual impacts in the Goslin Flats viewshed, which is located in an area of higher visibility than the Carter Gulch site. Impacts from the waste rock repository would include strong form and color contrasts which, when combined with the proposed heap leach pad in Goslin Flats, would create a large industrial area of substantial visual impacts to travellers on 7-mile and Bear Gulch roads. Both the proposed heap leach pad and the waste rock repository are in the foreground distance zone for users of the two roads into Zortman, and even after reclamation and successful revegetation, would present large scale, unnatural looking landforms causing significant visual contrasts. Other visual impacts caused by the expansion of the Zortman and Landusky mines would be as described for Alternative 4.

The following figures (found in Appendix D of the Draft EIS) display examples of future landscape condition associated with Alternative 6. Figure D-3 shows the Goslin Flats heap leach pad and the Ruby Flats waste rock repository as viewed from the junction of Highway 191 and Dry Fork Road. The large size and relative scale of the facilities, the regular geometric shape, and homogeneous vegetation cover (grass) contrasts with the surrounding landscape and attracts the viewers attention. Figure D-7 shows the Zortman Mine as viewed from Ricker Butte. As in Alternative 4, the mine pit highwalls contrasts strongly with the surrounding darker colored vegetation. The Ruby Flats waste rock repository is visible north of the Goslin Flats heap leach pad. Figure-11 shows the Ruby Flats waste rock repository as viewed from Beaver Mountain. At this distance (~4.2 miles), and from this viewing angle, the facility does not attract the viewers attention. Figure D-14 shows the Goslin and Ruby Flats area as viewed from Old Scraggy Mountain. The heap leach pad and the waste rock repository are both highly visible and attract the viewers attention with their large size and geometric shape. Figure D-28 shows the reclaimed Goslin Flats heap leach pad and the Ruby Flats waste rock repository as viewed from Saddle Butte. View distance is approximately 1 mile. At this distance the large size and scale of the facilities, and the homogeneous surface and vegetation pattern contrasts with the surrounding landscape and is very noticeable. Figure D-31 shows the view from Bear Gulch Road and includes the toe of the slope of the Ruby Flats waste rock repository. Figure D-34 shows the waste rock repository from the same viewpoint but looking more to the southwest. The facility is directly in front of the viewpoint and completely dominates the view.

4.8.8.1 Cumulative Impacts

Reasonable foreseeable developments would be the same as Alternative 4, including the future development of the Pony Gulch ore reserves. Cumulative impacts would be as described for Alternative 4, except for the impacts caused by the waste rock repository. Locating the waste rock repository on the Ruby Flats would cause additional significant impacts over those that would be caused by locating the facility in Carter Gulch since visual contrasts at the Carter Gulch site would be screened from the view of many observers, where the Ruby Flats site is out in the open in a very visible location.

The visual impacts resulting from a new powerline, described in Section 4.8.6.1, would apply to this alternative.

4.8.8.2 Unavoidable Adverse Impacts

Unavoidable impacts would generally be the same as described in Alternatives 4 and 5. However, the Ruby Flats waste rock repository would cause additional unavoidable visual impacts in the Goslin Flats/Ruby Flats viewshed.

4.8.8.3 Short-term Use/Long-term Productivity

Short-term use/long-term productivity would generally be the same as described in Alternatives 4 and 5. The long-term quality of Goslin Flats/Ruby Flats landscape would be further degraded by the Ruby Flats waste rock repository.

4.8.8.4 Irreversible or Irretrievable Resource Commitments

Irreversible resource commitments would be as described in Alternatives 4 and 5.

4.8.9 Impacts From Alternative 7

In Alternative 7, the major modification to ZMI's expansion plan (Alternative 4) at the Zortman Mine would be the location of the waste rock repository on top of existing facilities in and around the mine pit, instead of in Carter Gulch. At the Landusky Mine, rock and fill would be removed and the mine pits would be backfilled to a minimum elevation that would allow surface drainage into Montana Gulch. Reclamation covers would be modified to enhance reclamation success. Other plans and facility designs, including the Goslin Flats heap leach and conveyor system, would be generally the same as those described in Alternatives 4 and 6.

The vertical and lateral extension of the mine pit would bring the total pit disturbance to about 200 acres. Visual impacts of the pit expansion would include an increase in the alteration of existing topography, and exposure of soil and rock from the newly disturbed area, which would create color, form and texture contrasts. The impacts caused by pit extension would double the existing significant disturbance, and would change the magnitude of existing contrasts and draw additional visual attention to the site. The increased size of the disturbance would be most noticeable from viewpoints north of the Zortman Mine, including Beaver Mountain and the town of Lodge Pole. For Native Americans using these viewpoints, the change would be significant.

The overland conveyor for hauling ore from the mine area to the heap leach facility in Goslin Flats would be approximately 5.5 feet high, 4.5 feet wide, and 12,000 feet long. The conveyor corridor would be fenced for most of its length to limit public access; however, it would be engineered to maintain public access to Pony Gulch. A roadway, constructed along the conveyor route, would add additional disturbance, bringing the total width of visible ground disturbance to approximately 50 feet. The conveyor would pass through land which is generally undisturbed, mixed-forest/shrub land in the mountain section, and grassy pasture land in the Goslin Flats area. Construction of the conveyor would introduce a linear feature in the landscape, creating a line and color contrast noticeable from several roads the area (7-mile road and the Bear Gulch road), and from Saddle Butte and Old Scraggy Peak. Appendix D of the Draft EIS contains an artist's conception of the Goslin Flats heap leach pad and the conveyor system.

The heap leach pad and ancillary facilities in Goslin Flats would be located in what is now pasture land. Approximately 5,200 feet long by 1,800 feet wide, the facility would stack ore in 25-foot lifts up to a maximum depth of 200 feet. Other facilities include a soil stockpile on the east side of the leach pad, ore stockpiles and a building which would contain secondary and tertiary crushers, and solution ponds and a processing plant located on the south end of the facility. Construction of the leach pad and facilities would create a major new disturbance in the landscape, affecting approximately 250 acres of land. Visual impacts from the facilities would include strong form and color contrasts created by the introduction of a large geometric shape which would be incongruous with any natural features found in the surrounding landscape. Structures associated with the plant would also introduce line and form contrasts. Night lighting would be required at the mine pits, crusher facilities and at the new facilities in Goslin Flats, creating a visible light source for miles around.

The character of the land would be changed from agricultural to industrial. The leach pad and facilities would be most noticeable from the roads leading into the town of Zortman, and from several high peaks in the area including Saddle and Ricker Buttes. Travellers along U.S. Highway 191 would be able to see the leach pad from the section of highway near the junction with 7-mile Road. Users on 7-mile Road would have the longest duration of view of the leach pad, as the facility would be visible along the entire section of road from the junction with U.S. 191 to the junction with Bear Gulch road. Color contrasts would be the most evident in morning light, when sun illumination would brighten the facilities.

Rerouting of the Zortman to Landusky access road, transmission line and pipeline (the pipeline and transmission line are to be buried), and building new or upgrading existing access/haul roads, would have an additive effect on the overall amount of disturbance visible from viewpoints within the study area. Strong color and line contrasts are created by linear features like roads and cleared right-of-ways, and these contrasts can be visible from very long distances.

Relocating the waste rock repository from Carter Gulch to existing disturbed areas around the mine pit would reduce the total amount of previously undisturbed land impacted by the proposed mine expansion, causing a small reduction in visual impacts to those locations with views of the Zortman Mine site. Impacts to the visual quality of the Landusky Mine site would remain relatively unchanged from those described for Alternative 4, 5 and 6. Filling in more of the mine pits would cause a small improvement in the overall reclaimed appearance of the site. Any improvement in the success of reclamation and revegetation would reduce impacts to the visual quality at both mines, however, impacts would still be significant.

The following figures (found in Appendix D of the Draft EIS) show examples of future landscape condition with Alternative 7. Figure D-18 shows the Zortman Mine pit area at the full buildout stage. The close proximity of the viewpoint to the mine (~ 1.6 mi.), the light color of the exposed rock and soil material, and the line and form contrasts created by the pit highwalls combine to create a high visual impact that dominates the view. Figure D-19 shows the same view but after reclamation. Recontouring and revegetation which has occurred to some of the facilities has reduced the color contrasts, but the pit area remains an area of high visual contrast that attracts visual attention. Figure D-23 shows the mine area at full buildout as viewed from Saddle Butte. Both the mine pit area and the waste rock storage areas present strong color and line contrasts. Figure D-24 shows the same view after reclamation. Revegetation has subdued the color contrasts, but the area is still attracts the attention and is noticeable as a highly modified landscape.

Activities at the Landusky Mine include extension of existing mine pits and leach pads. Mining at the Queen Rose and August pits (see Figure 2.8-1) would not involve new disturbances. Extension of the Gold Bug Pit (called the South Gold Bug Pit on Figure 2.8-1) would disturb approximately 20 acres of previously undisturbed ground. The area of the proposed extension is in a highly visible location on the south face of Gold Bug Peak. This area can be seen by travellers on U.S. Highway 191 and Montana Highway 66. Disturbance from the Landusky Mine, particularly the heap leach pads, is visible for long distances (30 to 40 highway miles) to the south of the Little Rocky Mountains, including U.S. Highway 191 and areas within the Charles M. Russell National Wildlife Refuge. The south side of Gold Bug Butte is visible from many locations, and existing exploration roads coming out of the Gold Bug Pit and running across portions of the south face of Gold Bug Peak can be seen. Extension of the pit onto the south face would create more visible disturbance from southerly viewpoints. Impacts would include line, form and color contrasts. The topographic changes in Gold Bug Peak would be silhouetted from some viewpoints, drawing visual attention. From viewpoints north of Gold Bug Peak, the extension of the Gold Bug Pit would not be as noticeable, as the new disturbance would blend in with the existing pit disturbance.

Additions to the existing 1987 and 1991 heap leach pads would create additional surface area of visible disturbance noticeable from several key viewpoints, including points along U.S. Highway 191, Montana Highway 66, the Pow Wow grounds in Mission Canyon, and several high points in the surrounding area, such as Mission Peak and Thornhill Butte.

The following figures (found in Appendix D of the Draft EIS) display Alternative 7 at the Landusky Mine. Figure D-36 shows a view of the Landusky Mine from Thornhill Butte. The mine pit highwalls retain noticeable color and texture contrasts. Other reclaimed facilities have been regraded and revegetated to blend in the surrounding landscape and do not draw visual attention. Figure D-38 shows the view of the Landusky Mine as viewed from the Pow Wow grounds in Mission Canyon. The top of the 1987/1991 leach pad is visible and draws visual attention due to form and texture contrasts. During the summer when the grass on the reclaimed facility is a green color the contrasts would be reduced. Figure D-40 shows the Landusky Mine as viewed from Highway 66 at the Landusky turnoff. Reclamation has reduced the visual impacts of most of the facilities to a point where they are not readily noticeable, except for the pit highwalls which retain strong line contrasts. Figure D-43 shows the Landusky Mine at full buildout as viewed from Mission Peak. This viewpoint looks directly down into the mine at very close range (~.3 mile). From this vantage point the mine presents very strong line, form, color and texture contrasts. Figure D-43 shows the reclaimed mine from the same viewpoint. Partial backfilling of the pit and revegetation on some of the facilities has reduced the contrasts, however the mined area, especially the pit highwalls, still presents a very strong visual contrast to viewers on Mission Peak.

4.8.9.1 <u>Cumulative Impacts</u>

Cumulative impacts under Alternative 7 would be as described for Alternative 4. Reasonable foreseeable developments at the Zortman Mine include mining activity in the Pony Gulch area south of the existing mine, extension of the Goslin Flats heap leach pad, additional limestone quarry development, construction of a transmission line from Malta, Montana to the heap leach pad in Goslin Flats, and continued exploration activities. At the Landusky mine foreseeable future actions include continued mining of ore and waste rock at existing pits and additional heap leach capacity.

Exploration activities could occur over a ten year period and disturb an additional 155 acres throughout that portion of the Little Rocky Mountains outside of the Fort Belknap Indian Reservation. This additional disturbance would be from road and trench construction and drill sites. Road construction creates strong line and color contrasts that can be seen for miles from the disturbance.

Mine development in the Pony Gulch area would disturb approximately 14 acres of land. This site is not in a prominent location, but can be seen from Old Scraggy Peak and would be seen by recreationists using the area for dispersed recreation. Disturbance from additional ore and waste rock mining and exploration activities would increase the amount of industrial activity occurring in the area and decrease the amount of land in the Little Rocky Mountains that provide undisturbed, intact landscapes and environments. Future mine development would prolong the use of facilities in Goslin Flats, increasing the duration of visual impacts in that area. These activities would add to the overall amount of visual contrasts present in the Little Rocky Mountains and cause further degradation of the scenic qualities of the high-value mountain landscapes.

A transmission line may be built from Malta, Montana to the heap leach pad in Goslin Flats. It would likely be a 69 kV line with single, wood poles. The transmission line would add a new linear disturbance in the landscape, and, depending on its alignment, impact views from primary travel routes, dispersed recreation areas, and Native American cultural sites.

In summary, past and present mining activities, and those activities proposed under this alternative would continue and enlarge significant long-term impacts to the scenic resources of the area. Reclamation would reduce many of the visual contrasts existing in the landscape, and those which would be created by the proposed expansion, but the residual impacts (impacts after reclamation) from sensitive viewpoints in close proximity to the mine would still draw attention, and would not be consistent with VRM Class II objectives, which calls for change in the landscape to be low and not attract attention. Visual impacts are significant and would be significant even after successful reclamation from many viewpoints.

4.8.9.2 <u>Unavoidable Adverse Impacts</u>

Unavoidable adverse impacts would generally be the same as in Alternative 4, 5 and 6. That is, unavoidable adverse impacts include significant contrasts created by the exposed rock of the mine pit highwalls (including limestone quarries), contrasts caused by large man-made landforms (heap leach pads and waste rock dumps), and differences in the vegetative patterns and textures of the reclaimed surfaces compared to those occurring naturally in the surrounding lands. These types of impacts would nearly double over those occurring in Alternatives 1, 2, and 3.

The unavoidable adverse impacts in Alternative 7 differ from Alternatives 4, 5, and 6 in that the waste rock repository which would be relocated to the existing disturbance around and in the mine pit. This relocation of the waste rock repository would avoid visual impacts caused by facility development in Alder Gulch, Carter Gulch or Ruby Flats. Visual impacts are significant and would be significant even after successful reclamation from many viewpoints.

4.8.9.3 Short-term Use/Long-term Productivity

The relationship between short-term use/long-term productivity of the landscape's scenic quality would be the same as described in Alternative 4, 5 and 6. That is, the scenic resources of the area have been degraded in order for mine development to occur. The long-term productivity or quality of the visual resource will return to some degree with reclamation, but will not return to its original condition or quality. Under Alternative 7, this would include the area of current mine disturbance, and the proposed areas of new disturbance including the waste rock repository, the limestone quarries at LS-1 and Montana Gulch, and the heap leach and other ancillary facilities in Goslin Flats. These types of impacts would nearly double over those occurring in Alternatives 1, 2, and 3.

4.8.9.4 Irreversible or Irretrievable Resource Commitments

Irreversible and irretrievable resource commitments would be as described for Alternative 4, 5 and 6. That is, alteration of the topography has caused an irretrievable loss of the original scenery found in the area. This includes the large depressions in the ground surface caused by the mine pits and the large man-made landforms created by the heap leach pads and the waste rock dumps. Under Alternative 7, the area would increase over Alternatives 1, 2 and 3.

4.9 NOISE

4.9.1 Methodology

Noise impacts were assessed for each alternative by comparing expected noise levels from mining activities with guidelines set by the U.S. Environmental Protection Agency (EPA 1974). These guidelines were designed to protect against the interference of the public's outdoor activities. The guidance level the EPA has selected is 55 A-weighted decibels, shortened to "dBA." The dBA reflects a noise rating system which is adjusted to the human ear.

Noise impacts associated with the alternative actions were estimated by using data collected during on-site noise measurements, where possible. Noise measurements were made on days when no mining activities occurred to establish baseline levels. Operational noise levels were measured on days with normal mining activities.

4.9.1.1 Sources of Noise

Manufacturers data for noise levels for various pieces of equipment were used in the assessment. Table 4.9-1 presents noise levels for mining equipment and processes based on manufacturers specifications. These estimated noise levels from various sources were extrapolated to Zortman and Landusky mining operations using site specific information, if available. As an example, the manufacturers specifications indicate that noise levels from conveyors will be 56 dBA at 50 feet. Neither mine has a comparable conveyor, so the manufacturers estimates are used in the impact analysis. Similar noise levels have been reported in the literature for enclosed crushing operations. These noise levels are very close to background levels and would not be noticeable within a few hundred feet of the conveyor or enclosed crushing facilities. The secondary and tertiary crushers at the Zortman Mine under Alternatives 4, 6, and 7 would be enclosed and should have comparable noise levels. However, an unenclosed crusher would have noise levels of 72 dBA at 50 feet. The primary crusher for the Zortman Mine would not be enclosed and would exhibit the higher noise levels.

Actions taken to correct water quality problems (such as construction of ponds, water treatment plant operation, and pump operation) would not be expected to generate noise impacts greater than those sources shown on Table 4.9-1.

TABLE 4.9-1

OPERATIONAL NOISE LEVELS (DECIBELS) MEASURED AT 50 FEET FOR VARIOUS TYPES OF MINING EQUIPMENT

Equipment Type	Quantity	Noise Level (dBA)
Haul Trucks	13[1]	88
Loaders	3[1]	87
Dozers	5[1]	89
Drills	4[1]	90
Shovel	1[1]	95
Grader	1[1]	86
Water Truck	1[1]	88
Primary Crusher	1[2]	72
Secondary Crusher	1[3]	56
Tertiary Crusher	1[3]	56
Conveyor	1[3]	56
Blasting	2-3 per week	89[4]

Sources:
(1) Construction Engineering Research Laboratory 1978.
(2) CDM 1983.
(3) Gelhaus 1991b.
(4) Blasting noise measurement taken 1 mile from blasting location.

4.9.1.2 Source Areas

As shown on Table 4.9-1, there is a wide variety of individual sources generating noise at a mining operation. A very complicated modeling approach is required to estimate the combined noise levels from all of the different sources reaching a receptor. The noise analysis in this evaluation simplifies this problem by assuming that all individual noise sources would emanate from a single area location. Using this approach, the sources within an area are added logarithmically for a combined noise source. The combined noise level from each area source is then estimated at the receptor locations. This simplified approach can result in noise level over- or under-estimation, depending on where an actual noise emanates from within the source area.

The area noise sources for this analysis are the Zortman Mine, the Landusky Mine, and where applicable, Goslin Flats, Pony Gulch, and the Ruby Flats waste rock repository.

4.9.1.3 Noise Receptors

The sensitive receptors considered in this analysis are the towns of Zortman and Landusky, the Pow Wow Grounds and Azure Cave. To estimate the noise impacts at the closest sensitive receptors, the worst-case noise levels associated with each area source for each alternative was calculated by:

1) Determining the individual noise sources expected for the alternative

2) Logarithmically combining the individual sources into a single area source

3) Assuming a fixed attenuation (a constant reduction in noise) in noise level with distance

A common estimation of noise attenuation with distance is to reduce noise levels by 6 dBA with each doubling of distance from the source of the noise. For example, a noise level of 100 dBA at 50 feet would be reduced to 94 dBA at 100 feet and 88 dBA at 200 feet. This attenuation rate does not account for any intervening terrain between source and receptor or forestation, both of which may substantially reduce noise levels because of greater attenuation. Alternatively, the attenuation rate assumes that atmospheric conditions which could increase the distance which noise travels are not occurring. On the whole, the estimates are considered to be conservative, or higher, than would actually occur.

A potentially significant noise which is not included in the source area analysis is that caused by trucks hauling reclamation materials. Under many of the alternatives, haul trucks would travel through the towns of Zortman and Landusky to deliver materials such as clay, limestone, and soil to mine facilities. A separate analysis under the heading "Roads" is included for reclamation haul truck noise impacts. Noise impacts from reclamation materials hauling are estimated assuming no attenuation. In other words, the noise level generated would be that heard by the receptors in those two towns. This is appropriate considering the proximity of the haul trucks to businesses, schools, and residences in Zortman and Landusky.

4.9.1.4 Impact Significance

The noise levels estimated for each alternative have been compared against baseline noise conditions in the study area to determine the extent of impact. Table 4.9-2 shows typical noise values for various locations. Baseline noise conditions for this analysis are estimated to be typical of rural to wooded residential communities, approximately 40 to 50 dBA. All noise levels projected under this analysis, for all alternatives, would cause negative impacts. Baseline conditions would only be reached once all activity associated with the mines ceases.

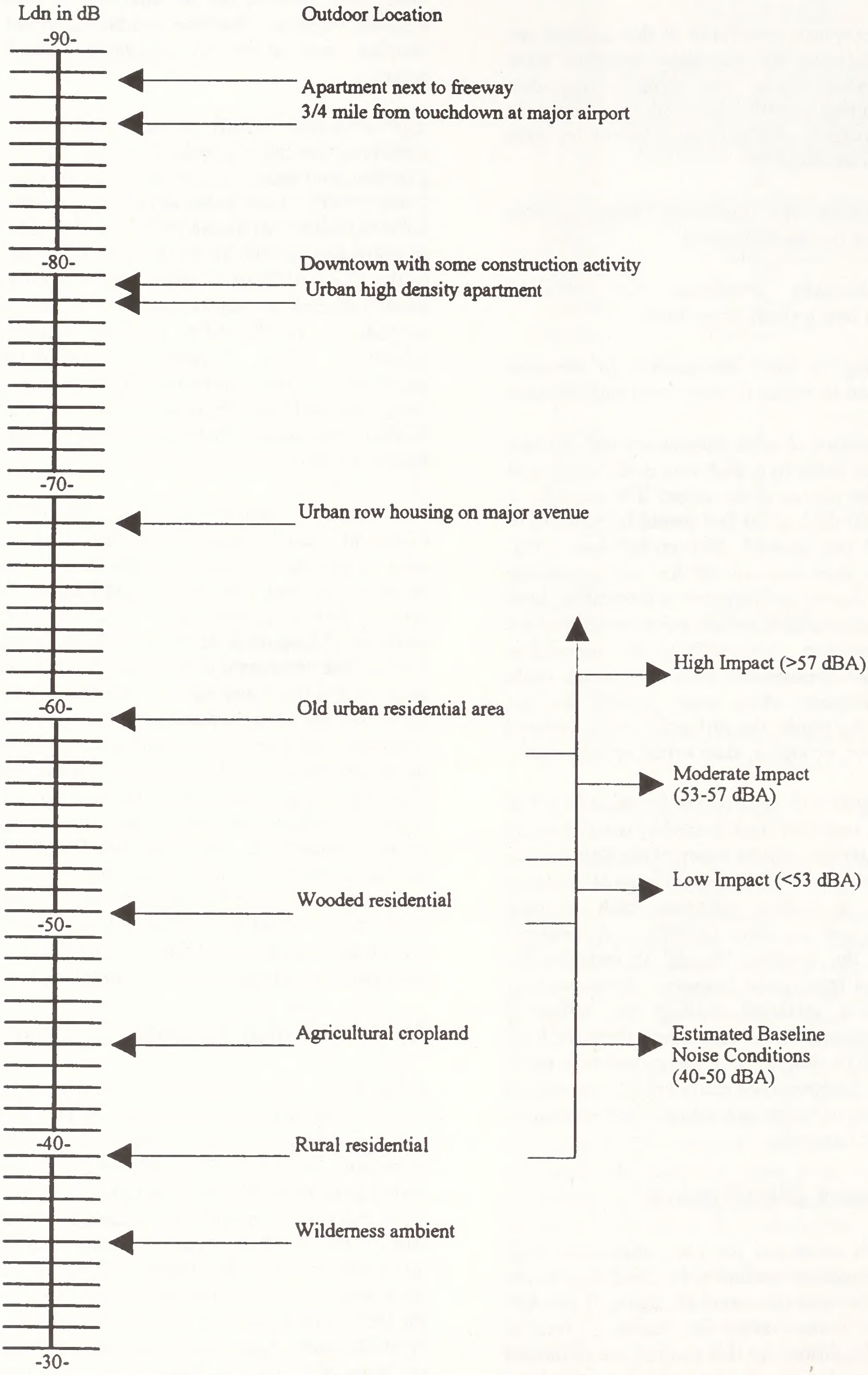
The estimated impacts have been rated as low, moderate, or high magnitude using the EPA noise guideline for outdoor activity as the rating criterion (see Table 3.9-3). Low noise impacts are those that are below 53 dBA. Moderate noise impacts were assigned to alternatives in which noise levels were estimated to be in the range of 53 to 57 dBA, and high noise impacts were assigned to alternatives in which substantial exceedances of the EPA guideline were estimated (above 57 dBA). Impacts are considered to be significant if the levels estimated at the receptor locations would interfere with outdoor activity, since outdoor recreation is a common activity of residents and visitors in the Little Rocky Mountains.

The frequency and duration of impacts are also evaluated. Noise caused by certain mining activities such as drilling or blasting could be of a short-term duration, in that the noise would occur for short, possibly intense periods then cease. Or, the impacts could be of long-term duration, such as the noise from reclamation which would extend after mine closure. The frequency of noise also varies. In particular, noise from most mining and reclamation activities would be constant. The loud noise resulting from blasting would be of very short duration and occur infrequently. The noise resulting from haul trucks passing through Zortman and Landusky would occur on a frequent, but short-duration basis. An assumption for all alternatives is that combined noise from mining activities is continuous, and would occur until mine closure. Noise levels at the mines and receptor locations would only return to baseline conditions after mine operations, reclamation, and remediation is complete.

4.9.1.5 Noise Estimation Procedures

Noise levels were estimated by first considering the sources of noise under each alternative (see Table 4.9-1) and the noise each source contributes at a distance of approximately 50 feet. The individual noise sources are added logarithmically for a combined noise source for each area considered (the two mines, Goslin Flats, and Ruby Flats, and Pony Gulch). Using the method for noise attenuation with distance described in Section 4.9.1, noise levels from the source areas were calculated for the selected sensitive receptor locations: the Pow Wow Grounds, Azure Cave, the town of Zortman, and the town of Landusky. Noise levels from truck traffic

TABLE 4.9-2
EXAMPLES OF AVERAGE NOISE LEVELS IN dB MEASURED AT VARIOUS LOCATIONS



Source: U.S. Environmental Protection Agency, Protective Noise Levels, EPA 550/9-79-100, November 1978.

were also calculated for the towns of Landusky and Zortman.

4.9.1.6 Cumulative Noise Impacts

Noise caused by historic and recent mine activities is not relevant to a cumulative impacts analysis, since noise dissipates almost immediately. Therefore, the cumulative impacts analysis for this resource relies on noise from existing sources (say, noise associated with the town of Zortman) combined with ongoing and/or projected mine activities, plus reasonably foreseeable developments if the noise generated would occur concurrent with the other noise sources. Because of the addition of all sources, cumulative noise impacts should always be higher than estimated direct impacts.

4.9.2 Impacts from Mining, 1979 to Present

No on-site noise monitoring is available prior to 1990. However, since no significant changes in the location of mining activities have occurred, noise levels for 1979 to present are probably similar to those measured in 1991 (see Table 4.9-3), which ranged from essentially background to levels representating a high, negative impact.

Noise levels in the project area were measured for baseline and operational activities during March 1991, and are reported in the "Application for Amendment to Operating Permit No. 00096" (ZMI 1993). (See Table 4.9-3 for operational noise levels measured during March 1991.) Operational noise levels ranged from 40 to 70 dBA. Operational noise levels were greater than baseline noise levels, ranging from 17 dBA greater at monitoring locations within 500 feet of the mining activities; to 4 dBA greater at the property boundary.

Noise levels from blasting were measured in 1990. Readings were 89 dBA at a location 1 mile from the blasting activities; and 65 dBA at the Pow Wow Grounds (2.5 miles from the blast). Peak noise levels from blasting lasted 2 to 3 seconds. Although blasting noise levels are above the EPA guidelines, these guidelines are based on continuous noise levels (24 hours per day). Therefore, even though the magnitude of the blasting noise is above the noise guidelines, the duration of the blasting noise is much less than the duration used to develop the guidelines. The blasting has historically occurred up to 5 times per week. An existing permit stipulation from 1990 requires that blasting at the Landusky Mine be decreased by four days per year, so that it does not occur during the Native American Sundance Ceremony. The Tribe is to provide the agencies 60 days advance notice, so that ZMI has sufficient time to plan for the change in operations.

TABLE 4.9-3

OPERATIONAL NOISE LEVELS (dBA) MEASURED IN THE PROJECT AREA

Site	March 12, 1991	March 14, 1991
1	60.4	53.7
2	62.1	60.4
3	48.2	63.6
4	47.9	---
5	54.2	61.9
6	59.1	56.9
7	51.3	58.1
8	46.6	54.9
9	---	58.6
10	47.3	60.9
11	51.9	59.3
12	54.6	69.7
13	50.9	60.4
14	51.0	68.1
15	40.8	48.1
16	40.9	40.4
17	53.4	51.8

Source: Gelhaus 1991b.

Note: Refer to Table 3.9-1 for a description of the noise monitoring locations.

4.9.3 Impacts from Alternative 1

This alternative limits activities at the Zortman and Landusky mines to already permitted actions. Noise impacts would result from the limited ore processing operations at the Zortman Mine, continued mining at the Landusky Mine until approximately early 1996, and reclamation at both mines until approximately the year 2000.

4.9.3.1 Impacts

Figure 4.9-1 presents estimated noise levels generated at the Zortman and Landusky mines for this alternative, using as sources the noise levels of the mining equipment listed in Table 4.9-1 applicable to each mine under this alternative. For the Landusky Mine, noise levels for all equipment listed in Table 4.9-1 except crushing and conveying were logarithmically added together. For the Zortman Mine, activities would include ore processing and hauling; other mining activities at the Zortman Mine ended in 1990. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The estimated noise level from Landusky Mine sources at a distance of 50 feet from the Landusky Mine is 104 dBA. Noise levels caused by Zortman Mine activities were estimated at 99 dBA at a distance of 50 feet from the Zortman Mine. The level of noise to sensitive receptors caused by mining activities is estimated to be:

Source	Receptor	Noise
Zortman Mine	Zortman	54 dBA
	Landusky	48 dBA
	Pow Wow Grounds	48 dBA
	Azure Cave	54 dBA
Landusky Mine	Zortman	52 dBA
	Landusky	61 dBA
	Pow Wow Grounds	57 dBA
	Azure Cave	54 dBA

Noise impacts from mining operations would generally be low to moderate magnitude and not significant, except for noise generated at the Landusky Mine and heard at the town of Landusky. This noise (61 dBA) is significant with a high magnitude of impact because it is well above the EPA guideline for outdoor activity.

Roads. Mine activities for Alternative 1 include the haulage of supplies and limited reclamation materials through Landusky to the Landusky Mine. Noise levels from haul trucks are 88 dBA at 50 feet. If the haul trucks travel through town in convoys of fifteen trucks, a peak noise level of 98 dBA at 50 feet can be expected for short periods as the trucks pass through town. This is a significant, high impact of short duration. The frequency of haul trips required for activities at the two mines under this alternative is 400 to 1,775 trips per year, until approximately 2000. Reclamation haul trucks would not pass through the town of Zortman under this alternative. (Refer to Tables 4.11-2 and 4.11-3 for a schedule of reclamation haul trips for each Alternative.)

4.9.3.2 Cumulative Impacts

There are no reasonably foreseeable developments for Alternative 1. Average noise levels in Zortman and Landusky are approximately 57 dBA. Average ambient noise level is estimated to be 45 dBA at the Pow Wow Grounds and Azure Cave. Combining background noise levels with those predicted to occur for Alternative 1 implementation results in cumulative noise levels:

Receptor	Noise
Zortman	59 dBA
Landusky	62 dBA
Pow Wow Grounds	58 dBA
Azure Cave	55 dBA

Cumulative impacts at the towns of Zortman and Landusky, and at the Pow Wow Grounds would be significant and of a high magnitude, while impacts at the Azure Cave would be of moderate magnitude and not significant.

4.9.3.3 Unavoidable Adverse Impacts

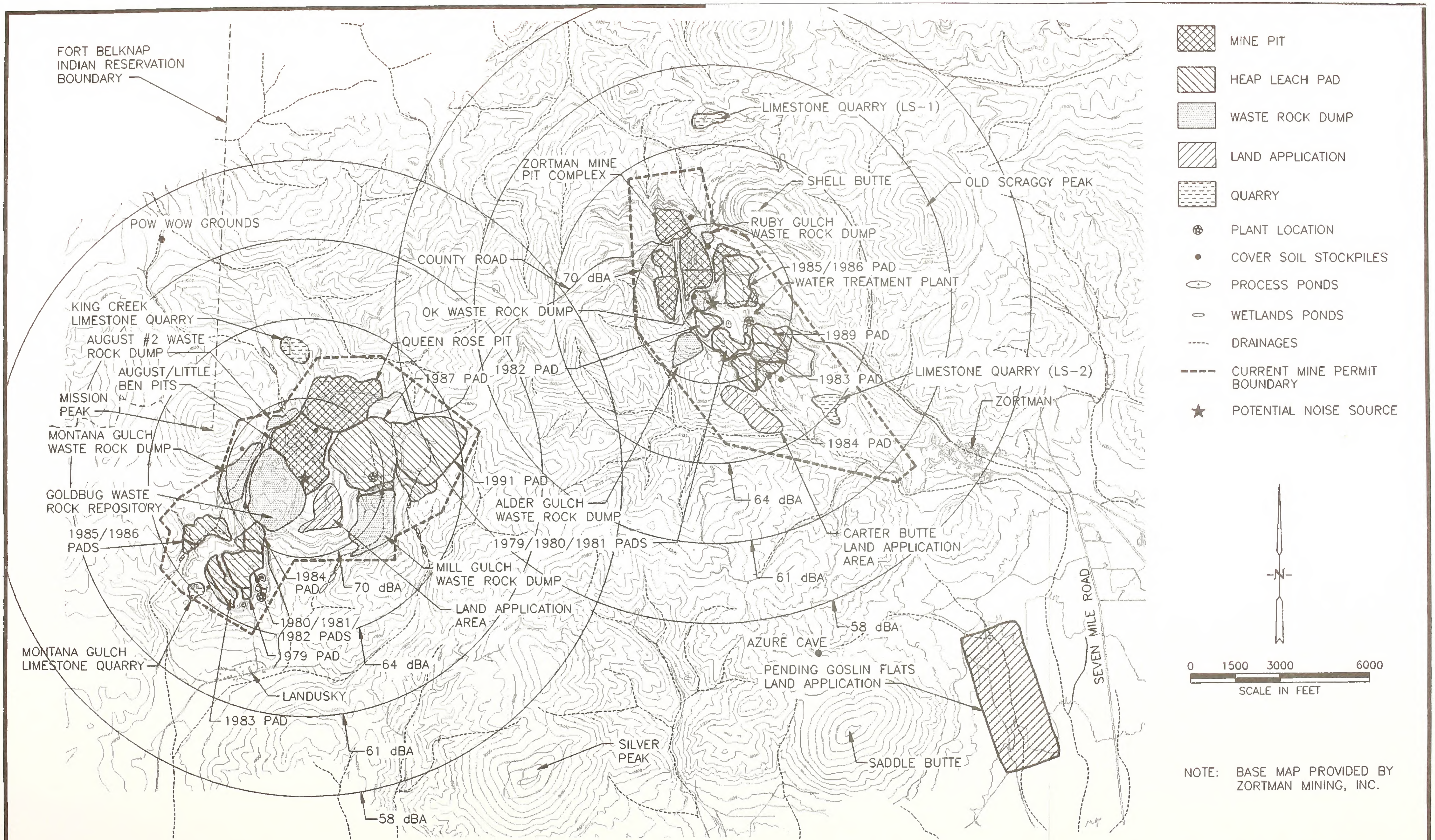
The significant adverse impacts described are considered unavoidable and adverse if this alternative is implemented.

4.9.3.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this alternative would last until 2000 (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.3.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this alternative. Noise levels would return to background levels after reclamation is completed and corrective measures for water quality improvement, such as water treatment plants, have been dismantled. However, because water quality improvements under this alternative would rely almost entirely on active treatment, noise levels above background would persist for the foreseeable future.



ESTIMATED CUMULATIVE NOISE LEVELS (dBA) ALTERNATIVES 1 AND 2

FIG. 4.9-1

ZLF-NLA1

TABLE 4.9-4
SUMMARY OF NOISE LEVELS AT SENSITIVE RECEPTORS FOR EACH ALTERNATIVE[1,2]

Receptor	Alt. 1	Alt. 2	Alt 3.	Alt. 4	Alt. 5	Alt. 6	Alt. 7[4]
Mining							
Pow Wow Grounds	57	57	57	59	59	59	59
Town of Landusky	61	61	61	61	61	61	61
Town of Zortman[3]	54	54	60	63	59	64	63
Azure Cave[3]	54	54	58	59	56	60	59
Cumulative							
Pow Wow Grounds	58	58	58	59	59	59	59
Town of Landusky	62	62	62	63	62	63	63
Town of Zortman	59	59	62	66	60	67	64
Azure Cave	55	55	59	66	57	66	60
Frequency of Truck Traffic at 98 dBA[5]							
Town of Landusky	12 days	27 days	none	27 days	27 days	27 days	none
Town of Zortman	none	12 days	53 days	17 days	26 days	14 days	40 days

1 All noise levels presented in A-weighted decibels, or dBAs. See text for assumptions and explanation.
2 Noise estimates do not account for attenuation from intervening terrain, which would reduce levels, or for atmospheric conditions which could result in higher noise levels downwind from the source.
3 For alternatives 3, 4, 6, and 7, includes noise from activities at Goslin Flats. For Alternative 6, also includes noise from Ruby Flats
4 Cumulative noise levels for Alternative 7 do not include a contribution from the Pony Gulch reasonably foreseeable development, as mining of that deposit would be precluded while mining and reclamation takes place at the Zortman Mine.
5 Estimate based on number of trucks in peak traffic year, divided by 10 convoys of 15 trucks per day.

4.9.4 Impacts from Alternative 2

This non-expansion alternative limits activities at the Zortman and Landusky mines to already permitted actions, with some limited reclamation as proposed by ZMI. Noise impacts would result from the limited ore processing operations at the Zortman Mine, continued mining at the Landusky Mine until approximately early 1996, and reclamation at both mines until about 2000.

4.9.4.1 Impacts

Figure 4.9-1 presents estimated noise levels generated at the Zortman and Landusky mines for this alternative, using as sources the noise levels of the mining equipment listed in Table 4.9-1 applicable to each mine under this alternative. For the Landusky Mine, noise levels for all equipment except crushing and conveying were logarithmically added together. For the Zortman Mine, activities would include ore processing and hauling; other mining activities at the Zortman Mine ended in 1990. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The noise levels created at the two mines are as described for Alternative 1 in Section 4.9.3.1, 104 dBA at a distance of 50 feet from the Landusky Mine and 99 dBA at a distance of 50 feet from the Zortman Mine. Therefore, the noise levels at the sensitive receptors are also the same as for Alternative 1.

Noise impacts from mining operations would generally be low to moderate magnitude and not significant, except for noise generated at the Landusky Mine and heard in Landusky. This noise is significant with a high magnitude because it is well above the EPA guideline for outdoor activity.

Roads. As described for Alternative 1, noise levels from truck traffic are estimated by assuming a peak noise level of 98 dBA at 50 feet for short periods as the trucks pass through town. This is a significant, high magnitude impact of short duration. The frequency of haul trips required for leaching and reclamation activities at the Zortman Mine under this alternative would peak at 1,750 round trips (with each round trip including travel through town twice) for the year 1998. Reclamation would be expected to end and haul trucks cease at the Zortman Mine in 1998. The frequency of haul trips required for leaching and reclamation activities at the Landusky Mine under this Alternative would peak at 4,000 round trips (again, through town twice for each round trip) in the year 2000. Reclamation would be expected to end and haul trucks cease at the Landusky Mine in 2000.

4.9.4.2 Cumulative Impacts

No reasonably foreseeable development activities are anticipated under this alternative. Since background noise levels and estimated noise levels from mining activities are the same as predicted for Alternative 1, cumulative noise levels would be the same. Cumulative impacts at the towns of Zortman and Landusky, and at the Pow Wow Grounds would be significant and of a high magnitude, while impacts at the Azure Cave would be of moderate magnitude and not significant.

4.9.4.3 Unavoidable Adverse Impacts

The significant noise impacts in Zortman and Landusky are considered unavoidable and adverse if this alternative is implemented.

4.9.4.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this Alternative would last until 1998 for the Zortman Mine and until 2000 for the Landusky Mine (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.4.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this alternative. Noise impacts would return to background levels after reclamation is completed and corrective measures for water quality improvement, such as water treatment plants, have been dismantled. However, because water quality improvements under this alternative would rely almost entirely on active treatment, noise levels above background would persist for the foreseeable future.

4.9.5 Impacts from Alternative 3

This non-expansion alternative limits activities at the Zortman and Landusky mines to already permitted actions, with Agency-mitigated reclamation imposed. Noise impacts would result from the limited ore processing operations at the Zortman Mine, continued mining at the Landusky Mine until approximately early

1996, and enhanced reclamation at both mines until the year 2001.

4.9.5.1 Impacts

Figure 4.9-2 presents estimated noise levels generated at the Zortman and Landusky mines for this alternative based on noise levels of the mining equipment listed in Table 4.9-1. For the Landusky Mine, noise levels for all equipment except crushing and conveying were logarithmically added together. For the Zortman Mine, activities would include ore processing and more hauling of reclamation materials than for alternatives 1 or 2; other mining activities at the Zortman Mine ended in 1990. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The noise levels created at the two mines would be as described for Alternative 1 in Section 4.9.3.1, 104 dBA at a distance of 50 feet from the Landusky Mine and 99 dBA at a distance of 50 feet from the Zortman Mine. Therefore, the noise levels at the sensitive receptors from mining and reclamation are also the same as for Alternative 1, except for noise created by reclamation mining at Goslin Flats.

Alternative 3 relies on the use of reclamation materials mined at Goslin Flats. This activity would use some of the types of mining equipment listed on Table 4.9-1, such as loaders, dozers, and haul trucks. Noise levels from this work at Goslin Flats would be:

Source	Receptor	Noise
Goslin Flats	Zortman	57 dBA
	Landusky	48 dBA
	Pow Wow Grounds	48 dBA
	Azure Cave	57 dBA

The noise from Goslin Flats combined with Zortman Mine reclamation activities would result in an additive noise level at the town of Zortman of 60 dBA, and an additive noise level at Azure Cave of 58 dBA. Noise impacts from mining operations would generally be significant with a high magnitude because they are well above the EPA guideline for outdoor activity. Noise levels at the Pow Wow Grounds would be of moderate magnitude and not significant.

Roads. As described for Alternative 1, noise levels from truck traffic are estimated by assuming a peak noise level of 98 dBA at 50 feet for short periods as the trucks pass through town. This is a significant, high magnitude impact of short duration. The frequency of haul trips through Zortman required for leaching and reclamation activities at the Zortman Mine under this alternative would peak at 7,930 round trips during 1999. Reclamation would be expected to end and haul trucks cease at the Zortman Mine in 1999. Haul trips required for leaching and reclamation activities at the Landusky Mine would not pass through the town of Landusky. Reclamation would be expected to end and haul trucks cease at the Landusky Mine in 2001.

4.9.5.2 Cumulative Impacts

No reasonably foreseeable development activities are anticipated under this alternative. Background noise levels are the same as predicted for Alternatives 1 and 2, but noise from mining reclamation materials at Goslin Flats alters the cumulative noise levels from Alternatives 1 and 2. Cumulative noise levels are estimated at:

Receptor	Noise
Zortman	62 dBA
Landusky	62 dBA
Pow Wow Grounds	58 dBA
Azure Cave	59 dBA

Cumulative impacts at all sensitive receptor locations would be significant and of a high magnitude.

4.9.5.3 Unavoidable Adverse Impacts

The significant, high magnitude impacts described are considered unavoidable and adverse if this alternative is implemented.

4.9.5.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this Alternative would last until 1999 for the Zortman Mine and until 2001 for the Landusky Mine (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.5.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this alternative. Noise impacts would return to background levels after reclamation is completed and corrective measures for water quality improvement, such as water treatment plants, have been dismantled. Because this alternative places more emphasis on enhanced reclamation measures to gradually improve water quality, noise should reach background levels more quickly than for alternatives 1 or 2.

4.9.6 Impacts from Alternative 4

Alternative 4 includes extension of mine activities at both the Zortman and Landusky mines. Increased reclamation would be implemented at both mines as well. Noise impacts would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities. Additional exploration and development actions are reasonably foreseeable.

4.9.6.1 Impacts

Figure 4.9-3 presents estimated noise levels generated at the Zortman and Landusky mines for this Alternative, based on a worst-case scenario that all mining equipment listed in Table 4.9-1 would be operating at the same time. For the Goslin Flats leach pad, noise levels for the haul trucks, loaders, graders, and water trucks were used to estimate the worst-case noise level for leaching activities. The secondary and tertiary crushers to be sited near the leach pad were not included in the analysis because they would be enclosed in buildings. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The noise level for both the Landusky and Zortman mines was calculated to be 104 dBA at a distance of 50 feet from the mines. The noise level generated by activities at the Goslin Flats leach pad was estimated to be 99 dBA at a distance of 50 feet from the leach pad.

The level of noise to sensitive receptors from the mining, reclamation, and leaching activities is estimated to be:

Source	Receptor	Noise
Zortman Mine	Zortman	59 dBA
	Landusky	52 dBA
	Pow Wow Grounds	53 dBA
	Azure Cave	55 dBA
Landusky Mine	Zortman	52 dBA
	Landusky	61 dBA
	Pow Wow Grounds	59 dBA
	Azure Cave	54 dBA
Goslin Flats	Zortman	59 dBA
	Landusky	47 dBA
	Pow Wow Grounds	43 dBA
	Azure Cave	58 dBA

The combined noise from Goslin Flats and Zortman Mine would result in an additive noise level at the town of Zortman of 63 dBA, and an additive noise level at Azure Cave of 59 dBA. These noise levels exceed the outdoor activity criterion and result in significant, high impacts at Zortman and Azure Cave. Noise generated at the Landusky Mine would exceed the criterion at Landusky and at the Pow Wow Grounds. These impacts would be significant and of a high magnitude.

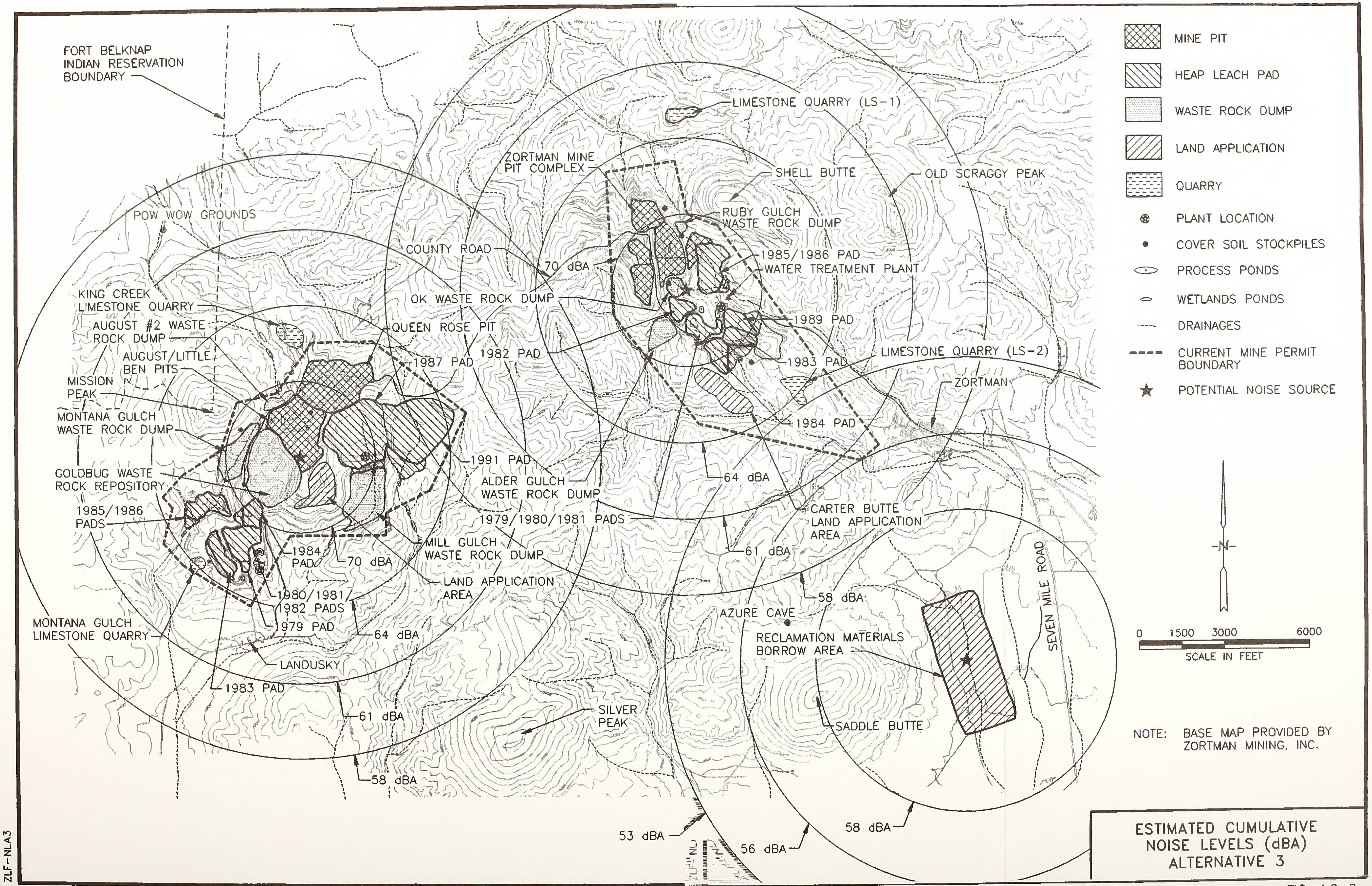
Roads. As described for Alternative 1, noise levels from truck traffic are estimated by assuming a peak noise level of 98 dBA at 50 feet for short periods as the trucks pass through town. This is a significant, high magnitude impact of short duration. The frequency of haul trips through the town of Zortman required for material hauling at the Zortman Mine under this alternative would peak at 2,450 round trips in the year 2007. Reclamation would be expected to end and haul trucks cease at the Zortman Mine in the year 2007. The frequency of haul trips through the town of Landusky required for leaching and reclamation activities at the Landusky Mine under this alternative would peak at 4,000 round trips in 2002. Reclamation would be expected to end and haul trucks cease at the Landusky Mine in the year 2002.

4.9.6.2 Cumulative Impacts

The reasonably foreseeable developments under Alternative 4 include mining extension into Pony Gulch. The Pony Gulch area is approximately 4000 feet from the town of Zortman. Noise levels from mining activities at Pony Gulch would be approximately:

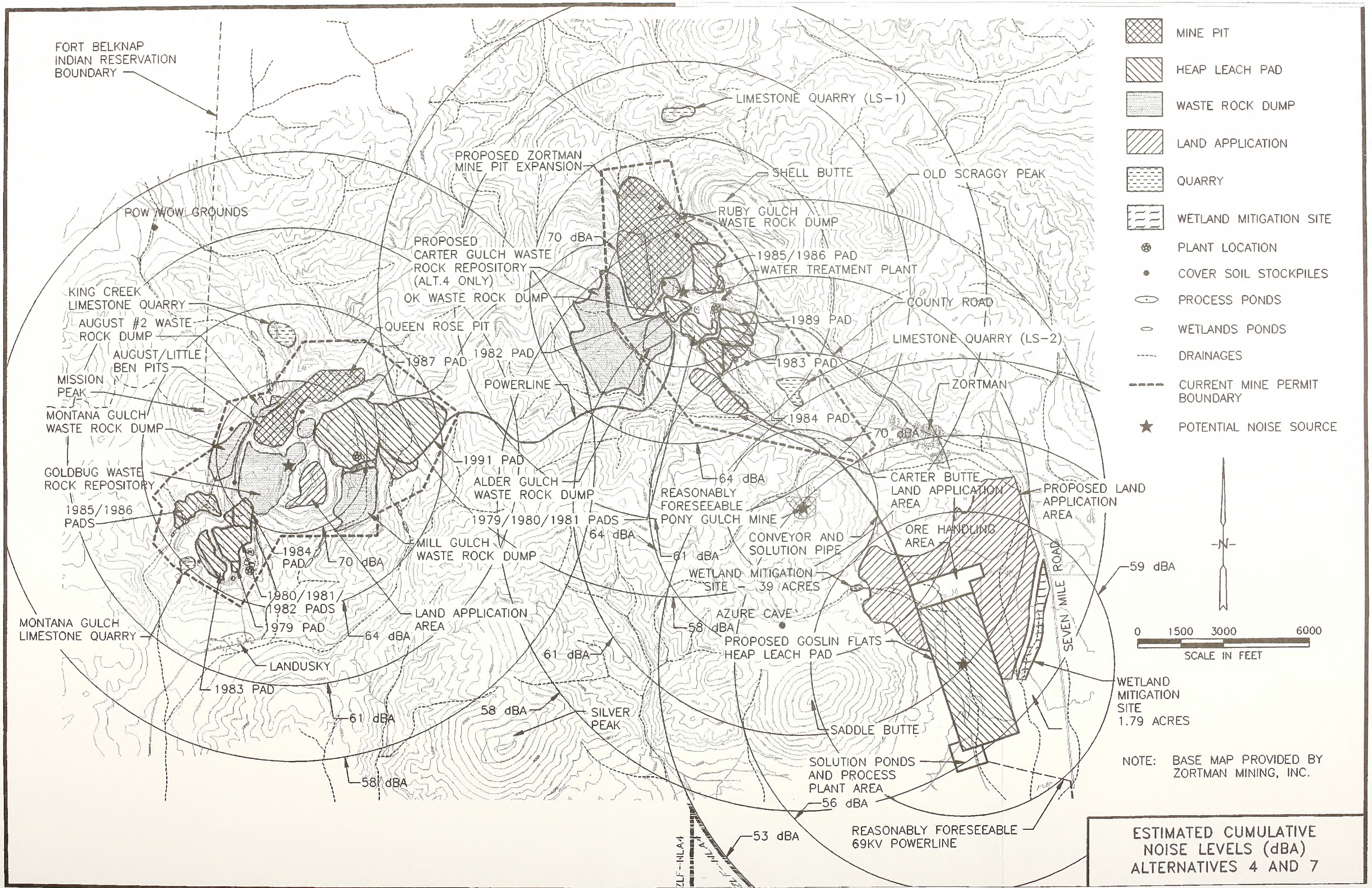
Source	Receptor	Noise
Pony Gulch	Zortman	65 dBA
	Landusky	53 dBA
	Pow Wow Grounds	48 dBA
	Azure Cave	64 dBA

Other reasonably foreseeable developments under Alternative 4 include addditional mining at the Landusky Mine and further exploration drilling. These activities are not incorporated into the cumulative effects analysis, because additional Landusky mining would merely extend the duration of mine noise levels for approximately one more year. Exploration activities are typically dispersed and short-term.Combining background noise levels with those predicted to occur for Alternative 4 and under reasonable foreseeable development scenarios results in cumulative noise levels of:



ESTIMATED CUMULATIVE NOISE LEVELS (dBA) ALTERNATIVE 3

FIG. 4.9-2



ESTIMATED CUMULATIVE NOISE LEVELS (dBA) ALTERNATIVES 4 AND 7

FIG. 4.9-3

Receptor	Noise
Zortman	66 dBA
Landusky	63 dBA
Pow Wow Grounds	59 dBA
Azure Cave	66 dBA

Cumulative impacts from mine operations at all receptor locations would be significant and of a high magnitude.

4.9.6.3 Unavoidable Adverse Impacts

The significant, high magnitude impacts described are considered unavoidable and adverse, if this alternative is implemented.

4.9.6.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this Alternative would last until 2007 for the Zortman Mine and until 2002 for the Landusky Mine (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.6.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this alternative. Noise impacts would return to background levels after reclamation is completed and corrective measures for water quality improvement have been dismantled. Based on the differences in surface reclamation procedures, it is estimated that noise from water quality treatment systems would persist longer than for Alternative 3, but not as long as for Alternatives 1 and 2.

4.9.7 Impacts from Alternative 5

This alternative includes extension of mine activities at both the Zortman and Landusky mines. A major operational modification affecting noise impacts would place the Zortman Mine heap leach pad in Upper Alder Gulch. Agency mitigated reclamation would be implemented at both mines. Noise impacts would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities.

4.9.7.1 Impacts

Figure 4.9-4 presents estimated noise levels generated at the Zortman and Landusky mines for this Alternative, based on a worst-case scenario that all mining equipment listed in Table 4.9-1 would be operating at the same time. The mining and reclamation activities associated with the heap leach pad in Upper Alder Gulch are considered part of the Zortman Mine area source for noise. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The noise level for the Landusky and Zortman mines was calculated to be 104 dBA at a distance of 50 feet from the mines. Noise levels at the sensitive receptors from mining activities at the Zortman and Landusky mines were estimated to be:

Source	Receptor	Noise
Zortman Mine	Zortman	59 dBA
	Landusky	52 dBA
	Pow Wow Grounds	53 dBA
	Azure Cave	56 dBA
Landusky Mine	Zortman	52 dBA
	Landusky	61 dBA
	Pow Wow Grounds	59 dBA
	Azure Cave	54 dBA

Noise generated at the Zortman Mine would exceed the outdoor activity criterion at the town of Zortman. This impact would be significant and of a high magnitude. Noise generated at the Landusky Mine would exceed the criterion at Landusky and at the Pow Wow Grounds. These impacts would be significant and of a high magnitude. Noise impacts from mining operations at the Azure Cave would be of a moderate magnitude and not significant.

Roads. As described for Alternative 1, noise levels from truck traffic are estimated by assuming a peak noise level of 98 dBA at 50 feet for short periods as the trucks pass through town. This is a significant, high magnitude impact of short duration. The frequency of haul trips through the town of Zortman required for material hauling at the Zortman Mine under this Alternative would peak at 3,800 round trips in the year 1996. This frequency would be associated with construction of the liner for the Upper Alder Gulch leach pad. Reclamation would be expected to end and haul trucks cease in the year 2007. The frequency of haul trips through the town of Landusky required for leaching and reclamation activities at the Landusky Mine under this alternative would peak at 4000 round trips in the year 2002. Reclamation would be expected to end and haul trucks cease in the year 2002.

4.9.7.2 Cumulative Impacts

Reasonably foreseeable developments under Alternative 5 include addditional mining at the Landusky Mine and further exploration drilling. These activities are not incorporated into the cumulative effects analysis, because additional Landusky mining would merely extend the duration of mine noise levels for approximately one more year. Exploration activities are typically dispersed and short-term.
Combining background noise levels with those predicted to occur for Alternative 5 implementation results in cumulative noise levels of:

Receptor	Noise
Zortman	60 dBA
Landusky	62 dBA
Pow Wow Grounds	59 dBA
Azure Cave	57 dBA

Cumulative impacts at all receptor locations but Azure Cave would be significant and of a high magnitude. Impacts to Azure Cave would be moderate and not significant.

4.9.7.3 Unavoidable Adverse Impacts

The significant, high magnitude impacts described are considered unavoidable and adverse if this alternative is implemented.

4.9.7.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this alternative would last until 2007 for the Zortman Mine and until 2002 for the Landusky Mine (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.7.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this alternative. Noise impacts would return to background levels after reclamation is completed and corrective measures for water quality improvement, such as water treatment plants, have been dismantled. Based on the differences in surface reclamation procedures and increased mining activities, it is estimated that noise from water quality treatment systems would persist longer than for Alternative 3, but not as long as for Alternatives 1, 2, and 4.

4.9.8 Impacts from Alternative 6

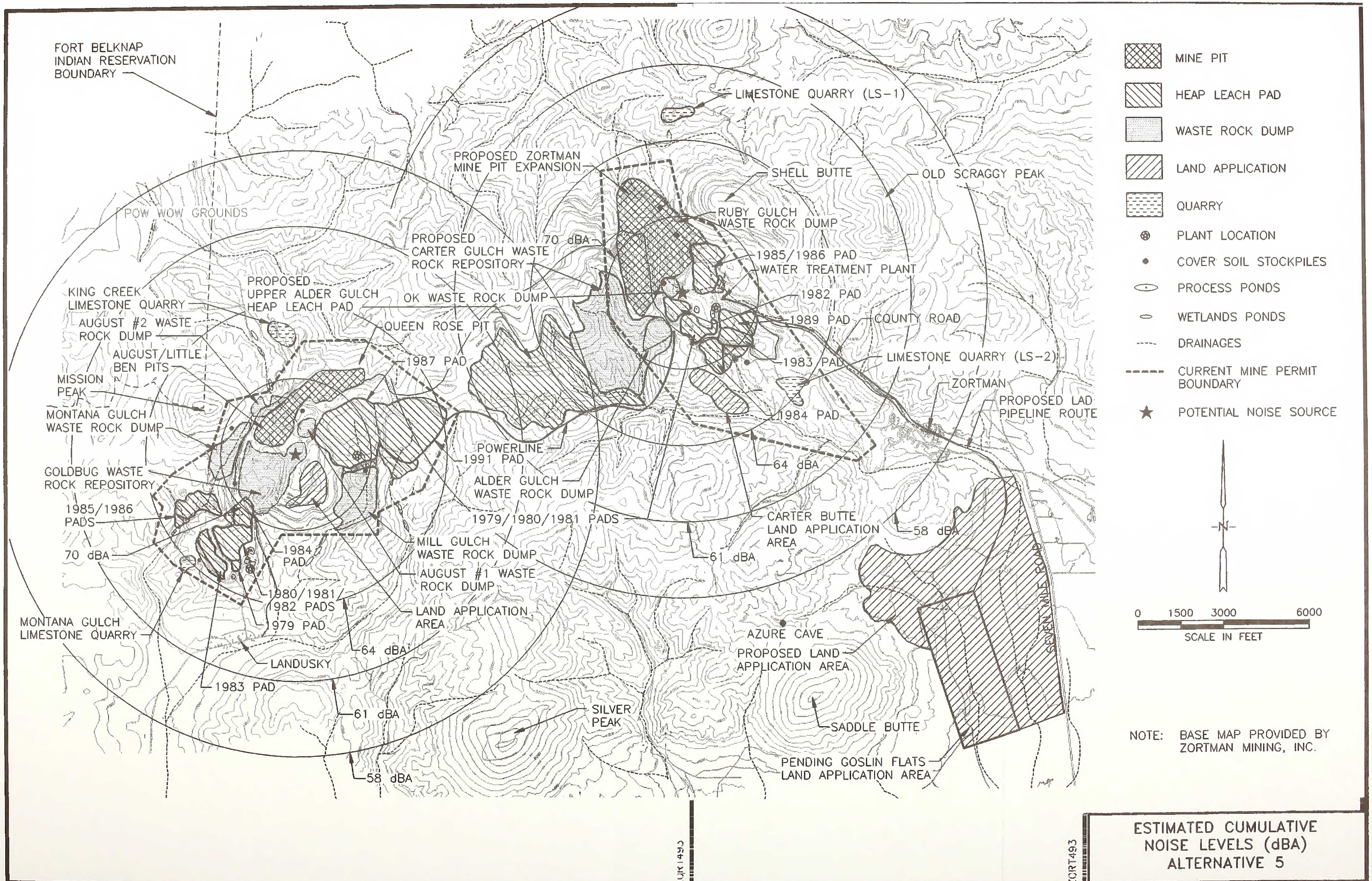
This alternative includes extension of mine activities at both the Zortman and Landusky mines. A major operational modification affecting noise impacts would place the Zortman Mine waste rock repository on the Ruby Flats. Agency mitigated reclamation would be implemented at both mines. Noise impacts would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities. Additional exploration and development activities are reasonably foreseeable.

4.9.8.1 Impacts

Figure 4.9-5 presents estimated noise levels generated at the Zortman and Landusky mines for this Alternative, based on a worst-case scenario that all mining equipment listed in Table 4.9-1 would be operating at the same time. For the Goslin Flats leach pad, noise levels for haul trucks, loaders, graders, and water trucks were used to estimate the worst-case noise level for leaching activities. The secondary and tertiary crushers to be sited near the leach pad were not included in this analysis because they would be enclosed in buildings. For the Ruby Flats waste rock repository, noise levels for haul trucks, loaders, and water trucks were used to estimate the worst-case noise level for leaching activities. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The noise level for both the Zortman and Landusky mines was calculated to be 104 dBA at a distance of 50 feet from the mines. The noise level generated by activities at the Goslin Flats leach pad and Ruby Flats waste rock repository was calculated to be 99 dBA at a distance of 50 feet from each facility (each facility was modeled as a separate noise source area, although their proximity makes them virtually indistinguishable for cumulative effects analysis).

The level of noise to sensitive receptors from the various mining and reclamation activities at the Zortman and Landusky mines is estimated to be:



ESTIMATED CUMULATIVE NOISE LEVELS (dBA) ALTERNATIVE 5

FIG. 4.9-4

ZORT493

ESTIMATED CUMULATIVE NOISE LEVEL (dBA) ALTERNATIVE 6

FIG. 4.9-5

ZLF-NLA6

Source	Receptor	Noise
Zortman Mine	Zortman	59 dBA
	Landusky	52 dBA
	Pow Wow Grounds	53 dBA
	Azure Cave	55 dBA
Landusky Mine	Zortman	52 dBA
	Landusky	61 dBA
	Pow Wow Grounds	59 dBA
	Azure Cave	54 dBA
Goslin Flats	Zortman	59 dBA
	Landusky	47 dBA
	Pow Wow Grounds	43 dBA
	Azure Cave	58 dBA
Ruby Flats	Zortman	62 dBA
	Landusky	44 dBA
	Pow Wow Grounds	43 dBA
	Azure Cave	57 dBA

The combined noise from Goslin Flats, Ruby Flats, and Zortman Mine would result in an additive noise level at the town of Zortman of 64 dBA, and an additive noise level at Azure Cave of 60 dBA. These noise levels exceed the outdoor activity criterion and result in significant, high impacts at Zortman and Azure Cave. Noise generated at the Landusky Mine would exceed the criterion at Landusky and at the Pow Wow Grounds. These impacts would be significant and of a high magnitude.

Roads. As described for Alternative 1, noise levels from truck traffic are estimated using a peak noise level of 98 dBA at 50 feet can be expected for short periods as the trucks pass through town. This is a significant, high magnitude impact of short duration. The frequency of haul trips through the town of Zortman required for material hauling at the Zortman Mine under this Alternative would peak at 2,000 round trips in the year 2006. Reclamation would be expected to end and haul trucks cease at the Zortman Mine in the year 2006. The frequency of haul trips required for leaching and reclamation activities at the Landusky Mine under this Alternative would peak at 4000 round trips in the year 2002. Reclamation would be expected to end and haul trucks cease at the Landusky Mine in the year 2002.

4.9.8.2 Cumulative Impacts

The reasonably foreseeable developments under Alternative 6 include mining extension into Pony Gulch. These noise levels were described in Section 4.9.6.2. Other reasonably foreseeable developments under Alternative 6 include addditional mining at the Landusky Mine and further exploration drilling. These activities are not incorporated into the cumulative effects analysis, because additional Landusky mining would merely extend the duration of mine noise levels for approximately one more year. Exploration activities are typically dispersed and short-term.

Combining background noise levels with those predicted to occur for Alternative 6 and under reasonably foreseeable development scenarios results in cumulative noise levels of:

Receptor	Noise
Zortman	67 dBA
Landusky	63 dBA
Pow Wow Grounds	59 dBA
Azure Cave	66 dBA

Cumulative impacts at all receptor locations would be significant and of a high magnitude.

4.9.8.3 Unavoidable Adverse Impacts

The significant, high magnitude impacts described are considered unavoidable and adverse if this alternative is implemented.

4.9.8.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this alternative would last until 2006 for the Zortman Mine and until 2002 for the Landusky Mine (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.8.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this Alternative. Noise impacts would return to background levels after reclamation is completed and corrective measures for water quality improvement, such as water treatment plants, have been dismantled. Based on the differences in surface reclamation procedures and increased mining activities, it is estimated that noise from water quality treatment systems would persist longer than for Alternative 3, but not as long as for Alternatives 1, 2, 4, and 5.

4.9.9 Impacts from Alternative 7

This alternative includes extension of mine activities at both the Zortman and Landusky mines. A major operational modification affecting noise impacts would place the Zortman Mine waste rock repository on top of existing disturbances and undisturbed areas around the mine site. Agency mitigated reclamation would be implemented at both mines. Noise impacts would result from ore blasting, hauling, and processing at both mines, and ongoing reclamation of existing and new facilities. Additional exploration and development activities are reasonably foreseeable.

4.9.9.1 Impacts

Figure 4.9-3 illustrated estimated noise levels generated at the Zortman and Landusky mines for Alternative 7. The noise levels for this alternative would be expected to be similar to Alternative 4, since the new waste rock repository would be within the mine source area, as was the Carter Gulch waste rock repository under Alternative 4. Noise impact analyses for this alternative are also based on a worst-case scenario that all mining equipment listed in Table 4.9-1 would be operating at the same time. For the Goslin Flats leach pad, noise levels for haul trucks, loaders, graders, and water trucks were used to estimate the worst-case noise level for leaching activities. The secondary and tertiary crushers to be sited near the leach pad were not included in the analysis because they would be enclosed in buildings. Table 4.9-4 summarizes the results of the noise analyses for this and all alternatives.

Mine. The noise levels from mining the Landusky and Zortman mines, estimated at 104 dBA at a distance of 50 feet from the mines, and noise generated by activities at the Goslin Flats leach pad, estimated to be 99 dBA at a distance of 50 feet from the leach pad, werecalculated at each sensitive receptor. The noise levels at the sensitive receptors resulting from the mining and reclamation activities at the two mines is estimated to be:

Source	Receptor	Noise
Zortman Mine	Zortman	59 dBA
	Landusky	52 dBA
	Pow Wow Grounds	53 dBA
	Azure Cave	55 dBA
Landusky Mine	Zortman	52 dBA
	Landusky	61 dBA
	Pow Wow Grounds	59 dBA
	Azure Cave	54 dBA
Goslin Flats	Zortman	59 dBA
	Landusky	47 dBA
	Pow Wow Grounds	43 dBA
	Azure Cave	58 dBA

The combined noise from Goslin Flats and Zortman Mine, including work at the LS-2 limestone quarry, would result in an additive noise level at the town of Zortman of 63 dBA, and an additive noise level at Azure Cave of 59 dBA. These noise levels exceed the outdoor activity criterion and result in significant, high impacts at Zortman and Azure Cave. Noise generated at the Landusky Mine would exceed the criterion at Landusky and at the Pow Wow Grounds. These impacts would be significant and of a high magnitude.

Roads. As described for Alternative 1, noise levels from truck traffic are estimated using a peak noise level of 98 dBA at 50 feet for short periods as the trucks pass through town. This is a significant, high magnitude impact of short duration. The frequency of haul trips through the town of Zortman required for material hauling at the Zortman Mine under this Alternative would peak at 4,500 in the year 2002. Reclamation would be expected to end and haul trucks cease at the Zortman Mine in the year 2007. Soil for reclamation covers at the Landusky Mine would be provided by existing stockpiles. Therefore, no truck trips through Landusky in support of reclamation activities at the Landusky Mine would be required.

4.9.9.2 Cumulative Impacts

The reasonably foreseeable developments under Alternative 7 include mining extension into Pony Gulch. The Pony Gulch area is approximately 4000 feet from Zortman. Noise levels from mining activities at Pony Gulch would be approximately:

Source	Receptor	Noise
Pony Gulch	Zortman	65 dBA
	Landusky	53 dBA
	Pow Wow Grounds	48 dBA
	Azure Cave	64 dBA

Alternative 7 precludes the mining of the Pony Gulch ore deposit concurrent with mining and reclamation activities at the Zortman Mine. This mitigation is applied because air quality standards for particulate matter would otherwise be exceeded (see Section

4.6.9.2). Therefore, noise from Pony Gulch is not factored into the cumulative noise impacts for Alternative 7.

Other reasonably foreseeable developments under Alternative 7 include addditional mining at the Landusky Mine and further exploration drilling. These activities are not incorporated into the cumulative effects analysis, because additional Landusky mining would merely extend the duration of mine noise levels for approximately one more year. Exploration activities are typically dispersed and short-term.

Combining background noise levels with those predicted to occur for Alternative 7 results in cumulative noise levels of:

Receptor	Noise
Zortman	64 dBA
Landusky	63 dBA
Pow Wow Grounds	59 dBA
Azure Cave	60 dBA

Cumulative impacts at all receptor locations would be significant and of a high magnitude.

4.9.9.3 Unavoidable Adverse Impacts

The significant, high magnitude impacts described are considered unavoidable and adverse if this alternative is implemented.

4.9.9.4 Short-term Use/Long-term Productivity

Mining and reclamation noise impacts under this Alternative would last until 2007 for the Zortman Mine and until 2002 for the Landusky Mine (see Table 4.11-2). After reclamation is completed, noise levels would return to background levels.

4.9.9.5 Irreversible or Irretrievable Resource Commitments

There are no irreversible or irretrievable resource commitments for noise for this alternative. Noise impacts would return to background levels after reclamation is completed and corrective measures for water quality improvement, such as water treatment plants, have been dismantled. Based on the differences in surface reclamation procedures and increased mining activities, it is estimated that noise from water quality treatment systems would persist longer than for Alternative 3, but not as long as for the other alternatives.

4.10 SOCIOECONOMICS

4.10.1 Methodology

4.10.1.1 Economic Assumptions

For the socioeconomics analysis, descriptions of the proposed action and alternatives as presented in Chapter 2 have been supplemented by information presented in Chapter 3 about the existing Zortman and Landusky mines. Assumptions about the economic characteristics of the alternatives have been developed after reviewing additional information provided by ZMI (Ryan 1994 and 1995). The economic characteristics that most affect the socioeconomic analysis are employment, payroll, business expenditures, and tax payments. Assumptions about the magnitude and timing of these characteristics are summarized in Tables 4.10-1 through 4.10-4.

Under the non-expansion alternatives, Alternatives 1 through 3, mining would cease in the near future. Differences among the non-expansion alternatives in terms of projected employment, payroll, business purchases, and taxes reflect differing activities due to the modification of reclamation procedures proposed by ZMI under Alternative 2 and the agency-mitigated reclamation procedures proposed under Alternative 3. ZMI's total tax liability is estimated to be virtually the same under the three non-expansion alternatives because they are similar in terms of capital spending and the outputs of gold and silver. These outputs are the economic characteristics which drive ZMI's liabilities for property taxes and the gross proceeds and metal mines license taxes.

The expansion alternatives, Alternatives 4 through 7, would permit continued mineral development activity and the construction of expanded or new facilities at the Zortman and Landusky mines. Differences among the expansion alternatives in terms of projected employment, payroll, business purchases, and taxes reflect the various locations and configurations of heap leaching and ore and waste rock handling facilities, as well as differing methods and intensities of reclamation activity. The timing of additional construction, mining, and reclamation is similar among the expansion alternatives although Alternative 6 lasts a year less overall compared to Alternatives 4, 5, and 7. Differences in the timing of additional construction, mining, and reclamation also account for the differences in how employment levels begin to decline as the transition is made from mineral development activity to the activities of the closure cycle. This effect is most noticeable in Alternatives 5 and 6, where employment levels for the year 2004 are substantially lower than the employment levels projected for Alternatives 4 and 7 for the same year. ZMI's tax liability would differ somewhat among the expansion alternatives, mainly because of varying levels of capital expenditure and productivity. In general, however, differences among Alternatives 4 through 7 fall within a relatively narrow range.

Figures 4.10-1 and 4.10-2 illustrate the similarities and differences across all seven alternatives in graphical terms by plotting employment and spending from 1996 to 2012, the time horizon encompassed by this assessment. The employment levels plotted in the figure are taken from Table 4.10-1, and they represent direct ZMI employment. The spending levels are taken from Table 4.10-3, and they represent the sum of operating and capital expenditures, plus expenditures for contracting, all expressed in 1994 dollars.

Readers of the following assessment should note that in socioeconomic terms, the key difference between the non-expansion alternatives (Alternatives 1 - 3) and the expansion alternatives (Alternatives 4 - 7) is the timing of the end of mineral development activity, and therefore the timing of impacts upon the social and economic environment. The end of mineral development activity occurs almost immediately under Alternatives 1 through 3 and is delayed for 5 to 7 years under Alternatives 4 through 7. Despite the difference in timing, it should be emphasized that the impacts that would occur as a result of the end of mineral development would be similar and would inevitably occur under all alternatives, even though these impacts would be delayed for a number of years under the expansion alternatives.

Some consideration has been given in this analysis to the economic effects of reasonably foreseeable future actions which may be undertaken by ZMI. This includes mining of ore in the Pony Gulch area and exploration activities. Development of Pony Gulch potentially would occur under Alternatives 4, 6 and 7. This development would add about 2 million tons of ore (or about 2.5%) to the prospective 80 million tons to be mined under these alternatives, translating into about two months of additional mining activity. It is unlikely that this additional development would require ZMI to add employees; additional spending would be proportional to the amount of new ore to be extracted and therefore would be relatively small.

Reasonably foreseeable exploration activity would be a drilling program to possibly expand ore reserves or

TABLE 4.10-1
ASSUMPTIONS ABOUT DIRECT ZMI EMPLOYMENT: ALTERNATIVES 1-7
(full- and part-time jobs)

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1996	185	185	185	205	205	205	205
1997	25	108	185	238	238	238	238
1998	15	15	15	238	238	238	238
1999	15	15	15	238	238	238	238
2000	8	8	8	238	238	238	238
2001	5	5	5	238	238	185	238
2002	5	5	5	185	185	185	185
2003	5	5	5	185	185	185	185
2004	5	5	5	113	40	30	185
2005	3	3	3	25	25	20	30
2006				15	15	15	20
2007				15	15	5	15
2008				5	5	5	5
2009				5	5	5	5
2010				5	5	5	5
2011				5	5	5	5
2012				5	5		5
Cumulative	271	354	431	1,958	1,885	1,802	2,040

Note: Employment figures reflect average annual full- and part-time jobs direct with ZMI. Cumulative is in full- and part-time job-years.

TABLE 4.10-2
ASSUMPTIONS ABOUT ZMI PAYROLL: ALTERNATIVES 1-7
(in millions of 1994 dollars)

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1996	$6.198	$6.198	$6.198	$6.868	$6.868	$6.868	$6.868
1997	0.838	3.618	6.198	7.973	7.973	7.973	7.973
1998	0.503	0.503	0.503	7.973	7.973	7.973	7.973
1999	0.503	0.503	0.503	7.973	7.973	7.973	7.973
2000	0.268	0.268	0.268	7.973	7.973	7.973	7.973
2001	0.168	0.168	0.168	7.973	7.973	6.198	7.973
2002	0.168	0.168	0.168	6.198	6.198	6.198	6.198
2003	0.168	0.168	0.168	6.198	6.198	6.198	6.198
2004	0.168	0.168	0.168	3.786	1.340	1.005	6.198
2005	0.101	0.101	0.101	0.838	0.838	0.670	1.005
2006				0.503	0.503	0.503	0.670
2007				0.503	0.503	0.168	0.503
2008				0.168	0.168	0.168	0.168
2009				0.168	0.168	0.168	0.168
2010				0.168	0.168	0.168	0.168
2011				0.168	0.168	0.168	0.168
2012				0.168	0.168		0.168
Cumulative	9.083	11.863	14.443	65.599	63.153	60.372	68.345

Note: ZMI payroll is wages and salaries, excluding benefits. ZMI benefits average an additional 33 cents per wage and salary dollar. Contractor payrolls are accounted for separately, under total ZMI expenditures. Total is cumulative expenditure in millions of 1994 dollars.

TABLE 4.10-3
ASSUMPTIONS ABOUT TOTAL EXPENDITURES BY ZMI: ALTERNATIVES 1-7
(in millions of 1994 dollars)

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1996	$10.919	$10.919	$10.919	$42.371	$38.600	$44.350	$42.371
1997	1.585	5.733	9.927	28.433	32.975	31.385	28.370
1998	0.569	0.569	0.569	27.449	27.081	30.514	27.326
1999	0.358	0.358	0.358	27.410	27.042	30.475	27.288
2000	0.464	0.937	0.937	27.372	27.005	30.438	27.250
2001	0.041	0.041	0.041	27.336	26.968	15.811	27.205
2002	0.039	0.039	0.039	20.613	13.269	12.923	20.679
2003	0.032	0.032	0.032	13.441	12.491	2.026	13.380
2004	0.031	0.031	0.031	3.467	2.351	0.711	6.684
2005	0.030	0.030	0.030	0.705	0.705	1.416	0.705
2006				1.384	1.068	1.016	1.384
2007				0.993	0.800	0.068	0.993
2008				0.066	0.066	0.066	0.066
2009				0.064	0.064	0.096	0.064
2010				0.026	0.026	0.026	0.026
2011				0.025	0.025	0.025	0.025
2012				0.025	0.025		0.025
Cumulative	14.068	18.689	22.883	221.180	210.561	201.346	223.841

Note: Expenditures include operating and capital expenditures, plus expenditures for contracting. Capital expenditures include expenditures for capital projects, plus working capital charges. Cumulative expenditure in millions of 1994 dollars.

TABLE 4.10-4
ZMI TAX PAYMENTS ESTIMATES: ALTERNATIVES 1-7
(in millions of 1994 dollars)

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
1996	$0.666	$0.666	$0.666	$2.030	$2.259	$2.315	$2.264
1997	0.302	0.302	0.302	2.102	1.947	1.676	1.640
1998	0.129	0.129	0.129	1.990	1.990	1.990	1.990
1999	0.091	0.091	0.091	1.990	1.990	1.990	1.990
2000	0.071	0.085	0.085	1.990	1.990	1.990	1.990
2001	0.019	0.019	0.019	1.990	1.990	1.258	1.990
2002	0.019	0.019	0.019	0.981	0.886	0.620	0.981
2003	0.012	0.012	0.012	0.404	0.260	0.254	0.404
2004	0.012	0.012	0.012	0.230	0.134	0.134	0.230
2005	0.012	0.012	0.012	0.134	0.096	0.091	0.134
2006				0.091	0.071	0.071	0.091
2007				0.054	0.020	0.019	0.054
2008				0.019	0.019	0.019	0.019
2009				0.012	0.012	0.012	0.012
2010				0.012	0.012	0.012	0.012
2011				0.012	0.012	0.012	0.012
2012				0.012	0.012		0.012
Cumulative	1.333	1.347	1.347	14.053	13.700	12.463	13.825

Note: Tax payments estimate represent estimates of ZMI's total liability for ad valorem taxes due Phillips County on real and personal property and gross proceeds, plus liability for Metal Mines License Taxes due the State. Total tax liabilities are to be further allocated among taxing entities within the County and entities due Metal Mines License Tax allocations by statute. Total is cumulative tax payments in millions of 1994 dollars.

Fig. 4.10-1. Direct ZMI Employment

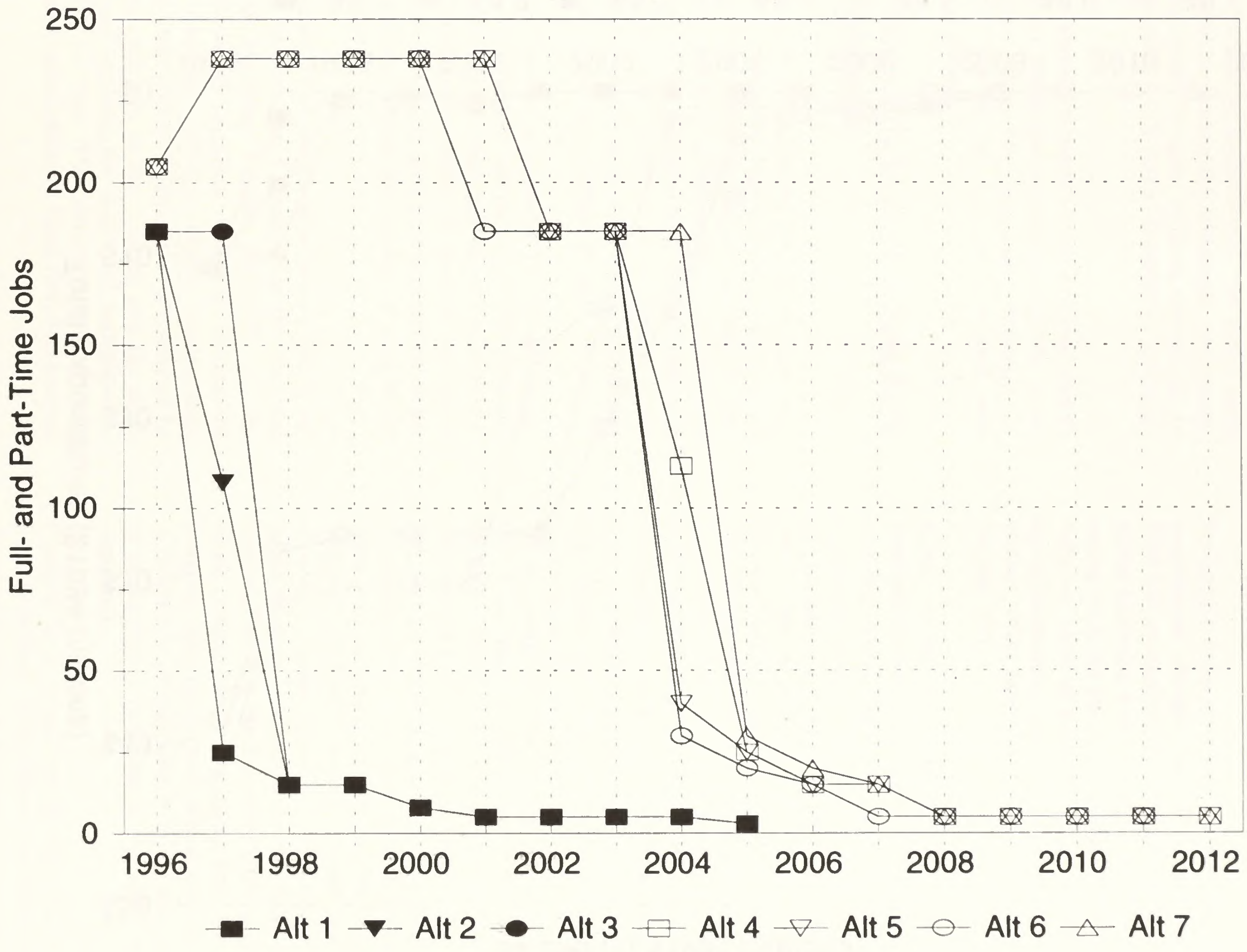
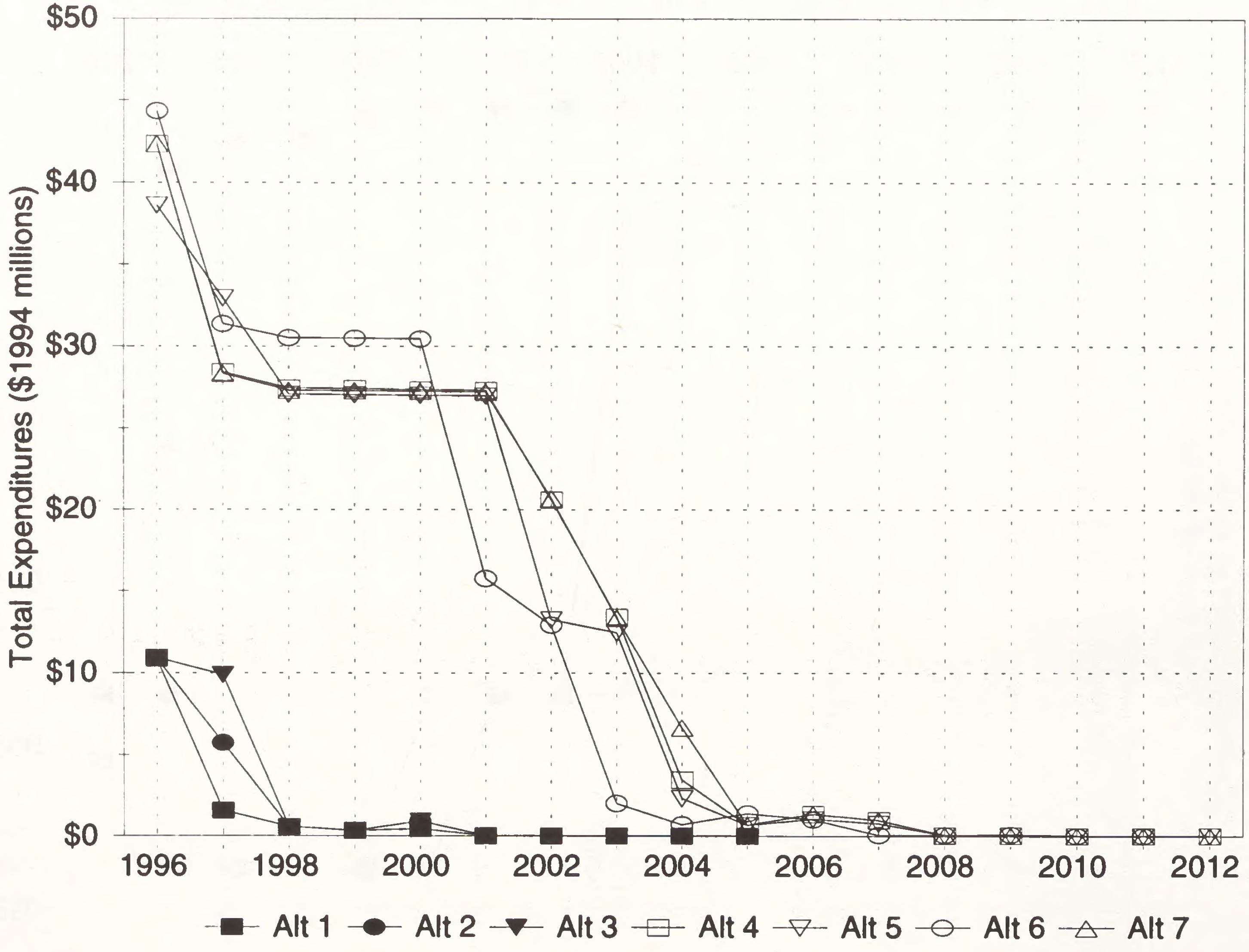


Fig. 4.10-2. Total Expenditures
by ZMI (in $1994 millions)



further define existing reserves. Such a program could involve a contract drilling crew of about 4 persons costing ZMI between $100,000 and $200,000 per year in each of 3 to 5 years. ZMI potentially could hire a local company, as it has in the past, or an outside contractor, in which case perhaps one-fifth of exploration expenditures would be made locally. In either case, local or outside contractor, the additional employment and spending would be quite small in comparison to proposed spending levels under Alternatives 4 through 7.

Therefore, reasonably foreseeable future actions, namely mining of Pony Gulch and exploration activity, would not materially change the magnitude, character, or evaluation of any of the impacts associated with Alternatives 4 through 7.

4.10.1.2 Economic Impact Assessment Methods

Economic impacts are measured in terms of changes in employment, earnings, total population and numbers of school age children. Employment and earnings changes were estimated using a multiplier approach similar to the one described in a report by the U.S. Department of Commerce (USDOC 1992). A multiplier is an economic ratio used to estimate the secondary economic repercussions of a direct economic impact.

Dollar impacts have been converted to 1994 dollars for consistency. Employment and earnings reflect jobs and earnings counted at the work site, regardless of where the person holding a job lives. In contrast, per capita income effects (which are described qualitatively in the following sections) reflect the income of workers by place of residence.

Multipliers used in the analysis were those available for the State of Montana as a whole from the Regional Input-Output Modeling System (RIMS II) of the Regional Economic Analysis Division, Bureau of Economic Analysis, USDOC (1992). County-level impacts and study area-level impacts were estimated by allocating expenditures to the counties and the study area, and then applying the state-level multipliers to each expenditure type. The allocations reflect local spending information obtained from ZMI (Eickerman 1993).

Changes in total population and school-age population were estimated from changes in total employment by using factors derived from information in Section 3.10. Perhaps the most important issue concerning changes in total and school-age population is the potential for outmigration of households of employees laid off due to ZMI's closure. The outmigration projections in this assessment are derived from the changes in direct and secondary employment estimated and projected as described above.

To develop factors needed to derive outmigration from employment changes, interviews were conducted with ZMI and knowledgeable individuals in the community to gather information about the percentage of workers with strong local ties and an impression of the likelihood of different types of workers to stay or outmigrate after loss of employment at ZMI (Boothe 1994, Boland 1994, Ereaux 1994, Erickson 1994, Kalal 1994, Rust 1994, Soiseth 1994).

Based on the information gathered in this process, assumptions were developed for three categories of workers. First, ZMI's managerial and professional employees, about 15 percent of ZMI employment, are all assumed to outmigrate because no comparable employment in gold mining would be available locally. Second, half of the hourly work force and their households are assumed to outmigrate. On the one hand, this reflects the fact that about 77 percent were hired locally (BLM 1992a) and have strong ties to communities in Phillips and Blaine counties through land ownership, involvement in agriculture, family allegiances, and other personal relationships. On the other hand, the local economy probably would not be strong enough at time of closure, either sooner under the non-expansion alternatives or later under the expansion alternatives, to offer satisfactory replacement employment for the long-term. If all workers with local ties were to remain in place, the outmigration rate for hourly workers would be about 23 percent. This has been increased to 50 percent on the assumption that some locally-hired workers would outmigrate for economic reasons and despite local ties. Finally, it was assumed that households of workers employed in communities as a result of secondary spending impacts would outmigrate at the same rate as hourly ZMI workers. After using these assumptions to project total outmigration, outmigration by community was projected in proportion to residency of the ZMI work force by community.

Readers of this assessment should note that the state-level multipliers used reflect conditions found in the Montana economy as a whole, an economy that is much more diversified than the local economies within the study area. Secondary, or multiplier, effects are smaller in local economies, like Phillips and Blaine counties, because of leakage, the loss of local business and household spending to markets and trade centers outside the local area. If accurate local multipliers were available for Phillips and Blaine counties, they would be smaller than the multiplier for the state as a whole. However, accurate local multipliers were not available and could not be estimated for this assessment.

The state-level multiplier has been used instead. As a result, employment, earnings, and population impacts are probably overstated. In other words, the secondary effect of ZMI's operation within the local economies of Phillips and Blaine counties probably is less than has been estimated and reported in this assessment. Similarly, the potential secondary effect of ZMI's closure probably would be less than has been projected and reported in this assessment.

Projections of outmigration presented in this assessment also probably overstate the amount of outmigration that actually would occur. In general, this is because of the combined effect of the uncertainty associated with each of the factors used to produce the projections. First, the projections of outmigration are derived from estimates and projections of employment change; therefore, they are subject to the limitations of the multiplier analysis used to estimate the secondary economic effects of ZMI employment in Phillips and Blaine counties. These limitations are discussed above. Second, there is the uncertainty associated with the outmigration rates developed for this assessment. Empirical information available was limited to the percentage of locally hired employees. Other rates have been assigned based upon impressions gathered from sources cited above, theory and professional experience. This approach may not sufficiently account for the strength of local ties, willingness to accept a lowered standard of living, or the possibility that other economic opportunities may arise at some point in the future, all contingencies that may mitigate the tendency for chronically unemployed or underemployed households to outmigrate to regions where there are job opportunities. In addition, information was not available to account for households containing more than one job holder; this adds to the overstating outmigration. Finally, note that actual outmigration by community may vary from the community-level projections presented here.

4.10.1.3 Facilities and Services Impact Assessment Methods

Facilities and services impacts were assessed by determining whether estimated population changes in communities of the study area would potentially alleviate or aggravate the specific limitations described in Section 3.10.

4.10.1.4 Fiscal Impact Assessment Methods

Changes in local government fiscal conditions were assessed for selected jurisdictions by comparing estimated changes in revenues and expenditures. Jurisdiction-specific revenues generated by the mines were projected from information presented in Section 3.10, combined with information provided by ZMI (Ryan 1994 and 1995) on the level of operation of the mine under each alternative.

Funds from the Phillips County Hard Rock Trust Reserve would be available to local officials to directly address the economic and fiscal effects of mine closure in Phillips County. These funds would potentially be available within a year or two after a decision is made to proceed under Alternatives 1 through 3 and within a year or two after the cessation of mining under Alternatives 4 through 7. The use of Hard Rock Trust Reserve funds to alleviate economic and fiscal impacts has been considered in the evaluation of impacts under the alternatives. These provisions would not address the localized economic impacts of closure in the community of Hays on the Fort Belknap Indian Reservation.

4.10.1.5 Social Impact Assessment Methods

Impacts on social conditions were assessed by considering the potential effects of the alternatives on objective conditions and attitudes affecting the sense of well-being or perception of the local quality of life among various groups as described in Section 3.10. The potential effects of the alternatives were projected on the basis of theory and professional experience. No scientific surveys or formal interviews with representatives of potentially affected groups were conducted in connection with this analysis.

To the extent there is some alleviation of economic and local government fiscal distress by the allocation of moneys from the Hard Rock Trust Reserve, some of the negative effects of mine closure on the sense of well-being also may be alleviated for Phillips County residents. This potential effect has been considered in the evaluation of the social impacts of the alternatives.

4.10.1.6 Impact Assessment Criteria

Potential socioeconomic impacts were determined to be either positive or negative, and were evaluated for significance (see introductory comments on impact methodology, Section 4.0).

Impacts are determined to be positive or negative according to the following definitions:

- Increases in employment and earnings are considered positive; decreases are considered negative.
- Increases in population are a positive economic impact, but may lead to negative facilities, services, or fiscal impacts.
- Facilities and services and fiscal impacts often interact; therefore these potential effects are considered in combination with each other. Impacts are positive if resources are created which allow for the alleviation of existing deficiencies in the balance of supply and demand or in the quality of service. Impacts are negative if demands are created without adequate resources to enhance supply or the quality of service. Impacts also are negative if surplus supply is created or left in place without adequate resources to support it.
- Social impacts are positive if they enhance a group's sense of social well-being or satisfaction with the quality of life. Social well-being may be enhanced by positive changes in socioeconomic factors (e.g., more jobs, higher incomes, lower taxes, better services, more shopping alternatives or a wider selection of commercial services), or by effects (or perhaps no effect) upon social, political or environmental characteristics that are in agreement with a group's strongly-held preferences. Environmental changes that can have an effect on social well-being and general satisfaction with the quality of life may include, but are not limited to, aspects of the physical and social environment such as recreation, transportation, water quality, air quality, noise, the ability to pursue habitual, customary, or traditional lifestyles, and the appearance of one's surroundings. Note that social impacts may differ for different groups within a community and therefore may not be identifiable or subject to evaluation in the aggregate.

The following topic-specific criteria for significance were also used:

- Economic and demographic impacts were rated significant if changes represented 10 percent or more of base conditions. Duration also was taken into account; impacts lasting more than a year are considered long-term and therefore of greater potential significance.
- Combined facilities, services and fiscal impacts were considered significant if changes in supply, demand, revenues, or expenditures would cause or prolong a lasting strain on the ability of an affected entity to maintain established or appropriate services or levels or service; or would leave an entity with excessive operating or debt service costs which cannot be reduced to match projected resources.
- Social impacts were considered significant if changes in social well-being would be manifested in lasting changes in group lifestyles or social behaviors.

Most impacts were evaluated in the local context or, in other words, whether they are significant when compared to existing conditions at the local level. However, statewide economic effects also were considered and were evaluated in a statewide context.

The following general criteria also were considered in evaluating the significance of impacts: the likelihood of the impact occurring, the extent to which an impact is reversible or may be mitigated, whether there is controversy over the impact, and whether the impact is relevant to the agencies' decision to permit or curtail additional mining activities.

4.10.2 Impacts from Mining, 1979 to Present

The existing Zortman and Landusky mines have been in operation in Phillips County since 1979. At that time, no other economic activity approached agriculture in importance in Phillips County and in the Little Rockies area. Over time, the mines have added diversity to an economy hampered by limited natural resources and distance from population centers. Initially, the mines created about 30 to 40 direct jobs in Phillips County, (DSL 1979a), a level that equated to about 1 percent of all the jobs available in the county in 1980. By 1985, there were about 190 direct jobs at the mines, consisting of about 90 jobs with Zortman Mining Inc. and about

100 jobs with contract miner N.A. Degerstrom (DSL/BLM 1990). Currently employment at the mines averages about 200 workers. The mines also employ about 20 additional persons annually between April and October to perform reclamation and other seasonal work.

Since their inception, the Zortman and Landusky mines have had a significant effect on the economic situation in Phillips County by diversifying the local economy, increasing local employment and earnings, and contributing to the local tax base. ZMI also has caused significant growth in Zortman and supported or enhanced property values in Phillips County, Malta, and Zortman. In Landusky, there seems to be little economic effect from the mines. ZMI has had little economic impact upon Blaine County or the bulk of the Fort Belknap Indian Reservation. However, jobs available at the mines are accessible to and are now being held by residents of Hays in the southern part of the reservation, providing employment for and improving the economic well-being of a number of households.

Social impacts of ZMI have been significant and beneficial in Malta and Zortman over the past 15 years, as mine employees have integrated into and strengthened local social structures. The impact of the mines on the social environment on the Fort Belknap Indian Reservation has been significant as well, and generally adverse. Although some Native Americans residing on the reservation are employed by ZMI and feel better off economically, many Native Americans oppose the mine and have expressed a high level of concern about its presence because of impacts on social and cultural activities, on sites of contemporary or heritage significance, on lifestyles which depend upon access to relatively natural land within the Little Rocky Mountains, and on watersheds which drain into the Fort Belknap Indian Reservation.

Table 4.10-5 presents total employment in Phillips County from 1979 to 1994 compared to the estimated number of direct and secondary jobs attributable to ZMI. For almost the entire 15-year period, employment attributable to ZMI has ranged between 8 percent and 16 percent of total employment in the county. Estimates for 1993 and 1994 show the influence of new shifts added at the mines and contract employment for reclamation and their effects on generating additional employment in Phillips County. The effect on earnings within the county has been proportionate to employment. ZMI's contribution to employment in Phillips County is illustrated graphically in Figure 4.10-3. (Impacts in Phillips County may be overstated, as described in Section 4.10.1.2)

The diversifying effect of ZMI's operations was felt most strongly in 1988 when the American Colloid bentonite operation, which also opened in 1979, closed abruptly. The impact of the departure was softened by the concurrent increases in ZMI's level of activity (Halverson 1994).

ZMI also has had a significant effect on the tax base of Phillips County. In 1978 the taxable value of Phillips County was about $14.5 million. Table 4.10-6 presents the taxable value of the combined Zortman and Landusky mines from 1979 to 1988. The total taxable valuation of Phillips County in 1988 was $32.8 million. The combined taxable valuation for ZMI and its construction and mining contractor was a total of about $2.3 million in 1988, or about 7 percent of the taxable valuation of Phillips County. In 1994, the Zortman and Landusky mines provide about 20 percent of the county's ad valorem tax base (Barnard 1994).

After 1988, equalization of valuations by the State caused a reduction of 14 percent in Phillips County's valuations (Barnard 1994). In the past few years, the state legislature made changes in tax categories and percentages of value that are taxable. The result is that in 1983 the county's property had a market value of $214 million and a taxable value of $35 million; in 1993 the county's property had a market value of $280 million but a taxable value of only $20 million—all due to the legislated changes (Halverson 1994).

The taxes paid by ZMI and its contractor have been significant for Phillips County. The $587,324 in taxes paid in 1989 was about 13 percent of the Phillips County government's non-levied tax budget for the year. From 1983 on, ZMI also paid the Metalliferous Mines License Tax, Resource Indemnity Trust Tax, and the Gross Proceeds Tax to the state of Montana. Note that all of the gross proceeds tax, except for a six mill university system levy, was returned to Phillips County during this period (DSL/BLM 1990). The total direct tax contribution of the mines to various taxing jurisdictions in Phillips County, mainly Phillips County government and school districts in Landusky, Malta (which includes the Zortman Elementary School), and Dodson, has fluctuated over the years, but has generally been within the range of $1 million to $1.2 million per year since about 1983.

A significant impact of ZMI's operations over the past 15 years has been to cause the town of Zortman to grow. Zortman's population is about 150 people, up

TABLE 4.10-5
TOTAL AND ZMI EMPLOYMENT IN PHILLIPS COUNTY, 1979 TO 1994
(full- and part-time jobs)

Year	Total Phillips County Employment	Direct and Secondary Employment Due to ZMI	Direct and Secondary Employment due to ZMI as Percent of Total
1979	2,508	70	0.03
1980	2,574	220	0.09
1981	2,532	260	0.10
1982	2,547	290	0.11
1983	2,647	300	0.11
1984	2,705	320	0.12
1985	2,574	300	0.12
1986	2,679	300	0.11
1987	2,689	310	0.12
1988	2,737	330	0.12
1989	2,784	330	0.12
1990	2,857	330	0.12
1991	2,782	310	0.11
1992	2,730	330	0.12
1993	2,760	380	0.14
1994	2,800	460	0.16
Cumulative	42,905	4,840	0.11

Sources: Total Phillips County employment from 1979 to 1992 from USDOC, Bureau of Economic Analysis 1994. Other estimates by Planning Information Corporation. Total employment is expressed in terms of full- and part-time job-years.

Fig. 4.10-3. Total and ZMI Employment in Phillips County, 1979-1994

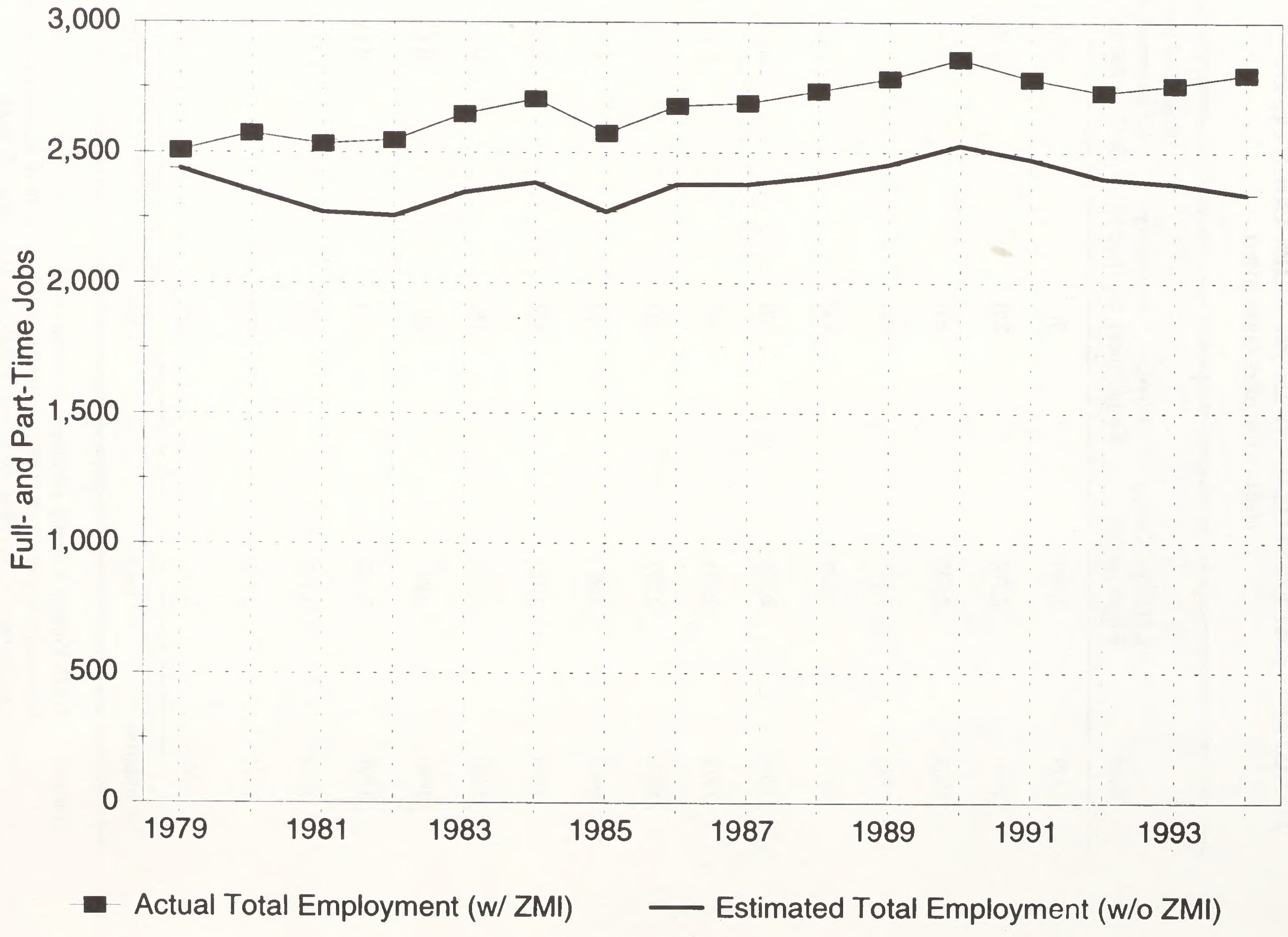


TABLE 4.10-6
TAXABLE VALUATION OF PHILLIPS COUNTY ATTRIBUTABLE TO THE ZORTMAN-LANDUSKY MINES, 1979 TO 1988
(in current dollars)

Year	Taxable Valuation of Mines	Taxable Valuation of Contractor Equipment	Taxable Valuation of Phillips County	Mine/Equipment Valuation as Percent of Total
1979	$ 45,949	$0	$19,151,583	< 1%
1980	950,036	384,449	25,135,640	5.3%
1981	504,106	131,806	26,645,930	2.4%
1982	413,620	455,252	32,895,781	2.6%
1983	1,018,006	539,360	35,121,783	4.4%
1984	787,758	673,155	39,347,917	3.7%
1985	594,251	714,335	38,313,122	3.4%
1986	1,006,854	835,674	27,107,642	6.8%
1987	1,493,866	684,503	32,650,350	6.7%
1988	1,493,658	772,145	32,839,024	6.9%

Sources: DSL 1990; and Phillips County Assessor's Office 1994.

from 10 residents only 15 years ago. In 1979, Zortman had two retail establishments, a small saw mill, and a self-employed building wholesaler (DSL 1979a). Zortman now has a post office, grocery store, bar and cafe, garage and motel, volunteer fire department and ambulance service, cable television, and a public water system which was developed by ZMI but is operated by the community (Boland 1994).

General tourism is not a factor in Zortman's economy although a few fossil hunters, geologists, and bird watchers come to Zortman from time to time. Hunting is a factor seasonally, and involves predominantly deer hunting and prairie dog shooting, with some elk hunting. Housing prices are stable now, but demand has diminished as people await a decision regarding ZMI's future (Boland 1994).

Impacts of ZMI's operations on the community of Landusky over the past 15 years have been mixed. Five Landusky households, or about a third of the households in the community, include mine employees, and two or three children from these households attend the Landusky Elementary School. ZMI offered to develop but not operate a water system for the town, but the offer was declined because of the cost to maintain the system. A few residents of the Landusky area have been concerned about water runoff from the mine and the changing face of the mountain (Mitchell 1994).

The presence of ZMI's operations has tended to support the value of private property in Phillips County. Therefore, property values have remained relatively stable over the past 15 years, in spite of the general lack of economic growth (Halverson 1994). ZMI bought a few lots near Camp Creek Acres for a landing strip (Barnard 1994), some near Seven-Mile Road for a leaching pad (Boland 1994), and an older house in Landusky, right below the mine as a buffer (Knudson 1994). Though the company paid relatively high prices for the lots, this has not affected sales prices in general (Knudson 1994).

Housing prices have been stable in Malta, too, at least up until about two years ago, when they began to rise and some new home construction was stimulated because a greater demand arose for houses to purchase than the market could provide. A house built and sold in 1989 for $70,000 would sell today for $90,000. ZMI itself owns five to seven houses for its upper management. More recently, uncertainty about the future of the Zortman and Landusky mines has caused demand for housing in Malta to fall off again (Knudson 1994).

Because most of the ZMI's employees and all of its property are physically in another county, the mine's presence has had little effect on the economy and property values in Blaine County. Prices for homes have been stable or fallen in past few years, and the housing market has been very slow recently (McMaster 1994).

ZMI's operations have provided a job base accessible to the Hays-Lodgepole area near the southern boundary of the Fort Belknap Indian Reservation and in the areas of the Reservation extending northward into Phillips County. These parts of the reservation had virtually no stable economic base and high unemployment in 1979 (DSL 1979). In 1993, according to ZMI, 41 employees of the mine were Native American (Eickerman 1993). The identification of ZMI's Native American employees is based on information voluntarily given to ZMI at time of hire (Ryan 1995). Of the employees identifying themselves as Native American, 18 employees reside in Hays (Blaine County), 10 employees reside in Malta (Phillips County), 9 employees reside in Zortman (Phillips County), 2 employees reside in Dodson (Phillips County) and 2 employees reside in Harlem (Blaine County). No information is available regarding whether Native American employees of ZMI are members of the Fort Belknap Indian Community or have strong familial or other ties to members of the Fort Belknap Indian Community (Ryan 1995). Twenty-two of the 41 Native American employees of ZMI, or about 53%, reside within the Fort Belknap Indian Reservation (Hays) or in communities near the Reservation (Harlem and Dodson).

The amount of privately-owned land on the Fort Belknap Indian Reservation is very small, and land values have not been affected by ZMI's presence over the past 15 years (Sather 1994).

Recreation resources which generate employment and income in Phillips and Blaine counties have been impacted by ZMI's operations between 1979 and 1994. Impacts like conversion of land to industrial use, access restrictions, and the indirect effects of visible and audible disturbance, all of which are known to reduce the quality of the recreation experience (see Section 4.7), have probably affected hunters, campers, picnickers, hikers, and sightseers, all of whom may contribute in some degree to the local economy (BLM 1992). Although the quality of recreation resources has been impacted, developed recreation facilities and lands accessible to hunters and other dispersed recreationists continue to be used in the vicinity of the Zortman and Landusky mines (SBS Economic Consulting 1990, Martin 1993). On one hand, it is likely that the reduced quality of the recreation resources near the Zortman and Landusky mines from 1979 to 1994 has made the propensity for recreationists to recreate in the area lower than it would have been absent ZMI's operations. All else equal, this would tend to lower the absolute level of recreation activity. On the other hand, an occurrence that would tend to have an offsetting effect would be the increased number of households in the immediate and surrounding area resulting from ZMI employment and employment indirectly supported by ZMI's operations. A larger pool of potential recreationists would tend to raise the absolute level of recreation activity, all else being equal. These two effects probably have occurred. However, information is not available to quantify the net impact to the local recreation economy and the local economy as a whole or to determine whether ZMI's operations have had a net positive or negative effect on the local recreation economy from 1979 to 1994.

The Zortman and Landusky mines have had a beneficial impact on consumer electric rates charged by the Big Flat Electric Cooperative over the past 15 years. Big Flat purchases its electricity from a generation and transmission company, and the constancy of demand for power by the mine decreases the unit price of electricity significantly. The mine accounts for about 50 or 60 percent of the Big Flat's electric sales. The nature of the mine's operations (24 hours a day, seven days a week) causes a leveling of the demand for electricity by the cooperative, and, in turn, the cooperative's supplier lowers its demand charge to the cooperative. This lower cost is reflected in rates for all users of Big Flat (residential, commercial, and 70 large power irrigators) as well as the mine (Henderson 1994).

The lower electric rates charged by Big Flat have disproportionately benefitted homes heated by electricity within Big Flat's service area. These are concentrated in rural areas of Phillips and Blaine counties where natural gas is not available. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation (Fewer 1995). Households heating with electricity benefit from lower rates because of the lower total cost they incur for the higher consumption of electricity that electric heat entails, especially in the winter months.

4.10.3 Impacts from Alternative 1

4.10.3.1 Impacts

Under Alternative 1 (the No Action Alternative), mining at the Zortman and Landusky mines would cease in the near future but certain permitted actions including ore leaching and rinsing would continue as a transition is made to reclamation and closure activities. As a result, Phillips County and the communities of Malta and Zortman would sustain almost immediate significant negative impacts to economic and fiscal conditions, community resources, and social well-being among its residents. Impacts also would be felt in Blaine County. However, impacts in Blaine County would be small compared to existing conditions. Businesses elsewhere in the state of Montana would be negatively affected, especially those in Billings and Helena which supply ZMI with goods and services. Property values potentially would decline in Phillips County, and especially in the communities of Malta and Zortman. There would be a significant increase in the amount that consumers pay for power purchased from the Big Flat Electric Cooperative.

The State treasury would sustain revenue losses over time; however, this impact also would be relatively small. Economic effects on the Fort Belknap Indian Reservation would be minor, and there would be no fiscal impact there because no direct revenues are derived from the mine. On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed (Eickerman 1993).

Social impacts of the alternative would be significant and negative, especially in Malta and Zortman where mine employees and their families are an integral part of local social structures. The impact of Alternative 1 on the social environment on the Fort Belknap Indian Reservation would be significant and generally beneficial. Although some Native Americans residing on the reservation are employed by ZMI and would be adversely affected in terms of economic well-being, many Native Americans who oppose the mine and have expressed a high level of concern about its presence would perceive an improvement in the local quality of life as closure activities begin and the mines ultimately are closed.

Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. This is a reduction of about 50 percent from the employment level of 1993. The socioeconomic effects of the layoffs are still developing. To date, spending for payroll and business purchases has decreased in proportion to the decrease in employment. Household spending within the study area probably has decreased, too, because of reduced incomes to laid off employees remaining in the study area. Unemployment has increased because most laid off employees have remained unemployed and have not relocated for the time being. The economic repercussions of reduced ZMI and household spending would be felt throughout Phillips and Blaine counties. Under Alternative 1, additional mining would not be approved.

The closure cycle of residual leaching, rinsing and final reclamation would begin in 1996. Final reclamation would occur by the year 2000, and some on-site monitoring activity would take place through 2005. The direct employment, payroll and expenditure associated with ZMI's continued operations under Alternative 1 are presented in Tables 4.10-1 through Table 4.10-3.

Table 4.10-7 summarizes the economic and fiscal impact impacts of Alternative 1 compared to the impacts of Alternatives 2 and 3. Under Alternative 1, ZMI's operations from 1996 to 2005 would cumulatively generate a total of 561 job-years of direct and secondary employment and $14.8 million in 1994 dollars of direct and secondary earnings within the state of Montana. This would include 437 job-years of employment and $12.3 million in 1994 dollars of earnings in Phillips County. During the same period, Blaine County would accumulate a total of 20 job-years of employment and $400,000 in earnings in 1994 dollars. (A job-year is a full- or part-time job held for a year, on average. Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2)

Significant negative economic impacts would occur almost immediately under Alternative 1 because ZMI would begin to scale down its activities almost immediately and ultimately would eliminate all jobs and spending at the Zortman and Landusky mines. Cutbacks would begin in 1996 or 1997 under Alternative 1. By 1998, there would be only 15 jobs at the Zortman and Landusky mines, down from 260 jobs in 1994. This reduction of 94 percent in direct employment would occur within the space of only four years. The impacts of this reduction in employment would be felt almost immediately. Smaller impacts would be felt as more reductions are made in employment and spending due to the gradually declining level of intensity of closure activities extending through the year 2005, the last year in which it is projected ZMI would require any jobs at the mine sites. Note that even though negative impacts would occur in the near future under Alternative 1 (and under Alternatives 2 and 3), as compared to Alternatives 4 through 7, ultimately these impacts are inevitable under all alternatives.

The impact of first job cutback, including its secondary repercussions, would be relatively large in comparison to the size of the Phillips County economy. Expressed on an average annual basis, ZMI's operations in 1994 generated a total of 460 direct and secondary jobs (a 16% impact) and $12.8 million in earnings (24% impact) within Phillips County. Almost all of the impact would be felt within four years, resulting in a significant shock to the local economy. Figure 4.10-4 illustrates the impact of Alternative 1 (and, for comparison, the impacts of Alternative 2 through Alternative 7) on projected total employment in Phillips County through the entire time horizon projected for both the non-expansion and expansion alternatives.

Economic impacts also would be felt in Blaine County, where ZMI's operations in 1994 generated a total of about 19 secondary jobs and $350,000 in earnings on an average annual basis. The loss of this economic activity would constitute an impact of less than one percent to the economy in Blaine County. However, the impacts within Blaine County would be concentrated on the Fort Belknap Indian Reservation, where a number of mine employees reside. (Impact in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.)

The State of Montana as a whole also would lose direct and secondary jobs and earnings. As a whole the impact on the state economy would not be significant. However, effects would be noticeable in specific cities where businesses are located that provide goods and services to ZMI. In the past, ZMI has made business expenditures ranging from a few thousand dollars a year to millions of dollars a year in 25 or more cities around the state. The most affected city would be Billings, where ZMI spent $6 million in 1993.

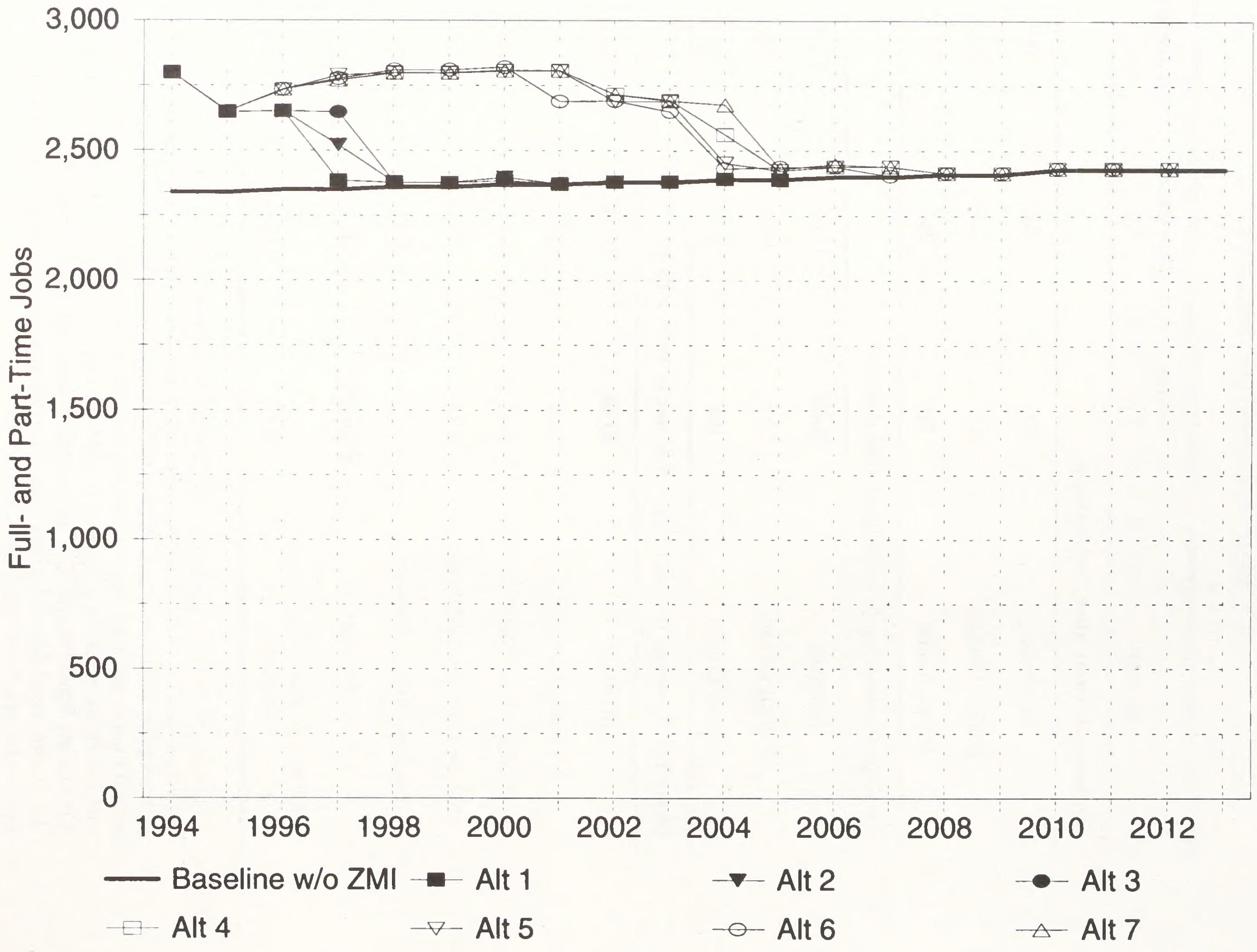
In the short-term, Alternative 1 would negatively affect the local economy as a whole; the alternative simultaneously may affect specific sectors of the economy that depend on spending by recreationists attracted to the area by its recreation resources. The quality of recreation resources that generate employment and income in Phillips and Blaine counties has been impacted by ZMI's operations in the past; Alternative 1 would continue these impacts until ZMI's operations have ceased and impacts like industrial land use, access restrictions, and the indirect effects of visible and audible disturbance are eliminated and reclamation and revegetation begins to take effect. The end of ZMI's

TABLE 4.10-7
ECONOMIC AND FISCAL IMPACTS OF ALTERNATIVES 1-3 FOR THE PERIOD 1996-2005

Impact	Alternative 1	Alternative 2	Alternative 3
Employment (cumulative, in job-years)			
Montana	561	744	909
Phillips County	437	571	698
Blaine County	20	26	32
Earnings (cumulative, in millions of 1994 dollars)			
Montana	$14.8	$19.5	$23.8
Phillips County	12.3	16.0	19.6
Blaine County	0.4	0.5	0.6
Direct Tax Revenues (cumulative, in millions of 1994 dollars)			
Montana	$0.44	$0.44	$0.44
Phillips County	0.25	0.25	0.25
Malta School Districts	0.12	0.12	0.12
Dodson High School District	0.11	0.11	0.11
Landusky School District	0.07	0.07	0.07
City of Malta	Negligible	Negligible	Negligible
Phillips Co. Hard Rock Trust Reserve	0.06	0.06	0.06

Notes: Employment and earnings impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2. Employment is cumulative direct and secondary full- and part-time employment generated by ZMI operations. A job-year represents one full- or part-time job offered for one year within a particular area. The amounts in the table are the cumulative sums of employment, earnings, and direct tax revenues generated by ZMI activity over the life of the alternative. The Zortman Elementary School is operated by the Malta Elementary School district. Montana tax revenues are due to the Metal Mines License Tax. Local tax revenues are due to ad valorem taxes on real and personal property and gross proceeds of mines.

Fig. 4.10-4. Baseline and Impact
Total Employment in Phillips County



operations and the elimination of indirect impacts on recreation resources would have two offsetting effects. On the one hand, it is likely that the improved quality of recreation resources in the Little Rocky Mountains near the Zortman and Landusky mines would raise the propensity of recreationists to recreate in the area. All else equal, this would tend to raise the level of recreation activity. On the other hand, the outmigration of ZMI employee and related households would shrink the pool of potential recreationists residing in Phillips and Blaine counties, especially in the town of Zortman and City of Malta. This would tend to lower the absolute level of recreation activity in the Little Rocky Mountains, all else being equal. These offsetting effects would have economic consequences for businesses in the retail trade and services sectors of the economy, such as eating and drinking places, lodging places, suppliers, and outfitters, especially those located in Zortman and Malta. However, information is not available to quantify the net impact to the local recreation economy and to the local economy as a whole. Therefore, it cannot be determined whether the potential to improve the quality of recreation resources after ZMI ceases operations and reclamation takes effect would result in a net positive or negative effect on the local recreation economy.

Outmigration potentially would occur as ZMI eliminates jobs although several factors would reduce the impact of the layoffs on the population within the study area. Current ZMI employees, many of whom were hired from the local labor force, maintain strong ties to communities in Phillips and Blaine counties through land ownership and involvement in agriculture, family allegiances, and other personal relationships.

Because of these ties, many newly unemployed workers would attempt to stay in the area. This probably would require a reduction in earnings and standard of living since, given recent trends, few jobs comparable to those offered by ZMI are likely to be available within the local economy. Others may not leave the area simply because of a lack of job availability in other nearby areas. Also, some of the jobs at the Zortman and Landusky mines (and perhaps at potentially affected trade and service businesses) currently are held by persons who reside outside the study area and therefore are not accounted for directly in this assessment.

The projections of outmigration that follow probably overstate the amount of outmigration that actually would occur over time, following closure of the Zortman and Landusky mines. Section 4.10.1.2 discusses the methods and assumptions used in the outmigration analysis and their limitations. Based on these assumptions, it is projected that approximately 150 direct and indirect worker households would outmigrate from Phillips County and about 10 direct and indirect worker households would outmigrate from Blaine County. Note that the potential exists for outmigration of worker households from Blaine County even though most ZMI employees living in Blaine County are residents of the Fort Belknap Indian Reservation who have very strong personal, social and economic ties to their place of residence.

Assuming 150 households would outmigrate, the total impact on the population of Phillips County would be an outmigration of about 400 persons (an impact of about 8%). This number potentially could include about 160 school-age children. Similarly, assuming an outmigration of 11 households, the total impact on the population of Blaine County would be an outmigration of about 40 persons (an impact of less than 1%). This total potentially could include about 10 school-age children. The estimates of total population and school-age children in relation to worker households are based on relationships that have actually existed within the current ZMI workforce, as reported by ZMI (Eickerman 1993).

Key communities in Phillips County that potentially would experience outmigration of direct and indirect worker households are Malta (100 households, 330 persons, and 130 school-age children) and Zortman (45 households, 50 persons, and 20 school-age children). Some ZMI worker households also reside in Dodson and Landusky, so these communities may experience outmigration; however, specific projections of outmigration are likely to be inaccurate because only a small number of households are involved. In Blaine County, the community of Hays potentially would experience outmigration of a projected 6 households, 20 persons, and 6 or 7 school-age children. Some ZMI worker households reside in Harlem, too; however, a specific projection of outmigration from Harlem is likely to be inaccurate because of the small number of households involved.

Although ZMI would eliminate jobs quickly under Alternative 1, population outmigration would occur more gradually as employment levels are reduced, because unemployed workers would take time to adjust to being laid off and may be able to subsist for a time on severance and unemployment benefits or other sources of household income. Unemployment probably would increase in Phillips County and on the Fort Belknap Indian Reservation immediately after mine closure and would then decline as workers either find new jobs, outmigrate, or become discouraged and become long-term unemployed workers. Per capita personal income also would tend to decline in Phillips and Blaine counties, all else being equal, since jobs at ZMI are among the highest-paying available.

Alternative 1 also would have an indirect but significant effect on property values and electric power costs. Property values potentially would decline in Phillips County, and especially in the communities of Malta and Zortman. Property values in Malta would be reduced significantly if the projected 100 employee households were to outmigrate from the community (Knudson 1994; Halverson 1994). The effect on Zortman also would be significant, in light of the fact that almost all the current population and economic development evident in the community today is attributable to the presence of ZMI's operations. As ZMI reduces its employment levels, residential and commercial property values would drop in Zortman. Over the long term, in the absence of other industrial development or another basis for attracting new residents, Zortman potentially would wither away to the size it was in 1979 before the inception of mining activity (Boland 1994).

The amount that consumers pay for electricity from the Big Flat Electric Cooperative potentially would increase significantly if ZMI closes. This is because Big Flat would lose the lower rates it currently enjoys due to the volume and pattern of ZMI's power consumption. The local utility would have to pay more for the power it purchases, and Big Flat would still face a number of fixed costs which could not be cut to any appreciable degree, including existing debt. Big Flat would pass on higher unit costs to its remaining customers, including 70 large power irrigators, and this would have significant impact on customer electric bills. It is estimated that a household now heating with electricity (as do a third or more of the homes in Big Flat's service area) could pay $280 a month for electricity in the winter instead of $200 a month (Henderson 1994).

Homes heated by electricity within Big Flat's service area are concentrated in rural areas of Phillips and Blaine counties where natural gas is not available. These areas include the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation (Fewer 1995). Households heating with electricity would be affected by higher electric rates because of the higher total cost they incur for the higher consumption of electricity that electric heat entails, especially in the winter months.

Local jurisdictions in Phillips County would accumulate direct tax revenues under Alternative 1. However, average annual revenues would decline rapidly after 1996 and would eventually disappear entirely at the conclusion of all activity at the mine site in 2005. ZMI's operations from 1996 to 2005 would generate cumulative total revenues of $250,000 for Phillips County, $120,000 for the Malta High School and Elementary School districts combined, $110,00 for the Dodson High School District, and $70,000 for Landusky Elementary School, all in 1994 dollars (Table 4.10-7). Direct revenues to the City of Malta would be negligible.

The impact of the decline of average annual revenues between 1996 and 2005 and their disappearance beginning in 2006 may be measured by the degree to which local jurisdictions depend on revenues generated by ZMI now. In 1994, Landusky Elementary School District received $96,000 in property and gross proceeds taxes, or about 81 percent of total budgeted revenues; Dodson School District received $125,000, or about 20 percent of total budgeted revenues; the Malta high school and elementary school districts received about $158,00, or about 13 percent of total budgeted revenues; and Phillips County received $388,000, or about 9 percent of total budgeted revenues. Under Montana's system of school finance, schools would also lose direct state aid and budget capacity for every student lost.

Phillips County also would lose annual Metal Mines License Tax distributions to the Phillips County Hard Rock Trust Reserve, which had a balance of about $1 million in 1994. Under Alternative 1, the Hard Rock Trust Reserve would be projected to accumulate only an additional $60,000. The school districts also would lose about $16,000 per year per district in Metal Mines License Tax distributions.

In 1994, the Zortman and Landusky mines paid about $765,000 in metal mines license taxes, 75 percent of which is retained by the State. Although ZMI would continue to pay metal mines license taxes for a time under Alternative 1, the amount would decline rapidly between 1996 and 2000, the last year of gold and silver production. Under Alternative 1, the State would accumulate an additional $440,000 in metal mines license taxes.

Costs for providing services may decline somewhat for Phillips County government as mine employment declines and population begins to outmigrate. However, revenues lost would potentially exceed the County's ability to cut costs for several reasons. Agriculture continues to generate most of the demand for County services, the County already is at minimal levels for many services, and Phillips County officials probably would find it politically unacceptable to raise taxes sufficiently to offset all lost mine-generated revenues.

Therefore, it is likely that some services would have to be reduced or cut entirely. Among existing services, those provided to seniors citizens are potentially vulnerable to cuts or elimination (Kienenberger 1994; Cowan 1994).

The general fund of the City of Malta relies very little on direct tax revenue from ZMI, although the City does rely on revenues from property owned by mine-related employees or paid by mine-related employees for utilities. Therefore, as ZMI phases out its operations and population possibly declines, the City may have to raise utility rates or increase taxes somewhat to cover the fixed costs of operating its water, sewer, and landfill. In particular, the City has outstanding debt on a new land fill and on two improvement districts, all serviced by property tax revenues. If additional revenues must be raised to offset the losses due to the mine closure, the City may be required to cut its recreation budget, which now runs about $15,000 to $20,000 a year (Ereaux 1994).

School district costs, which relate primarily to staff salaries and benefits, would potentially decline over the long run, as the student population declines. However, school staff and program reductions are hard to accomplish in proportion to incremental declines in student population. Therefore, the net impact for the school districts would potentially be negative, especially for the Dodson High School District, where mine-related revenues are relatively large in proportion to the number of mine-related students.

In schools in Malta and Dodson, the school board probably would have to increase taxes to make up for tax base lost to mine closure. However, it is unlikely that the board would raise tax rates enough to continue all programs at current levels. Some teachers might be replaced with lower-salaried aides, classes might be consolidated, certain classes may be offered less frequently, and high-cost extracurricular activities such as drama and speech would be vulnerable to cuts or elimination. As a result the quality of education would likely decline overall within affected school districts (Rust 1994; Sherman 1994).

The Zortman K-6 school, operated by the Malta Elementary School District, also would be impacted. This school serves about 20 students, all but two or three of whom are children of mine employee families. With the closure of the mine, the Zortman school would potentially close, and the school district would have to bus several students from Zortman to Malta daily (Rust 1994).

The Hays-Lodgepole School District relies on Montana state school aid programs, and on Federal Impact Aid under Title 8 of the Education Act, for virtually all of its funding. Federal Impact Aid is awarded on a per capita basis to districts that educate certain categories of students, including those who live on American Indian lands. The district derives almost no revenue from property taxes. Recently, the district has experienced budget difficulties, and in 1994 ZMI made a $10,350 grant to the district to help offset a budget shortfall (Ryan 1994). The district is projected to lose a cumulative total of 6 or 7 students due to Alternative 1 and would lose Federal Impact Aid and state school aid almost in direct proportion to each student lost. This would contribute somewhat to the district's long-term financial problems.

A distribution from the Phillips County Hard Rock Trust Reserve would be limited in its ability to mitigate impacts to local governments and schools. The amount distributed would be relatively small and available only on a one-time basis, while fiscal problems faced by each jurisdiction would be long-term. The Phillips County Hard Rock Trust Reserve had a balance of about $1 million in 1994; under Alternative 1 the fund would accumulate an additional $60,000. Money in this account potentially would be released for local use in 1996 or 1997 when mine employment potentially would drop to 50 percent of the average for the preceding 5 years.

At least one-third of the principal and interest in the trust reserve account must be allocated proportionally among affected school districts within the county. Assuming the minimum one-third of the funds are allocated, all the affected school districts in Phillips County would proportionally share in an estimated total of about $350,000. Districts affected by the closure might include those where ZMI employees' school-age children reside or attend school and districts where the mines have been a part of the tax base. After the school district allocation, the remaining funds in the trust reserve account may be expended directly by Phillips County. Alternatively, the County may make grants and loans to other local government units to pay off debt, offset tax increases caused by the mine shutdown, promote economic development, recruit new industry, or assist with impacts caused by the mine shutdown.

Alternative 1 would involve on-site employment of contractor crews consisting of 4 workers in 1996 for a water treatment plant construction and 8 workers in the year 2000 for reclamation. Crews of this size on temporary assignment can generally be accommodated within housing and temporary lodging in the town of Zortman.

The social impacts of Alternative 1 would differ among the potentially affected groups within the study area. For residents of Phillips County and its communities, the closure of the Zortman and Landusky mines would have a significant negative impact on social well-being. The primary effect on local residents would be due to the negative impact on local economic vitality, both because of the immediate shock of mine layoffs and the long-term effect of reduced employment opportunities, personal income levels, and fiscal resources. Mine employees are among the highest wage earners in the communities where they live; for example, only 30 or so oil and gas workers in Phillips County earn at the same level.

The secondary and cumulative repercussions of these effects would be felt as negative impacts on local social structures, facilities and services, and retail trade and service sectors in Malta and Zortman. In communities where they live, especially Malta, ZMI employees are active in local churches, civic service and economic development organizations, volunteer public safety and emergency services, and youth recreation programs. Over the years, ZMI's donations have help to sustain or enhance the activities of various educational, civic, and social organizations. Traditional rural family values have been sustained to some extent in Malta and Phillips County by ZMI's policy of hiring local youth both for seasonal and permanent work, thereby allowing generations of families to live and work near one another (Rust 1994; Boothe 1994; Ereaux 1994).

Some facilities and services offered by local governments in Phillips County would be at risk due to diminished fiscal resources. As noted above, these would include the County's programs for senior citizens and recreation programs offered by the City. Assuming the projected loss of population, Malta potentially would lose one physician (Wambold 1994).

Projected population losses also would negatively effect the retail trade and service sectors in Malta, the main shopping center located in Phillips County, where many businesses have been struggling. ZMI and its employees represent a significant market for goods and services in Malta now. This market has been especially important to Malta's business community of late because prices for cattle have been depressed and local ranchers have had less to spend. Therefore, there would be an even larger cumulative effect of the loss of this market represented by ZMI and its employees (Boothe 1994).

The impact of closure upon the sense of well-being of most residents of Blaine County would be minimal because relatively few mine employees live in the communities of the county. Most mine employees living in Blaine County live in the southern part of the Fort Belknap Indian Reservation. For these residents, Alternative 1 would represent a loss of economic opportunity, a negative impact affecting about 20 households of workers employed directly by ZMI and a few households of workers in secondary jobs attributable to ZMI's economic impacts.

Alternative 1 potentially would impact the sense of well-being among residents of the Fort Belknap Indian Reservation as a whole, despite the loss of the mine as a source of economic opportunity, but for an entirely different reason. This is because Native Americans on the reservation have expressed a high level of concern about the presence of ZMI's operations and its impacts; that is, a secondary impact of the mine's direct effects on the physical and human environment has been its effect on the way many residents of the Fort Belknap Indian Reservation feel about the quality of life in their community. Native American quality of life issues reflect a distinctive social and cultural group's reaction to how ZMI's presence and the actual effects of ZMI operations upon the environment have affected social and cultural activities, sites of contemporary or heritage significance, lifestyles which depend on access, use and appreciation of relatively natural land within the Little Rocky Mountains, and the use and appreciation of streams that drain portions of the Zortman and Landusky mining area and eventually enter the Fort Belknap Indian Reservation. Although some Native Americans residing on the reservation are employed by ZMI and feel better off economically, many Native Americans would view closure of the mine as potentially benefitting social well-being within the Native American community because mineral development activity would halt within a relatively short period of time, additional modification of the landscape of the Little Rocky Mountains would be avoided, and disturbed areas would be reclaimed and returned to other non-mining uses. This would be the likely net effect of Alternative 1 on the social well-being of the Fort Belknap Indian Reservation, even though for some Native Americans, as well as some in the non-Native American community, some impacts of Alternative 1 would be viewed as unsatisfactory, e.g. risk of reclamation failure, the perpetual need for water capture and treatment, risk of overtopping capture systems, and the loss of drainage area to northern tributaries.

Some non-Native Americans may react positively to the impacts of Alternative 1, viewing the more immediate conclusion of ZMI operations and reclamation of disturbed areas as having a positive effect on the quality of life within the study area. However, within the non-

Native American community as a whole within the study area, these views probably would not affect the likely consensus that closure of the mine would lead to a negative impact on social well-being within the study area because economic opportunity may shrink and social vitality may decline.

4.10.3.2 Cumulative Impacts

Further mining at the Zortman and Landusky mines would not be allowed beyond that already permitted under this alternative, and the agencies believe the reasonably foreseeable opportunity for future mining would be limited. Therefore, no significant additional socioeconomic impacts would occur under Alternative 1 due to reasonably foreseeable developments.

Big Flat Electric Cooperative may build a new powerline even if the Zortman and Landusky mines expansion is not approved. If constructed, the powerline upgrade would be funded at least in part by revenues from Big Flat's customer base. It is possible that Big Flat would have to raise rates by an unknown amount to generate sufficient revenue to build the powerline upgrade, although Big Flat would try to keep any rate impact minimal for the consumer (Barnard 1996).

If the Zortman and Landusky mines expansion is not approved, Big Flat's revenues may be reduced. Therefore, it is possible that if the powerline were to be build in conjunction with Alternative 1, the rate impact to Big Flat customers, were one to occur, probably would be greater than any impact that might occur if the powerline upgrade were built in conjunction with Alternatives 4 through 7.

The powerline upgrade is anticipated to cost Big Flat about $4.1 million (Barnard 1996). A project of this size could involve a contract construction crew of 15 to 20 for a period of about a year. If Big Flat were to use the services of a contractor located within the study area, the local direct and secondary economic impacts of the project could be significant but they would be short lived. Any positive economic impacts of the powerline upgrade that may occur would be an offset, albeit a small one, to the negative economic effects of the closure of the Zortman and Landusky mines under Alternative 1.

The cumulative economic impact of the Zortman and Landusky mines may be represented in summary fashion in terms of the cumulative employment generated by ZMI's operations in the past and projected in the future. From 1979 through 1994, ZMI's operations are estimated to have generated 4,840 job-years of full- and part-time direct and secondary employment in Phillips County (see Table 4.10-5), 170 job-years in Blaine County, and 6,930 job-years in Montana as a whole. Alternative 1 would generate an additional 437 job-years of employment in Phillips County, 20 job-years in Blaine County, and 561 job years in Montana as a whole. Therefore, the cumulative impact of Alternative 1 would be 5,277 job-years of employment in Phillips County, 190 job-years of employment in Blaine County, and 7,491 job years of employment in Montana as a whole. Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.

Over time, the Zortman and Landusky mines also have had a cumulative effect on the social environment of the communities and groups within the study area. Social impacts of ZMI have been significant and beneficial in Malta and Zortman over the past 15 years as mine employees have integrated into and strengthened local social structures. In the absence of other economic development, the relatively immediate closure of ZMI's operation under Alternative 1 and the potential for outmigration of employees who are also key members of community social structures will curtail and potentially reverse some of the positive social effects that have accumulated over time. For the Fort Belknap Indian Reservation, the more immediate end to mining in the Little Rocky Mountains and the likelihood that no other mining operations would be developed would potentially help to alleviate the negative effect that ZMI's operation has had in the past on the sense of social well-being among Native Americans on the reservation. Because relatively few employees of the mine reside in Blaine County outside the Fort Belknap Indian Reservation, the cumulative social effect that has occurred in the past or would occur in the future in conjunction with this alternative would be negligible.

4.10.3.3 Unavoidable Adverse Impacts

All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 1 would be unavoidable. Adverse impacts described in detail above are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.3.4 Short-term Use/Long-term Productivity

Alternative 1 involves the closure and reclamation of the Zortman and Landusky mines and the restoration of pre-disturbance land uses, to the extent practicable under the proposed reclamation procedures. To a reasonable degree, long-term productivity for wildlife habitat, grazing, and recreation would be restored. However, in the short-run, the more intensive economic development and productivity associated with mining would be foregone.

4.10.3.5 Irreversible or Irretrievable Resource Commitments

No irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 1.

4.10.4 Impacts from Alternative 2

4.10.4.1 Impacts

Under Alternative 2, as under Alternative 1, the agencies would not approve expansion of the Zortman and Landusky mines, although mine activities already permitted would continue. Reclamation procedures currently in use at the two mines would be modified as proposed by ZMI. Due to the proposed modifications to reclamation procedures under Alternative 2, total expenditures by ZMI over the life of Alternative 2 would be slightly more than under Alternative 1, and contract employment under Alternative 2 would be somewhat higher than Alternative 1. (See Table 4.10-1 and 4.10-3.) These differences would have only a small effect upon the socioeconomic impacts of the alternative. Therefore, the impacts of Alternative 2 and the rationale for those impacts would be virtually the same as those described for Alternative 1. For details, the reader may refer to Section 4.10.3. and Table 4.10-7.

Implementation of Alternative 2 could begin in 1996, and ZMI would continue to operate through the year 2005 under its current permits. Significant negative economic impacts would occur because ZMI would scale down its activities and ultimately eliminate all jobs and spending at the Zortman and Landusky mines. Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. The impacts to date of the layoffs were described in Section 4.10.3.1 and are incorporated here by reference. Cutbacks would continue in 1996, and by 1998, there would be only 15 jobs, down from 260 jobs in 1994. This reduction of 94 percent in direct employment would be felt almost immediately. Smaller impacts would be felt as further reductions are made in employment and spending due to the gradually declining level of intensity of closure activities through the year 2005. Note that although negative impacts would occur in the near future under Alternative 2 (and under Alternatives 1 and 3), as compared to Alternatives 4 through 7, ultimately these impacts are inevitable under all alternatives.

Under Alternative 2, Phillips County and the communities of Malta and Zortman would sustain significant negative impacts to economic and fiscal conditions, community resources, and social well-being among its residents. Impacts also would be felt in Blaine County. However, these would be small compared to existing conditions. Businesses elsewhere in the State of Montana would be negatively affected, especially those in Billings and Helena which supply ZMI with goods and services. Property values potentially would decline in Phillips County and especially in the communities of Malta and Zortman. There would be a significant increase in the amount that consumers, including 70 large power irrigators, pay for power purchased from the Big Flat Electric Cooperative. This effect would be concentrated in parts of Big Flat's service area that rely disproportionately on electric heat for home heating because they lack access to natural gas. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation. On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed.

The State treasury would sustain revenue losses over time; however, this impact also would be relatively small. Economic effects on the Fort Belknap Indian Reservation would be minor, and there would be no fiscal impact because no direct revenues are derived from the mine.

Under Alternative 2, the effects to recreation resources would be similar to those of Alternative 1. Therefore, the alternative probably would raise the propensity of recreationists to use recreation resources near the Zortman and Landusky mines as closure eliminates land use, visual, noise and access impacts to recreation resources and reclamation begins to take effect. At the same time, the outmigration of ZMI employee and related households would shrink the pool of potential recreationists, especially in the town of Zortman and City of Malta, tending to lower the level of recreation use. However, information is not available to quantify the net impact of these two offsetting effects to the local recreation economy and to the local economy as a whole, or to determine whether the net effect would be positive or negative. The potential over the long term to raise the propensity of recreationists to use recreation resources previously impacted by the Zortman and

Landusky mines may be slightly higher under Alternative 2, compared to Alternative 1, because of the higher probability of reclamation success.

Social impacts of the alternative would be significant and negative especially in Malta and Zortman where mine employees and their families are in integral part of local social structures. The impact of Alternative 2 on the social environment on the Fort Belknap Indian Reservation would be significant and generally beneficial. Although some Native Americans residing on the reservation are employed by ZMI and would be adversely affected in terms of economic well-being, Native Americans who oppose the mine and have expressed a high level of concern about its presence would be beneficially affected as the closure activities begin and the mines ultimately are closed. This beneficial impact of Alternative 2 would be slightly higher than under Alternative 1 because of the improved probability of successful reclamation and correcting existing water quality problems. However, the improvement would not be significant because there still may be some areas where reclamation efforts would not completely succeed and where water quality and loss of drainage area may still be an issue.

4.10.4.2 Cumulative Impacts

Further mining at the Zortman and Landusky mines would not be allowed beyond that already permitted under Alternative 2, and the agencies believe the reasonably foreseeable opportunity for future mining would be limited. Therefore, no significant additional socioeconomic impacts would occur under Alternative 2 due to reasonably foreseeable mining development.

Big Flat Electric Cooperative may build a new powerline even if the Zortman and Landusky mines expansion is not approved. The impacts of this action under Alternative 2 would be the same as described in Section 4.10.3.2.

In terms of employment, the cumulative impact of Alternative 2 would be 5,411 job-years of full- and part-time employment in Phillips County, 196 job-years of employment in Blaine County, and 7,764 job years of employment in Montana as a whole. Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2. The cumulative social impacts of Alternative 2 would be the same as those of Alternative 1; these are described in Section 4.10.3.2.

4.10.4.3 Unavoidable Adverse Impacts

All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 2 would be unavoidable. Adverse impacts described above are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.4.4 Short-term Use/Long-term Productivity

Alternative 2 involves the closure and reclamation of the Zortman and Landusky mines and the restoration of pre-disturbance land uses, to the extent practicable under the company modified reclamation procedures. To a reasonable degree, long-term productivity for wildlife habitat, grazing, and recreation would be restored. However, in the short-run, more intensive economic productivity associated with mining would be foregone.

4.10.4.5 Irreversible or Irretrievable Resource Commitments

No irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 2.

4.10.5 Impacts from Alternative 3

4.10.5.1 Impacts

Under Alternative 3, as under Alternative 1, the agencies would not approve expansion of the Zortman and Landusky mines, although mine activities already permitted would continue. Reclamation procedures currently in use at the two mines would be modified to incorporate changes developed by the agencies. Due to the proposed agency modifications to reclamation procedures under Alternative 3, total expenditures by ZMI would be greater than under Alternative 1 or Alternative 2 while contract employment under Alternative 3 would be greater than under Alternative 1 and the same as Alternative 2 (see Tables 4.10-1 through 4.10-3).

Total expenditures by ZMI under Alternative 3 are about 3 times as much as under the other two non-extension alternatives. This difference has a noticeable effect on the socioeconomic impacts of the alternative;

however, they are short-lived since the additional expenditures are concentrated within 1 year. The employment and earnings impacts of Alternative 3, compared to those of Alternatives 1 and 2, are described in Table 4.10-7. Other impacts of Alternative 3 and the rationale for those impacts would be essentially the same as those described for Alternative 1; these are detailed in Section 4.10.3.

As under the other no-expansion alternatives, implementation of Alternative 3 could begin in 1996, and ZMI would continue to operate through the year 2005 under its current permits. Significant negative economic impacts would occur because ZMI would scale down its activities and ultimately eliminate all jobs and spending at the Zortman and Landusky mines. Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. The impacts to date of the layoffs were described in Section 4.10.3.1 and are incorporated here by reference. Cutbacks would continue in 1996, and by 1998, there would be only 15 jobs, down from 260 jobs in 1994. This reduction of 94 percent in direct employment would be felt almost immediately. Smaller impact would be felt as further reductions are made in employment and spending due to the gradually declining level of intensity of closure activities through the year 2005. Note that although negative impacts would occur in the near future under Alternative 3 (and under Alternatives 1 and 2), as compared to Alternatives 4 through 7, ultimately these impacts are inevitable under all alternatives.

Under Alternative 3, Phillips County and the communities of Malta and Zortman would sustain significant negative impacts to economic and fiscal conditions, community resources, and social well-being among its residents. Impacts also would be felt in Blaine County. However, they would be small compared to existing conditions. Businesses elsewhere in the state of Montana would be negatively affected, especially those in Billings and Helena which supply ZMI with goods and services. Property values potentially would decline in Phillips County and especially in the communities of Malta and Zortman. There would be a significant increase in the amount that consumers, including 70 large power irrigators, pay for power purchased from the Big Flat Electric Cooperative. This effect would be concentrated in parts of the Big Flat's service area that rely disproportionately on electric heat for home heating because they lack access to natural gas. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation. On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed.

The state treasury would sustain revenue losses over time; however, this impact also would be relatively small. Economic effects on the Fort Belknap Indian Reservation would be minor, and there would be no fiscal impact because no direct revenues are derived from the mine.

Under Alternative 3, the effects to recreation resources would be similar to those of Alternative 1. Therefore, the alternative probably would raise the propensity of recreationists to use recreation resources near the Zortman and Landusky mines as closure eliminates land use, visual, noise and access impacts to recreation resources and reclamation begins to take effect. At the same time, the outmigration of ZMI employee and related households would shrink the pool of potential recreationists, especially in the town of Zortman and City of Malta, tending to lower the level of recreation use. However, information is not available to quantify the net impact of these two offsetting effects to the local recreation economy and to the local economy as a whole, or to determine whether the net effect would be positive or negative. The potential over the long term to raise the propensity of recreationists to use recreation resources previously impacted by the Zortman and Landusky mines may be slightly higher under Alternative 3, compared to Alternatives 1 and 2, because Alternative 3 further increases the probability of reclamation success.

Social impacts of the alternative would be significant and negative especially in Malta and Zortman where mine employees and their families are in integral part of local social structures. The impact of Alternative 3 on the social environment on the Fort Belknap Indian Reservation would be significant and generally beneficial. Although some Native Americans residing on the reservation are employed by ZMI and would be adversely affected in terms of economic well-being, many Native Americans who oppose the mine and have expressed a high level of concern about its presence would be beneficially affected as the closure activities begin and the mines ultimately are closed. This beneficial impact of Alternative 3 would be slightly higher than under Alternative 1 or Alternative 2 because of further improvement in the probability of reclamation success and correction of existing water quality problems. The improvement may be significant to those Native Americans whose concerns have centered upon access to relatively natural land within the Little Rocky Mountains and upon water quality. This would be in spite of a potential for a short-term decrease in water quality in the Kings Creek drainage due to the additional disturbance required to mine limestone for use in reclamation.

4.10.5.2 Cumulative Impacts

Further mining at the Zortman and Landusky mines would not be allowed beyond that already permitted under Alternative 3, and the agencies believe the reasonably foreseeable opportunity for future mining would be limited. Therefore, no significant additional socioeconomic impacts would occur under Alternative 3 due to reasonably foreseeable mining development.

Big Flat Electric Cooperative may build a new powerline even if the Zortman and Landusky mines expansion is not approved. The impacts of this action under Alternative 3 would be the same as described in Section 4.10.3.2.

In terms of employment, the cumulative impact of Alternative 3 would be 5,538 job-years of full- and part-time employment in Phillips County, 202 job-years of employment in Blaine County, and 7,839 job years of employment in Montana as a whole. Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2. The cumulative social impacts of Alternative 3 would be the same as those of Alternative 1; these are described in Section 4.10.3.2.

4.10.5.3 Unavoidable Adverse Impacts

All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 3 would be unavoidable. Adverse impacts described above are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.5.4 Short-term Use/Long-term Productivity

Alternative 3 involves the closure and reclamation of the Zortman and Landusky mines and the restoration of pre-disturbance land uses, to the extent practicable under the agency-modified reclamation procedures. To a reasonable degree, long-term productivity for wildlife habitat, grazing, and recreation would be restored. However, in the short-run, more intensive economic productivity associated with mining would be foregone.

4.10.5.5 Irreversible or Irretrievable Resource Commitments

No irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 3.

4.10.6 Impacts from Alternative 4

4.10.6.1 Impacts

Under Alternative 4 (the Company Proposed Action), the Zortman and Landusky mines would be expanded and operated for an additional 7 years before a transition is made and closure activities begin. Implementation of Alternative 4 could begin as early as 1996. Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. The impacts to date of the layoffs were described in Section 4.10.3.1 and are incorporated here by reference. Under Alternative 4, the mine work force would soon be restored to historical levels. Construction of new facilities would require substantial capital expenditure and employment of some construction contracting. This is assumed to occur in 1996 and 1997. During the extended mining operations, which last into the year 2002, ZMI would require levels of employment similar to those characterizing full operations in the past and would expend similar levels of annual operating and working capital expenditures. Closure activities are assumed to begin in the year 2002 and last through 2012, with final reclamation taking place in 2006 and 2007 and monitoring occurring thereafter. The direct employment, payroll and expenditure associated with ZMI's continued operations under Alternative 4 are presented in Table 4.10-1 through Table 4.10-3.

During the extended mining period, Alternative 4 would sustain direct and indirect economic activity in the State of Montana, in Phillips County and, to a much lesser extent, in Blaine County. The additional employment and earnings generated as a result would be a significant benefit, especially when compared in magnitude to the effects of the no expansion alternatives (Alternatives 1 through 3).

Also, sustaining ZMI operations at historical operating levels for 7 more years would have significant positive impacts on Phillips County and the communities of Malta and Zortman in terms of fiscal conditions, community resources, and social well-being among its residents. Positive effects also would be felt in Blaine County. However, they would be small compared to existing conditions. Businesses elsewhere in the State of Montana would continue to be positively affected over the extended life of ZMI's operations, especially those in Billings and Helena which supply ZMI with goods and services. Property values would be supported at present levels in Phillips County and especially in the communities of Malta and Zortman. Consumers, including 70 large power irrigators, who buy electricity from the Electric Cooperative would continue to benefit from the volume and demand-spreading discounts Big Flat earns from its supplier by having the mines as a customer. This effect would be concentrated in parts of Big Flat's service area that rely disproportionately on electric heat for home heating because they lack access to natural gas. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation. On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed (Eickerman 1993).

The State treasury would earn additional revenues for each year of continued operation, a positive impact. Economic effects on the Fort Belknap Indian Reservation would be relatively small, if positive, and there would be no fiscal impact because no direct revenues are derived from the mine.

The extended mining phase of Alternative 4 also would sustain beneficial conditions in the social environment in Malta and Zortman, where mine employees and their families are perceived as positive contributors to, and an integral part of, local social structures. The impact of Alternative 4 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. Although some Native Americans residing on the reservation are employed by ZMI and would benefit economically from the additional years of employment and income, many Native Americans who oppose the mine and have expressed a high level of concern about its presence and its impact on the environment. Their sense of well-being and evaluation of the quality of life on the Fort Belknap Indian Reservation would continue to be adversely affected during the extended mining phase before closure activities begin and the mines ultimately are closed.

The economic impacts of closure under Alternative 4 would be the similar to those described for Alternative 1 in Section 4.10.3. The main difference is that, for Alternative 4, the impacts would occur later than under Alternative 1. It is possible that by delaying closure under Alternative 4, the relative magnitude of the impacts may be somewhat different because conditions may change farther out in the future. However, this is not likely since population and employment projections available now for Phillips County indicate that almost no growth is anticipated for the county through the year 2012. In Blaine County, where the available population and employment projections indicate some growth is anticipated through the year 2012, the relative impacts of closure would therefore be even smaller under Alternative 4 than under Alternative 1, because they would occur against the backdrop of a somewhat larger local economy.

Table 4.10-8 summarizes the economic and fiscal impacts of Alternative 4 compared to the impacts of Alternatives 5 through 7. Under Alternative 4, ZMI's operations from 1996 to 2012 would cumulatively generate an additional 5,000 job-years of direct and secondary employment and $126.4 million in 1994 dollars of direct and secondary earnings within the State of Montana. These cumulative effects on state employment are more than 9 times the magnitude of the effects of Alternative 1. The statewide cumulative effects include 3,480 job-years of employment and $95.6 million in 1994 dollars of earnings in Phillips County, about 8 times the employment effects of Alternative 1. During the same period, Blaine County would accumulate an additional 144 job-years of employment and $2.6 million in earnings in 1994 dollars, about 7 times the employment effects of Alternative 1. (A job-year is a full- or part-time job held for a year, on average.) Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.

Alternative 4 also would affect specific sectors of the economy that depend on spending by recreationists who use the recreation resources within the Little Rocky Mountains near the mines. The quality of recreation resources that generate employment and income in Phillips and Blaine counties has been impacted by ZMI's operations in the past. Alternative 4 would continue these impacts for a number of years and would intensify them somewhat (see Section 4.7). During the period of continued operations, developed recreation facilities and lands accessible to hunters and other dispersed recreationists would continue to be used, although it is likely that mining's land use, access, noise, and visual impacts to the quality of the recreation resources would continue to hold the propensity for recreationists to recreate in the area at a lower level than what it would be absent ZMI's operations. On the other hand, sustaining ZMI employment and employment indirectly supported by ZMI's operations would tend to generate more recreation activity, all else being equal, because it would sustain a larger pool of residents and potential

TABLE 4.10-8
ECONOMIC AND FISCAL IMPACTS OF ALTERNATIVES 4-7
FOR THE PERIOD 1996-2012

Impact	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Employment (cumulative, in job-years)				
Montana	5,000	4,821	4,524	5,156
Phillips County	3,480	3,356	3,173	3,608
Blaine County	144	139	133	133
Earnings (cumulative, in millions of 1994 dollars)				
Montana	$126.4	$121.8	$114.8	$130.6
Phillips County	95.6	92.2	87.4	99.3
Blaine County	2.6	2.5	2.4	2.7
Direct Tax Revenues (cumulative, in millions of 1994 dollars)				
Montana	$4.46	$4.30	$3.60	$4.29
Phillips County	2.63	2.57	2.44	2.61
Malta School Districts	1.25	1.22	1.15	1.24
Dodson High School District	1.12	1.10	1.03	1.11
Landusky School District	0.73	0.72	0.68	0.73
City of Malta	< $10,000	< $10,000	< $10,000	< $10,000
Phillips Co. Hard Rock Trust Reserve	0.59	0.57	0.48	0.57

Notes: Employment and earnings impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2. Employment is cumulative direct and secondary full- and part-time employment generated by ZMI operations. A job-year represents one full- or part-time job offered for one year within a particular area. The amounts in the table are the cumulative sums of employment, earnings, and direct tax revenues generated by ZMI activity over the life of the alternative. The Zortman Elementary School is operated by the Malta Elementary School district. Montana tax revenues are due to the Metal Mines License Tax. Local tax revenues are due to ad valorem taxes on real and personal property and gross proceeds of mines.

recreationists within the area, especially in Zortman and Malta. The two offsetting effects just described probably would continue to occur in the short-term under Alternative 4, although they probably would be quite small, compared to the total economic effect of the alternative. Since information is not available to quantify the effect to the local recreation economy or to determine whether it would be positive or negative, the magnitude and direction of impacts to the local recreation economy are uncertain.

Under Alternative 4, laid off workers potentially would be called back to work beginning as soon as approval is given for the mine life extensions. The mine work force would attain historical levels again within a short period of time, and the work force potentially would stay in place for an additional 7 years. With employment and operations under Alternative 4 expected to be comparable to historical levels, total community and school population also would continue to be at historical levels and would not be significantly different from levels existing prior to the layoffs occurring, with the exception of changes occurring because of other trends described in Section 3.10. Approval of the mine life extensions potentially would alleviate temporary unemployment created by the lay offs. Some turnover would occur in the mine work force and community and school populations because of employment decisions made by individuals and ZMI during the layoff and rehiring cycle.

ZMI would employ contract crews for construction of new facilities, including a water treatment plant, crusher, conveyor, and leach pad, as well as contract crews for final reclamation. It is assumed Big Flat Electric Cooperative would employ a contracted crew for construction of a power line between the Zortman and Landusky mines. Contract employment would occur in 1996 and 1997 and in 2006 and 2007.

Contractor employees would seek temporary housing in Zortman and would be likely to commute weekly without their families. Accommodating this demand would be most difficult when permanent employment at the mines is at full strength. In addition, there is a greater demand for housing in Zortman during the summer, when the mine hires temporary workers; during prairie dog season, from March through October; and during the big game hunting season, from September to November. However, sufficient housing has been available in the past for contract crews and would probably be available when needed during the construction phases (Kalal 1994).

Local jurisdictions in Phillips County would accumulate additional tax revenues under Alternative 4. Revenue flows would be sustained for an additional 7 years, but average annual revenues would decline rapidly after 2001 and would disappear entirely after the conclusion of all activity at the mine site in 2012.

Under Alternative 4, additional direct revenues due to ZMI's operations from 1996 to 2012 would accumulate for local jurisdictions. Projected amounts would be a cumulative total of $2.6 million for Phillips County, $1.3 million for the Malta High School and Elementary School districts combined, $1.1 million for the Dodson School District, and $730,000 for Landusky Elementary School, all in 1994 dollars (Table 4.10-8). The impact of the decline and loss of these annual tax revenues may be measured by the degree to which local jurisdictions depend on revenues generated by ZMI now. In 1994, Landusky Elementary School District received $96,000 in property and gross proceeds taxes, or about 81 percent of total budgeted revenues; Dodson School District received $125,000, or about 20 percent of total budgeted revenues; Malta High School and Elementary School districts received about $158,000, or about 13 percent of total budgeted revenues; and Phillips County received $388,000, or about 9 percent of total budgeted revenues. Under Montana's system of school finance, schools would also lose direct state aid and budget capacity for every student lost.

The Phillips County Hard Rock Revenue Fund would potentially receive annual distributions from state Metal Mines License Tax receipts for an additional 7 years. Local school districts would also receive about $16,000 annually per district in Metal Mines License Tax distributions for additional years of mining.

A distribution from the Phillips County Hard Rock Trust Reserve would be limited in its ability to mitigate impacts to local governments and schools. The amount distributed would be relatively small and available only on a one-time basis, while fiscal problems faced by each jurisdiction would be long-term. The Phillips County Hard Rock Trust Reserve had a balance of about $1 million in 1994; under Alternative 4 the fund would accumulate an additional $590,000. Money in this account potentially would be released for local use in range of the years 2004 through 2006, depending on when mine employment potentially would drop to 50 percent of the average for the preceding 5 years. At least one-third of the principal and interest in the trust reserve account must be allocated proportionally among affected school districts within the county. Assuming the minimum one-third of the funds are allocated, all the affected school districts in Phillips County would proportionally share in an estimated total of about $530,000. Districts affected by the closure might include those in which ZMI employees' school age children reside or attend school and districts where the mines have been a part of the tax base. After the school district allocation, the remaining funds in the trust reserve account may be expended directly by Phillips County. Alternatively, the County may make grants and loans to other local government units to pay off debt, offset tax increases caused by the mine shutdown, promote economic development, recruit new industry, or assist with impacts caused by the mine shutdown.

In 1994, the Zortman and Landusky mines paid about $765,000 in metal mines license taxes, 75 percent of which is retained by the State. ZMI is projected to continue paying metal mines license taxes under Alternative 4 through 2007. Under Alternative 4, the State would be projected to accumulate an additional $4.5 million in metal mines license taxes, about 10 times the total projected to be accumulated under Alternative 1.

Under Alternative 4, costs for providing services would continue at current levels for most jurisdictions through 2003 or 2004, when layoffs would begin as the closure cycle commences at the Zortman and Landusky mines. Until that time, facilities within the study area that presently are at capacity would continue to operate under some strain. These include Malta's water and wastewater utilities, schools in Malta, medical care and emergency-response providers in Phillips County, and schools at Hays and Lodgepole. Additional revenues accumulated during ZMI's additional 7 years of mining may provide sufficient fiscal resources to accomplish some improvements for the Phillips County providers. Schools at Hays and Lodgepole, however, would not benefit because the mine facilities are not taxable by the Hays-Lodgepole school district.

The social impacts of Alternative 4 would differ among the potentially affected groups within the study area. For residents of Phillips County and its communities, the mine would have a significant positive impact on social well-being. The primary effect on local residents would be due to sustaining the local economy at its current level and maintaining employment opportunities, personal income levels, and fiscal resources for an additional 7 years.

The secondary and cumulative repercussions of these effects would be felt as positive impacts on local social structures, facilities and services, and retail trade and service sectors in Malta and Zortman. Mine employees are among the highest wage earners in the communities where they live; for example, only 30 or so oil and gas workers in Phillips County earn at the same level. ZMI employees also would remain active in local churches, civic service and economic development organizations, volunteer public safety and emergency services, and youth recreation programs. ZMI also directly donates funds which help to sustain or enhance the activities of various educational, civic, and social organizations; this pattern potentially would continue. Traditional rural family values would continue to be sustained to some extent in Malta and Phillips County by ZMI's policy of hiring local youth both for seasonal and permanent work (Rust 1994; Boothe 1994; Ereaux 1994).

Facilities and services offered by local governments in Phillips County would continue to be offered at current levels. Additional revenue flows will allow reduction of debt in Malta (Ereaux 1994). Senior citizen programs, recreation programs, and population sensitive services, such as medical practices, would be sustained for at least another 7 years (Wambold 1994).

By sustaining the current population, Alternative 4 also would positive affect retail trade and service sectors in Malta, the main shopping center located in Phillips County, since ZMI and its employees are a significant market for goods and services in Malta now (Boothe 1994).

The impact of Alternative 4 on the well-being of groups in Blaine County, such as farmers, ranchers, and townspeople, would be similar to those described for Phillips County. However, the effect would be much less intense and much less widely felt because so many fewer residents of Blaine County depend on the mines as an economic generator.

Alternative 4 potentially would have a negative impact on the sense of social well-being of residents of the Fort Belknap Indian Reservation as a whole, even though the extension of mine operation would represent sustained economic opportunity for those Native Americans employed by ZMI and others who may benefit from the secondary economic effects of ZMI's operations. This is because, regardless of economic issues, many Native Americans on the reservation oppose the mines and have expressed a high level of concern about their presence and their impacts in the past and potentially in the future. In other words, a secondary impact of the mine's direct effects on the physical and human environment has been, and potentially would continue to be, its effect on the way many residents of the Fort Belknap Indian Reservation feel about the quality of life in their community.

Native American concerns about quality of life reflect a distinctive social and cultural group's reaction to how

ZMI's presence and the mines' effects upon the environment have affected social and cultural activities, sites of contemporary or heritage significance, lifestyles which depend on access, use and appreciation of relatively natural land within the Little Rocky Mountains, and the use and appreciation of streams that drain portion of the Zortman and Landusky mining area and eventually enter the Fort Belknap Indian Reservation. Although some Native Americans residing on the reservation are employed by ZMI and feel better off economically, expansion of mining activity potentially would be viewed, because of past and potential future impacts, and because closure would be delayed another 7 years, as a significant and generally adverse quality of life impact by the Fort Belknap Indian Reservation in general.

Therefore, the net effect of Alternative 4 on the social well-being of the Fort Belknap Indian Reservation, and on some non-Native Americans within the study area as well, would be negative, even though some Native Americans, as well as some in the non-Native American community, would view the predominantly positive economic effects of the alternative as benefitting the quality of life.

Also, some non-Native Americans, for similar or other reasons, may react negatively to the impacts of Alternative 4, viewing the extension of ZMI's operations, its expansion in terms of additional land disturbance, and the delay of closure and reclamation as having a negative effect on the quality of life within the study area. However, for the non-Native American community as a whole within the study area, these views probably would not affect the likely consensus that extension of mineral development activity and delaying closure and reclamation would have a beneficial effect on social well-being since the alternative represents prolonging the life of a source of economic and fiscal opportunity and social vitality for localities such as Malta and Zortman and for Phillips County as a whole.

4.10.6.2 Cumulative Impacts

The development of Pony Gulch would add about 2 million tons of ore (or about 2.5%) to the prospective 80 million tons to be mined. This would translate into about two months of additional mining activity. It is unlikely the additional mining would lead ZMI to add employees, and additional spending would be proportionately small. Reasonably foreseeable exploration activity to possibly expand ore reserves or further define existing reserves could involve the hiring of a contract drilling in crew of about 4 persons costing ZMI between $100,000 and $200,000 per year for 3 to 5 years, a small increment of employment and spending in comparison to proposed spending levels under Alternative 4. Therefore, neither reasonably foreseeable development would materially change the magnitude or duration of any of the impacts identified for Alternative 4.

Big Flat Electric Cooperative probably would build a new powerline if the Zortman and Landusky mines expansion is not approved. If built, the powerline upgrade would be funded at least in part by revenues from Big Flat's customer base. It is possible that Big Flat would have to raise rates by an unknown amount to generate sufficient revenue to build the powerline upgrade, although Big Flat would try to keep any rate impact minimal for the consumer (Barnard 1996).

If the Zortman and Landusky mines expansion is approved, Big Flat's revenues would be sustained or even increased because of the mine expansion. Therefore, it is possible that were the powerline to be built in conjunction with Alternative 4, the rate impact to Big Flat customers would be minimal or there may be no rate impact at all.

The powerline upgrade is anticipated to cost Big Flat about $4.1 million (Barnard 1996). A project of this size could involve a contract construction crew of 15 to 20 for a period of about a year. If Big Flat were to use the services of a contractor located within the study area, the local direct and secondary economic impacts of the project could be significant if short lived. Any positive economic impacts of the powerline upgrade that may occur would be a small addition to the economic effect of expansion and continued operation of the Zortman and Landusky mines under Alternative 4.

The cumulative socioeconomic impact of Alternative 4 may be represented in summary fashion in terms of the employment generated by the ZMI's operations in the past and in the future. From 1979 through 1994, ZMI's operations are estimated to have generated 4,840 job-years of full- and part-time direct and secondary employment in Phillips County (see Table 4.10-5), 170 job-years in Blaine County, and 6,930 job-years in Montana as a whole. Alternative 4 would generate an additional 3,480 job-years of employment in Phillips County, 144 job-years in Blaine County, and 5,000 job years in Montana as a whole. Therefore, the cumulative impact of Alternative 4 would be 8,320 job-years of employment in Phillips County, 314 job-years of employment in Blaine County, and 11,930 job years of employment in Montana as a whole.

Over time, the Zortman and Landusky mines also have had a cumulative effect on the social environment of the communities and groups within the study area. Social impacts of ZMI have been significant and beneficial in Malta and Zortman over the past 15 years as mine employees have integrated into and strengthened local social structures. Those beneficial effects would be sustained for an additional 7 years under Alternative 4. This effect would be especially important in the absence of other economic development, delaying the potential for outmigration of employees who are also key members of community social structures. For the Fort Belknap Indian Reservation, delaying the closure and reclamation of the mines under Alternative 4 would prolong the sense that the quality of life for reservation residents is being negatively impacted by ZMI's presence and the effects upon the physical and human environment. Because relatively few employees of the mine reside in Blaine County outside the Fort Belknap Indian Reservation, the cumulative social effect that has occurred in the past or would occur in the future in conjunction with this alternative would be negligible.

4.10.6.3 Unavoidable Adverse Impacts

The impact of Alternative 4 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. This impact would be unavoidable. All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 4 would be unavoidable, as well. Adverse impacts described above are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.6.4 Short-term Use/Long-term Productivity

Under Alternative 4, the productivity of pre-existing and additional existing economic resources such as grazing land would be disturbed in exchange for mining, a significantly more intensive economic development. However, in the long run, assuming the success of reclamation procedures, pre-disturbance uses could be restored to long-term productivity.

4.10.6.5 Irreversible or Irretrievable Resource Commitments

In economic terms, no irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 4. Native Americans may view physical impacts upon cultural resource sites important to their lifestyle as an irreversible and irretrievable resource commitment associated with the alternative.

4.10.7 Impacts from Alternative 5

4.10.7.1 Impacts

Alternative 5 would allow expansion of both the Zortman and Landusky mines but impose agency-developed mitigation on the expansion and reclamation activities. The major modification to ZMI's expansion plans would be at the Zortman Mine where the proposed ore heap leach facility would be within Upper Alder Gulch instead of at Goslin Flats. Also, at the Landusky Mine, ZMI would be required to remove fill from the head of King Creek and backfill mine pits so that the reclaimed area drains freely into King Creek. Under Alternative 5, it is assumed mining would occur for about 6 years before a transition is made and closure activities begin. Although many of the plans and facilities for Alternative 5 are similar to, or the same as, those described in Alternative 4, total expenditures by ZMI would be less under Alternative 5 than Alternative 4 because, with the leach pad in Upper Alder Gulch, a conveyor system would not have to be built.

After construction but during the extended mining operations, which would last through the year 2001, ZMI would require levels of employment similar to those in the past and would expend similar levels of annual operating and working capital expenditures. Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. The impacts to date of the layoffs were described in Section 4.10.3.1 and are incorporated here by reference. Under Alternative 5, the mine work force would soon be restored to historical levels. Closure activities are assumed to begin in the year 2002 and last through 2012, with final reclamation occurring in the years 2006 and 2007. During closure and reclamation, employment and spending would be similar to that for Alternative 4. The direct employment, payroll and expenditure associated with ZMI's continued operations under Alternative 5 are presented in Table 4.10-1 through Table 4.10-3.

During the extended mining period, Alternative 5 would sustain direct and indirect economic activity in the state of Montana, in Phillips County and, to a much lesser extent, in Blaine County. The additional employment and earnings generated as a result would be a significant benefit, especially when compared in magnitude to the effects of the no-expansion alternatives, Alternatives 1 through 3.

Also, sustaining ZMI operations at current levels for about 6 more years would have significant positive impacts on Phillips County and the communities of Malta and Zortman in terms of fiscal conditions, community resources, and social well-being among its residents. Cumulative positive effects also would be felt in Blaine County. However, they would be small, compared to existing conditions. Businesses elsewhere in the State of Montana would continue to be positively affected over the extended life of ZMI's operations, especially those in Billings and Helena which supply ZMI with goods and services. Property values would be supported at present levels in Phillips County and especially in the communities of Malta and Zortman. Consumer, including 70 large power irrigators, who buy electricity from the Big Flat Electric Cooperative would continue to benefit from the volume and demand-spreading discounts Big Flat earns from its supplier by having the mines as a customer. This effect would be concentrated in parts of Big Flat's service area that rely disproportionately on electric heat for home heating because they lack access to natural gas. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation.On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed.

Under Alternative 5, the effects to sectors of the local economy that rely on recreation resources near the Zortman and Landusky mines would be similar to those of Alternative 4. Although disturbance to the visible landscape would increase in Alder Gulch, some access would be preserved because no conveyor would be built. Disturbance to the landscape in Goslin Flats would be avoided. The effect of these differences probably would be that Alternative 5, as compared to Alternative 4, would slightly raise the propensity of recreationists to use recreation-based resources near the Zortman and Landusky mines, even during the period of continued operations. The effect is likely to occur but probably would be quite small, compared to the total economic effect of the alternative. Since information is not available to quantify the effect to the local recreation economy or to determine whether it would be positive or negative, the magnitude and direction of impacts to the local recreation economy are uncertain.

The State treasury would earn cumulative revenues, a significant beneficial impact. Economic effects on the Fort Belknap Indian Reservation would also be relatively small, if positive, and there would be no fiscal impact because no direct revenues are derived from the mine.

The extended mining phase of Alternative 5 also would sustain beneficial conditions in the social environment in Malta and Zortman, where mine employees and their families are positive contributors to, and an integral part of, local social structures. The impact of Alternative 5 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. Although some Native Americans residing on the reservation are employed by ZMI and would benefit economically from the additional years of employment and income, many Native Americans who oppose the mine and have expressed a high level of concern about its presence would continue to be adversely affected during the extended mining phase before closure activities begin and the mines ultimately are closed.

The predominantly negative impacts of closure under Alternative 5 would be similar to those described for Alternative 1 in Section 4.10.3, and which also occur under Alternatives 2 and 3. The only difference is that, for Alternative 5, the impacts would occur later than under the no-expansion alternatives, Alternatives 1 through 3. It is possible that by delaying closure under Alternative 5, the relative magnitude of the impacts may be somewhat different because conditions may change farther out in the future. However, this is not likely since population and employment projections available now for Phillips County indicate almost no growth is anticipated for the county through the year 2012. In Blaine County, where the available population and employment projections indicate some growth is anticipated through the year 2012, the relative impacts of closure would therefore be even smaller under Alternative 5 than under Alternative 1.

Table 4.10-8 summarizes the economic and fiscal impact impacts of Alternative 5 compared to the impacts of Alternatives 4, 6 and 7. Under Alternative 5, ZMI's operations from 1996 to 2012 would generate a cumulative total of 4,821 job-years of direct and secondary employment and $121.8 million in 1994 dollars of direct and secondary earnings within the state of Montana. These cumulative effects on state employment are about 9 times the magnitude of the effects of Alternative 1. The statewide effects include a cumulative total of 3,356 job-years of employment and $92.2 million in 1994 dollars of earnings in Phillips County, about 8 times the employment effects of Alternative 1. During the same period, ZMI's operations would generate a cumulative total of 139 job-years of employment and $2.5 million in earnings in 1994 dollars for Blaine County, about 7 times the employment effects of Alternative 1. (A job-year is a full- or part-time job held for a year, on average.) Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.

Under Alternative 5, laid off workers potentially would be called back to work beginning as soon as approval is given for the mine life extensions. The mine work force would attain historical levels again within a short period of time, and the work force potentially would stay in place for an additional 6 years. With employment and operations under Alternative 5 expected to be comparable to historical levels, total community and school population also would continue to be at historical levels and would not be significantly different from levels existing prior to the layoffs occurring, with the exception of changes occurring because of other trends described in Section 3.10. Approval of the mine life extensions potentially would alleviate temporary unemployment created by the lay offs. Some turnover would occur in the mine work force and community and school populations because of employment decisions made by individuals and ZMI during the layoff and rehiring cycle.

ZMI would employ contract crews for construction of new facilities, including a water treatment plant, crusher, and leach pad, as well as contract crews for final reclamation. It is assumed Big Flat Electric Cooperative would employ a contracted crew for construction of a power line between the Zortman and Landusky mines. Contract employment would occur in 1996 and 1997 and in 2006 and 2007. Temporary housing accommodations would be available for contractor employees as described in section 4.10.6.1.

Local jurisdictions in Phillips County would accumulate additional tax revenues under Alternative 5. Revenue flows would be sustained for an additional 6 years, but revenues would decline rapidly after 2002, and would disappear entirely after the conclusion of all activity at the mine site in 2012.

ZMI's operations from 1996 to 2012 would generate additional direct revenues for local jurisdictions. Projected amounts would be a cumulative total of $2.6 million for Phillips County, $1.2 million for the Malta High School and Elementary School districts combined, $1.1 million for the Dodson High School district, $720,000 for Landusky Elementary School, all in 1994 dollars (Table 4.10-8). Revenues are somewhat lower under Alternative 5 because of ZMI's lower capital spending requirements, compared to Alternative 4. Under Alternative 5, the impact on local jurisdictions of the decline and eventual loss of tax revenues would be essentially the same as under Alternative 4. This was described in Section 4.10.6.1.

The Phillips County Rock Hard Trust Reserve Fund would potentially receive annual distributions from state Metal Mines License Tax receipts for an additional 6 years, and the funds would be available for distribution when mine employment declines to half the previous five-year average. A distribution from the Phillips County Hard Rock Trust Reserve would be limited in its ability to mitigate impacts to local governments and schools. The amount distributed would be relatively small and available only on a one-time basis, while fiscal problems faced by each jurisdiction would be long-term. The Phillips County Hard Rock Trust Reserve had a balance of about $1 million in 1994; under Alternative 5 the fund would accumulate an additional $570,000. According to the statutory formula (described in Section 4.10.6.1) all the affected school districts in Phillips County would proportionally share in at least an estimated total of about $530,000 while the remainder of the fund would be available for expenditure directly by Phillips County or for distribution by the County as grants and loans to other local government units.

ZMI would continue to pay metal mines license taxes under Alternative 5 through 2006. Under Alternative 5, the state would accumulate an additional $4.3 million in metal mines license taxes, about 10 times the total collected under Alternative 1.

Under Alternative 5, costs for providing services would continue at current levels for most jurisdictions through 2003 or 2004. Facilities within the study area that presently are at capacity would continue to operate under some strain. These include Malta's water and wastewater utilities, schools in Malta, medical care and emergency-response providers in Phillips County, and schools at Hays and Lodgepole. Additional revenues accumulated during ZMI's additional 6 years of mining may provide sufficient fiscal resources to accomplish some improvements for the Phillips County providers. Schools at Hays and Lodgepole, however, would not benefit because the mine facilities are not taxable by the Hays-Lodgepole school district.

The social impacts of Alternative 5 would differ among the potentially affected groups within the study area. For residents of Phillips County and its communities, the mine would have a significant positive impact on social well-being. The primary effect on local residents would be due to sustaining the local economy at its current level and maintaining employment opportunities, personal income levels, and fiscal resources for 6 more years.

The secondary and cumulative repercussions of these effects would be felt as positive impacts on local social structures, facilities and services, and retail trade and service sectors in Malta and Zortman. Mine employees are among the highest wage earners in the communities where they live; for example, only 30 or so oil and gas workers in Phillips County earn at the same level. ZMI employees also would remain active in local churches, civic service and economic development organizations, volunteer public safety and emergency services, and youth recreation programs. ZMI also directly donate funds which help to sustain or enhance the activities of various educational, civic, and social organizations; this pattern potentially would continue. Traditional rural family values would continue to be sustained to some extent in Malta and Phillips County by ZMI's policy of hiring local youth both for seasonal and permanent work (Rust 1994; Boothe 1994; Ereaux 1994).

Facilities and services offered by local governments in Phillips County would continue to be offered at current levels. Additional revenue flows will allow reduction of debt in Malta (Ereaux 1994). Senior citizen programs, recreation programs, and population sensitive services, such as medical practices, would be sustained for at least another 6 years (Wambold 1994).

By sustaining the current population, Alternative 5 also would positively affect retail trade and service sectors in Malta, the main shopping center located in Phillips County. This would be the case because ZMI and its employees are a significant market for goods and services in Malta now (Boothe 1994).

The impact of Alternative 5 on the well-being of groups in Blaine County, such as farmers, ranchers, and townspeople, would be similar to those described for Phillips County. However, the effect would potentially be much less intense and much less widely felt because so many fewer residents of Blaine County depend on the mines as an economic generator.

The effect of Alternative 5 on the sense of social well-being of residents of the Fort Belknap Indian Reservation as a whole was described in Section 4.10.6.1, and that description is incorporated here by reference. Although some Native Americans residing on the reservation are employed by ZMI and would feel better off economically, Alternative 5, like Alternative 4, would be viewed by many Native Americans as allowing a significant and generally adverse quality of life impact to persist and expand in extent over an additional 6 years. A difference is that under Alternative 5, the adverse impact to the social well-being of Native Americans may be slightly lower than under Alternative 4 because of long-term improvements in terms of a higher probability of reclamation success, the potential to correct existing water quality problems, and the restoration of drainage to King Creek. However, there may be a higher level of concern about the quality of water flowing into King Creek. Although these positive effects probably would occur, they may not be perceived as significant by Native Americans adversely impacted by the higher level of permanent change to the landscape in the Little Rocky Mountains incurred under Alternative 5.

As described in Section 4.10.6.1, some non-Native Americans, for similar or other reasons, may also react negatively to the impacts of Alternative 5 on the local quality of life. However, these views probably would not affect the overall consensus within the non-Native American community that the extension of ZMI's mineral development activity would be of overall economic and social benefit in Malta, Zortman and Phillips County.

4.10.7.2 Cumulative Impacts

Under Alternative 5, reasonably foreseeable exploration activity to possibly expand ore reserves or further define existing reserves could involve the hiring of a contract drilling in crew of about 4 persons costing ZMI between $100,000 and $200,000 per year for 3 to 5 years, a small increment of employment and spending in comparison to proposed spending levels under the alternative. This would not materially change the magnitude or duration of any of the impacts identified for Alternative 5.

Big Flat Electric Cooperative probably would build a new powerline if the Zortman and Landusky mines expansion is approved. The impacts of this action under Alternative 5 would be the same as described in Section 4.10.6.2 and are incorporated here by reference.

The cumulative socioeconomic impact of Alternative 5, summarized in terms of employment generated by ZMI's operations in the past and in the future, would be 8,196 job-years of full- and part-time employment in Phillips County, 309 job-years of employment in Blaine County, and 11,751 job years of employment in Montana as a whole.

The cumulative social effects under Alternative 5 would be essentially the same as those under Alternative 4. These were in Section 4.10.6.2, and are incorporated here by reference.

4.10.7.3 Unavoidable Adverse Impacts

The impact of Alternative 5 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. This impact would be unavoidable. All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 5 would be unavoidable, as well. Adverse impacts of closure are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.7.4 Short-term Use/Long-term Productivity

Under Alternative 5, the productivity of pre-existing and additional existing economic resources such as grazing land would be disturbed in exchange for mining, a significantly more intensive economic development. However, in the long run, assuming the success of reclamation procedures, pre-disturbance uses could be restored to long-term productivity.

4.10.7.5 Irreversible or Irretrievable Resource Commitments

In economic terms, no irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 5. Native Americans may view physical impacts upon cultural resource sites important to their lifestyle as an irreversible and irretrievable resource commitment associated with the alternative.

4.10.8 Impacts of Alternative 6

4.10.8.1 Impacts

Alternative 6 would approve expansion of both the Zortman and Landusky mines but impose agency-developed mitigation on the expansion and reclamation activities. The major modification to ZMI's expansion plans, as described under Alternative 4, would be to relocate the waste rock repository to the Ruby Flats just east of the Goslin Flats leach pad. No drainage would be restored to King Creek under Alternative 6.

Under Alternative 6, it is assumed mining would occur for only 5 years before closure activities begin. This is because the additional cost of moving waste rock to the repository at Ruby Flats would make it uneconomical to recover and process some ore at the Zortman mine. Implementation and the construction phase of Alternative 6 would be as described for other expansion alternatives. Alternative 6 would require high initial expenditures to construct of new facilities, including a larger system to process and move ore and waste rock to the Goslin Flats leach pad and the Ruby Flats repository. However, total expenditures over the life of the alternative would be lower under Alternative 6, as compared to Alternatives 4, 5, and 7 because less time would be devoted to mining and closure and reclamation would occur a year sooner. During the closure and reclamation cycle, employment and spending would be similar to that described for Alternative 4. The direct employment, payroll and expenditure associated with ZMI's continued operations under Alternative 6 are presented in Table 4.10-1 through Table 4.10-3.

Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. The impacts to date of the layoffs were described in Section 4.10.3.1 and are incorporated here by reference. Under Alternative 6, the mine work force would soon be restored to historical levels.

During the extended mining period, Alternative 6 would sustain direct and indirect economic activity in the state of Montana, in Phillips County and, to a much lesser extent, in Blaine County. The additional employment and earnings generated as a result would be a significant benefit, especially when compared in magnitude to the effects of Alternatives 1 through 3.

Also, sustaining ZMI operations at current levels for 5 more years would have significant positive impacts on Phillips County and the communities of Malta and Zortman in terms of fiscal conditions, community resources, and social well-being among its residents. Cumulative positive effects also would be felt in Blaine County. However, they would be small, compared to existing conditions. Businesses elsewhere in the state of Montana would continue to be positively affected over the extended life of ZMI's operations, especially those in Billings and Helena which supply ZMI with goods and services. Property values would be supported at present levels in Phillips County and especially in the communities of Malta and Zortman. Consumers, including 70 large power irrigators, who buy electricity from the Big Flat Electric Cooperative would continue to benefit from the volume and demand-spreading discounts Big Flat earns from its supplier by having the mines as a customer. This effect would be concentrated in parts of Big Flat's service area that rely disproportionately on electric heat for home heating because they lack access to natural gas. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation. On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed (Eickerman 1993).

The State treasury would earn cumulative revenues, a significant beneficial impact. Economic effects on the Fort Belknap Indian Reservation would also be relatively small, if positive, and there would be no fiscal impact because no direct revenues are derived from the mine.

The extended mining phase of Alternative 6 also would sustain beneficial conditions in the social environment in Malta and Zortman, where mine employees and their families are positive contributors to, and an integral part of, local social structures. The impact of Alternative 6 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. Although some Native Americans residing on the reservation are employed by ZMI and would benefit economically from the additional years of employment and income, many Native Americans who oppose the mine and have expressed a high level of concern about its presence would continue to be adversely affected during the extended mining phase before closure activities begin and the mines ultimately are closed.

The impacts of closure under Alternative 6 would be similar to those described for Alternative 1 in Section 4.10.3. The only difference is that, for Alternative 6, the impacts would occur later than under Alternative 1. It is possible that by delaying closure under Alternative 6, the relative magnitude of the impacts may be somewhat different because conditions may change farther out in the future. However, this is not likely since population and employment projections available now for Phillips County indicate almost no growth is anticipated for the county through the year 2012. In Blaine County, where the available population and employment projections indicate some growth is anticipated through the year 2012, the relative impacts of closure would therefore be even smaller under Alternative 6 than under Alternative 1.

Table 4.10-8 summarizes the economic and fiscal impact impacts of Alternative 6 compared to the impacts of Alternatives 4, 5 and 7. Under Alternative 6, ZMI's operations from 1996 to 2012 would generate a cumulative total of 4,524 job-years of direct and secondary employment and $114.8 million in 1994 dollars of direct and secondary earnings within the state of Montana. The cumulative effect on state employment would be about 8 times the magnitude of Alternative 1. The statewide effects include a cumulative total of 3,173 job-years of employment and $87.4 million in 1994 dollars of earnings in Phillips County, about 7 times the employment effect of Alternative 1. During the same period, ZMI's operations would generate a cumulative total of 133 job-years of employment and $2.4 million in earnings in 1994 dollars for Blaine County, about 7 times the employment effect of Alternative 1. (A job-year is a full- or part-time job held for a year, on average.) Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.

Under Alternative 6, effects to sectors of the local economy that rely on recreation resources near the Zortman and Landusky mines would be similar to those of Alternative 4. However, locating both the heap leach and waste rock repository in the Goslin Flats area would increase the magnitude and intensity of indirect impacts to the quality of the recreation experience for users of the developed campgrounds, sightseers driving the roads, and recreationists accessing nearby lands. Therefore, Alternative 6 probably would slightly lower the propensity of recreationists to use recreation resources near the Zortman and Landusky mines during the period of continued operations. The effect is likely to occur but probably would be quite small compared to the total economic effect of the alternative. Since information is not available to quantify the effect to the local recreation economy or to determine whether it would be positive or negative, the magnitude and direction of impacts to the local recreation economy are uncertain.

Under Alternative 6, laid off workers potentially would be called back to work beginning as soon as approval is given for the mine life extensions. The mine work force would attain historical levels again within a short period of time, and the work force potentially would stay in place for an additional 5 years. With employment and operations under Alternative 6 expected to be comparable to historical levels, total community and school population also would continue to be at historical levels and would not be significantly different from levels existing prior to the layoffs occurring, with the exception of changes occurring because of other trends described in Section 3.10. Approval of the mine life extensions potentially would alleviate temporary unemployment created by the lay offs. Some turnover would occur in the mine work force and community and school populations because of employment decisions made by individuals and ZMI during the layoff and rehiring cycle.

ZMI would employ contract crews for construction of new facilities, including a water treatment plant, crusher, conveyor, and leach pad, as well as contract crews for final reclamation. It is assumed Big Flat Electric Cooperative would employ a contracted crew for construction of a power line between the Zortman and Landusky mines. Contract employment would occur in 1996 and 1997 and in 2005 and 2006. Temporary housing accommodations would be available for contractor employees as described in section 4.10.6.1.

Local jurisdictions in Phillips County would accumulate additional tax revenues under Alternative 6. Revenue flows would be sustained for an additional 5 years, but revenues would decline rapidly after 2001 and would disappear entirely after the conclusion of all activity at the mine site in 2011.

ZMI's operations from 1996 to 2011 would generate cumulative total revenues of $2.4 million for Phillips County, $1.2 million for the Malta High School and Elementary School districts combined, $1.0 million for the Dodson High School district, and $680,000 for Landusky Elementary School, all in 1994 dollars (Table 4.10-8). The impact upon local jurisdictions of the decline and eventual loss of revenues would be essentially the same as under Alternative 4 and was described in Section 4.10.6.1.

The Phillips County Hard Rock Trust Reserve fund would potentially receive annual distributions from state Metal Mines License Tax receipts for an additional 5 years, and the funds would be available for distribution when mine employment declines to half the previous five-year average. A distribution from the Phillips County Hard Rock Trust Reserve would be limited in its ability to mitigate impacts to local governments and schools. The amount distributed would be relatively small and available only on a one-time basis, while fiscal problems faced by each jurisdiction would be long-term. The Phillips County Hard Rock Trust Reserve had a balance of about $1 million in 1994; under Alternative 6 the fund would accumulate an additional $480,000. According to the statutory formula (described in Section 4.10.6.1) all the affected school districts in Phillips County would proportionally share in at least an estimated total of about $490,000 while the remainder of the fund would be available for expenditure directly by Phillips County or for distribution by the County as grants and loans to other local government units. Local school districts would also receive about $16,000 annually per district in Metal Mines License Tax distributions for additional years of mining.

In 1994, the Zortman and Landusky mines paid about $765,000 in metal mines license taxes, 75 percent of which is retained by the State. Under Alternative 6, the state would accumulate an additional $3.6 million in metal mines license taxes, about 8 times the total collected under Alternative 1.

Under Alternative 6, costs for providing services would continue at current levels for most jurisdictions through 2002 or 2003. Facilities within the study area that presently are at capacity would continue to operate under some strain. These include Malta's water and wastewater utilities, schools in Malta, medical care and emergency-response providers in Phillips County, and schools at Hays and Lodgepole. Additional revenues accumulated during ZMI's additional 5 years of mining may provide sufficient fiscal resources to accomplish some improvements for the Phillips County providers. Schools at Hays and Lodgepole, however, would not benefit because the mine facilities are not taxable by the Hays-Lodgepole school district.

The social impacts of Alternative 6 would differ among the potentially affected groups within the study area. For residents of Phillips County and its communities, the mine would have a significant positive impact on social well-being. The primary effect on local residents would be due to sustaining the local economy at its current level and maintaining employment opportunities, personal income levels, and fiscal resources for 5 more years.

The secondary and cumulative repercussions of these effects would be felt as positive impacts on local social structures, facilities and services, and retail trade and service sectors in Malta and Zortman. Mine employees are among the highest wage earners in the communities where they live; for example, only 30 or so oil and gas workers in Phillips County earn at the same level. ZMI employees also would remain active in local churches, civic service and economic development organizations, volunteer public safety and emergency services, and youth recreation programs. ZMI also directly donate funds which help to sustain or enhance the activities of various educational, civic, and social organizations; this pattern potentially would continue. Traditional rural family values would continue to be sustained to some extent in Malta and Phillips County by ZMI's policy of hiring local youth both for seasonal and permanent work (Rust 1994, Boothe 1994; Ereaux 1994).

Facilities and services offered by local governments in Phillips County would continue to be offered at current levels. Additional revenue flows will allow reduction of debt in Malta (Ereaux 1994). Senior citizen programs, recreation programs, and population sensitive services, such as medical practices, would be sustained for at least another 5 years (Wambold 1994).

By sustaining the current population, Alternative 6 also would positively affect retail trade and service sectors in Malta, the main shopping center located in Phillips County. This would be the case because ZMI and its employees are a significant market for goods and services in Malta now (Boothe 1994).

The impact of Alternative 6 on the well-being of groups in Blaine County, such as farmers, ranchers, and townspeople, would be similar to those described for Phillips County. However, the effect would potentially be much less intense and much less widely felt because so many fewer residents of Blaine County depend on the mines as an economic generator.

The effect of Alternative 6 on the sense of social well-being of residents of the Fort Belknap Indian Reservation as a whole was described in Section 4.10.6.1, and that description is incorporated here by reference. Although some Native Americans residing on the reservation are employed by ZMI and would feel better off economically, Alternative 6, like Alternatives 4 and 5, would be viewed by many Native Americans as allowing a significant and generally adverse quality of life impact to persist and expand in extent over an additional 5 years. Under Alternative 6, the adverse impact to the social well-being of Native Americans may be slightly lower than under Alternative 4 because of the improved probability of reclamation success and potential to correct existing water quality problems over the long term. Although these positive effects would occur, they may not be significant to Native Americans adversely impacted by the higher level of permanent change to the landscape in the Little Rocky Mountains which would be incurred under Alternative 6.

4.10.8.2 Cumulative Impacts

Reasonably foreseeable mining and exploration activity would not materially change the magnitude or duration of any of the impacts identified for Alternative 6. The cumulative socioeconomic impact of Alternative 6, summarized in terms of employment generated by ZMI's operations in the past and in the future, would be 8,013 job-years of full- and part-time employment in Phillips County, 303 job-years of employment in Blaine County, and 11,454 job years of employment in Montana as a whole.

Big Flat Electric Cooperative probably would build a new powerline if the Zortman and Landusky mines expansion is approved. The impacts of this action under Alternative 6 would be the same as described in Section 4.10.6.2 and are incorporated here by reference.

The cumulative social effects under Alternative 6 would be essentially the same as those under Alternative 4. These were in Section 4.10.6.2, and are incorporated here by reference.

4.10.8.3 Unavoidable Adverse Impacts

The impact of Alternative 6 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. This impact would be unavoidable. All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 6 would be unavoidable, as well. Adverse impacts of closure are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.8.4 Short-term Use/Long-term Productivity

Under Alternative 6, the productivity of pre-existing and additional existing economic resources such as grazing land would be disturbed in exchange for mining, a significantly more intensive economic development. However, in the long run, assuming the success of reclamation procedures, pre-disturbance uses could be restored to long-term productivity.

4.10.8.5 Irreversible or Irretrievable Resource Commitments

In economic terms, no irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 6. Native Americans may view physical impacts upon cultural resource sites important to their lifestyle as an irreversible and irretrievable resource commitment associated with the alternative.

4.10.9 Impacts of Alternative 7

4.10.9.1 Impacts

Alternative 7 would approve expansion of both the Zortman and Landusky mines but impose agency developed mitigation on the expansion and reclamation activities. In socioeconomic terms, Alternative 7 is similar to Alternative 4; however, there are differences that potentially affect socioeconomic impacts. A difference at the Zortman Mine is the fact that under Alternative 7, the proposed waste rock repository would be constructed on top of existing facilities. At the Landusky Mine, a modification of reclamation requirements would be for ZMI to remove rock fill from the head of King Creek and backfill the pits so that they freely drain into King Creek, a feature Alternative 7 shares with Alternative 5. The use of water balance reclamation covers at both mines to reduce or eliminate environmental impacts differentiates Alternative 7 from the reclamation cover types used in Alternatives 2 through 6.

Under Alternative 7, it is assumed mining would occur for 7 years before a transition is made and closure activities begin. Implementation of Alternative 7 could begin as soon as early 1996. Construction of new facilities, assumed to occur in 1996 and 1997, would require substantial capital outlays and employment of some construction contracting. Cumulative expenditures by ZMI would be higher under Alternative 7, as compared to Alternatives 4 through 6, mainly because of the modified reclamation requirements.

After construction but during the extended mining operations, which would last into the year 2002, ZMI would require levels of employment similar to those in the past and would expend similar levels of annual operating and working capital expenditures. Closure activities are assumed to begin in the year 2002 and last through 2012, with additional reclamation contracting occurring in 2006 and 2007. During the closure and reclamation cycle, employment and spending would be somewhat higher than in other alternatives. The direct employment, payroll and expenditure associated with ZMI's continued operations under Alternative 7 are presented in Table 4.10-1 through Table 4.10-3.

Layoffs of a total of 106 employees have occurred because ZMI has run out of permitted ore. This is a reduction of about 50 percent from the employment level of 1993. The socioeconomic effects of the layoffs are still developing. To date, spending for payroll and business purchases has decreased in proportion to the decrease in employment. Household spending within the study area probably has decreased, too, because of reduced incomes to laid off employees remaining in the study area. Unemployment has increased because most laid off employees have remained unemployed and have not relocated for the time being. The economic repercussions of reduced ZMI and household spending would be felt throughout Phillips and Blaine counties. Under Alternative 7, the mine work force would soon be restored to historical levels.

During the extended mining period, Alternative 7 would sustain direct and indirect economic activity in the State of Montana, in Phillips County and, to a much lesser extent, in Blaine County. The additional employment and earnings generated as a result would be a significant benefit, especially when compared in magnitude to the effects of Alternatives 1 through 3.

Also, sustaining ZMI operations at current levels for 7 more years would have significant positive impacts on Phillips County and the communities of Malta and Zortman in terms of fiscal conditions, community resources, and social well-being among its residents. Cumulative positive effects also would be felt in Blaine County; however, they would be small compared to existing conditions. Businesses elsewhere in the State of Montana would continue to be positively affected over the extended life of ZMI's operations, especially those in Billings and Helena which supply ZMI with goods and services. Property values would be supported at present levels in Phillips County and especially in the communities of Malta and Zortman. Consumers who buy electricity from the Big Flat Electric Cooperative, including 70 large power irrigators, would continue to benefit from the volume and demand-spreading discounts Big Flat earns from its supplier by having ZMI as a customer. This effect would be concentrated in parts of Big Flat's service area that rely disproportionately on electric heat for home heating because they lack access to natural gas. These areas are the rural area of Phillips County south of Malta and around Regina, rural areas around Turner and Hogeland within Blaine County, and the Fort Belknap Indian Reservation. On certain occasions, ZMI would allow employee wood gathering as long as all State and Federal guidelines are followed.

The State treasury would earn cumulative revenues, a significant beneficial impact. Economic effects on the Fort Belknap Indian Reservation would also be relatively small, if positive, and there would be no fiscal impact because no direct revenues are derived from the mine.

The extended mining phase of Alternative 7 also would sustain beneficial conditions in the social environment in Malta and Zortman, where mine employees and their families are positive contributors to, and an integral part of, local social structures. The impact of Alternative 7 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. Although some Native Americans residing on the reservation are employed by ZMI and would benefit economically from the additional years of employment and income, many Native Americans who oppose the mine and have expressed a high level of concern about its presence would continue to be adversely affected during the extended mining phase before closure activities begin and the mines ultimately are closed.

Closure impacts would be shown on the tables and figures previously referenced, but would occur later. It is possible that by delaying closure under Alternative 7, the relative magnitude of the impacts may be somewhat different because conditions may change farther out in the future. However, this is not likely since population and employment projections available now for Phillips County indicate almost no growth is anticipated for the county through the year 2012. In Blaine County, where the available population and employment projections indicate some growth is anticipated through the year 2012, the relative impacts of closure would therefore be even smaller under Alternative 7 than under Alternative 1.

Table 4.10-8 summarizes the economic and fiscal impact impacts of Alternative 7 compared to the impacts of Alternatives 4 through 6. Under Alternative 7, ZMI's operations from 1996 to 2012 would generate a cumulative total of 5,156 job-years of direct and secondary employment and $130.6 million in 1994 dollars of direct and secondary earnings within the State of Montana. The cumulative effect on state employment would be about 9 times that of Alternative 1. The statewide effects include a cumulative total of 3,608 job-years of employment and $99.3 million in 1994 dollars of earnings in Phillips County, about 8 times the employment effect of Alternative 1. During the same period, ZMI's operations would generate a cumulative total of 133 job-years of employment and $2.7 million in earnings in 1994 dollars for Blaine County, about 7 times the employment effect of Alternative 1. (A job-year is a full- or part-time job held for a year, on average). Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.

Under Alternative 7, the effects to sectors of the local economy that rely on recreation resources near the Zortman and Landusky mines would be similar to those of Alternative 4. However, locating both the waste rock repository on top of facilities at the Zortman Mine and the use of water balance reclamation covers may improve the appearance of reclaimed areas in the long term, a beneficial effect for recreation users in the Little Rocky Mountains. Therefore, Alternative 7 may slightly increase the propensity of recreationists to use recreation resources near the Zortman and Landusky mines in the long-term. The effect is likely to occur but probably would be quite small compared to the total economic effect of the alternative. Since information is not available to quantify effects to the local recreation economy or to determine whether they would be positive or negative, the magnitude and direction of impacts to the local recreation economy are uncertain.

Under Alternative 7, laid off workers potentially would be called back to work beginning as soon as approval is given for the mine life extensions. The mine work force would attain historical levels again within a short period of time, and the work force potentially would stay in place for an additional 7 years. With employment and operations under Alternative 7 expected to be comparable to historical levels, total community and school population also would continue to be at historical levels and would not be significantly different from levels existing prior to the layoffs occurring, with the exception of changes occurring because of other trends described in Section 3.10. Approval of the mine life extensions potentially would alleviate temporary unemployment created by the lay offs. Some turnover would occur in the mine work force and community and school populations because of employment decisions made by individuals and ZMI during the layoff and rehiring cycle.

ZMI would employ contract crews for construction of new facilities, including a water treatment plant, crusher, conveyor, and leach pad, as well as contract crews for final reclamation. It is assumed Big Flat Electric Cooperative would employ a contracted crew for construction of a power line between the Zortman and Landusky mines. Contract employment would occur in 1996 and 1997 and in 2006 and 2007.

Contractor employees would seek temporary housing in Zortman and would be likely to commute weekly without their families. Accommodating this demand would be most difficult when permanent employment at the mines is at full strength. In addition, there is a greater demand for housing in Zortman during the summer, when the mine hires temporary workers; during prairie dog season, from March through October; and during the big game hunting season, from September to November. However, sufficient housing has been available in the past for contract crews and would probably be available when needed during the construction phases (Kalal 1994).

Local jurisdictions in Phillips County would accumulate additional tax revenues under Alternative 7. Revenue flows would be sustained for an additional 7 years, but revenues would decline rapidly after 2001, and would disappear entirely after the conclusion of all activity at the mine site in 2012.

ZMI's operations from 1996 to 2012 would generate cumulative total revenues of $2.6 million for Phillips County, $1.2 million for the Malta High School and Elementary School districts combined, $1.1 million for the Dodson High School district, and $730,000 for Landusky Elementary School, all in 1994 dollars (Table 4.10-8). The impact of the decline and loss of these annual tax revenues may be measured by the degree to which local jurisdictions depend on revenues generated by ZMI now. In 1994, Landusky Elementary School District received $96,000 in property and gross proceeds taxes, or about 81 percent of total budgeted revenues; Dodson School District received $125,000, or about 20 percent of total budgeted revenues; Malta High School and Elementary School districts received about $158,000, or about 13 percent of total budgeted revenues; and Phillips County received $388,000, or about 9 percent of total budgeted revenues. Under Montana's system of school finance, schools would also lose direct state aid and budget capacity for every student lost.

The Phillips County Hard Rock Trust Reserve would receive annual distributions from state Metal Mines License Tax receipts during the extended operations, and the funds would be available for distribution when mine employment declines to half the previous five-year average. A distribution from the Phillips County Hard Rock Trust Reserve would be limited in its ability to mitigate impacts to local governments and schools. The amount distributed would be relatively small and available only on a one-time basis, while fiscal problems faced by each jurisdiction would be long-term. The Phillips County Hard Rock Trust Reserve had a balance of about $1 million in 1994; under Alternative 7 the fund would accumulate an additional $570,000. According to the statutory formula (described in Section 4.10.6.1) all the affected school districts in Phillips County would proportionally share in at least an estimated total of about $530,000 while the remainder of the fund would be available for expenditure directly by Phillips County or for distribution by the County as grants and loans to other local government units. Local school districts would also receive about $16,000 annually per district in Metal Mines License Tax distributions for additional years of mining.

In 1994, the Zortman and Landusky mines paid about $765,000 in metal mines license taxes, 75 percent of which is retained by the State. Under Alternative 7, the state would accumulate an additional $4.3 million in metal mines license taxes, about 10 times the total collected under Alternative 1.

Under Alternative 7, costs for providing services would continue at current levels for most jurisdictions through 2003 or 2004. Facilities within the study area that presently are at capacity would continue to operate under some strain. These include Malta's water and wastewater utilities, schools in Malta, medical care and emergency-response providers in Phillips County, and schools at Hays and Lodgepole. Additional revenues accumulated during ZMI's additional 7 years of mining may provide sufficient fiscal resources to accomplish some improvements for the Phillips County providers. Schools at Hays and Lodgepole, however, would not benefit because the mine facilities are not taxable by the Hays-Lodgepole school district.

The social impacts of Alternative 7 would differ among the potentially affected groups within the study area. For residents of Phillips County and its communities, the mine would have a significant positive impact on social well-being. The primary effect on local residents would be due to sustaining the local economy at its current level and maintaining employment opportunities, personal income levels, and fiscal resources for 7 more years.

The secondary and cumulative repercussions of these effects would be felt as positive impacts on local social structures, facilities and services, and retail trade and service sectors in Malta and Zortman. Mine employees are among the highest wage earners in the communities where they live; for example, only 30 or so oil and gas workers in Phillips County earn at the same level. ZMI employees also would remain active in local churches, civic service and economic development organizations, volunteer public safety and emergency services, and youth recreation programs. ZMI also directly donate funds which help to sustain or enhance the activities of various educational, civic, and social organizations; this pattern potentially would continue. Traditional rural family values would continue to be sustained to some extent in Malta and Phillips County by ZMI's policy of hiring local youth both for seasonal and permanent work (Rust 1994; Boothe 1994; Ereaux 1994).

Facilities and services offered by local governments in Phillips County would continue to be offered at current levels. Additional revenue flows would allow reduction of debt in Malta (Ereaux 1994). Senior citizen programs, recreation programs, and population sensitive services, such as medical practices, would be sustained for at least another 7 years (Wambold 1994).

By sustaining the current population, Alternative 7 also would positively affect retail trade and service sectors in Malta, the main shopping center located in Phillips County. This would be the case because ZMI and its employees are a significant market for goods and services in Malta now (Boothe 1994).

The impact of Alternative 7 on the well-being of groups in Blaine County, such as farmers, ranchers, and townspeople, would be similar to those described for Phillips County. However, the effect would potentially be much less intense and much less widely felt because so many fewer residents of Blaine County depend on the mines as an economic generator.

Alternative 7 potentially would have a negative impact on the sense of social well-being of residents of the Fort Belknap Indian Reservation as a whole, even though the extension of mine operation would represent sustained economic opportunity for those Native Americans employed by ZMI and others who may benefit from the secondary economic effects of ZMI's operations. This is because, regardless of economic issues, many Native Americans on the reservation oppose the mines and have expressed a high level of concern about their presence and their impacts in the past and potentially in the future. In other words, a secondary impact of the mine's direct effects on the physical and human environment has been, and would continue to be its effect on the way many residents of the Fort Belknap Indian Reservation feel about the quality of life in their community.

Native American concerns about quality of life reflect a distinctive social and cultural group's reaction to how ZMI's presence and the mines' effects upon the environment have affected social and cultural activities, sites of contemporary or heritage significance, lifestyles which depend on access, use and appreciation of relatively natural land within the Little Rocky Mountains, and the use and appreciation of streams that drain portion of the Zortman and Landusky mining area and eventually enter the Fort Belknap Indian Reservation. Although some Native Americans residing on the reservation are employed by ZMI and feel better off economically, expansion of mining activity potentially would be viewed, because of past and potential future impacts, and because closure would be delayed another 7 years, as a significant and generally adverse quality of life impact by the Fort Belknap Indian Reservation in general.

Therefore, the net effect of Alternative 7 on the social well-being of the Fort Belknap Indian Reservation, and on some non-Native Americans within the study area as well, would be negative, even though some Native Americans, as well as some in the non-Native American community, would view the predominantly positive economic effects of the alternative as benefitting the quality of life.

Also, some non-Native Americans, for similar or other reasons, may react negatively to the impacts of Alternative 7, viewing the extension of ZMI's operations, its expansion in terms of additional land disturbance, and the delay of closure and reclamation as having a negative effect on the quality of life within the study area. However, for the non-Native American community as a whole within the study area, these views probably would not affect the likely consensus that extension of mineral development activity and delaying closure and reclamation would have a beneficial effect on social well-being since the alternative represents prolonging the life of a source of economic and fiscal opportunity and social vitality for localities such as Malta and Zortman and for Phillips County as a whole.

Under Alternative 7, the adverse impact to the social well-being of Native Americans may be slightly lower in comparison to Alternative 4 because of the improved probability of reclamation success over the long term and the potential to correct existing water quality problems. Although these positive effects would occur, they may not be significant to Native Americans adversely impacted by the higher level of permanent change to the landscape in the Little Rocky Mountains which would be incurred under Alternative 7.

4.10.9.2 Cumulative Impacts

Reasonably foreseeable mining and exploration activity would not materially change the magnitude or duration of any of the impacts identified for Alternative 7. The cumulative socioeconomic impact of Alternative 7, summarized in terms of employment generated by ZMI's operations in the past and in the future, would be 8,448 job-years of full- and part-time employment in Phillips County, 303 job-years of employment in Blaine County, and 12,086 job years of employment in Montana as a whole. Impacts in Phillips and Blaine counties may be overstated, as described in Section 4.10.1.2.

Big Flat Electric Cooperative probably would build a new powerline if the Zortman and Landusky mines expansion is not approved. If built, the powerline upgrade would be funded at least in part by revenues from Big Flat's customer base. It is possible that Big Flat would have to raise rates by an unknown amount to generate sufficient revenue to build the powerline upgrade, although Big Flat would try to keep any rate impact minimal for the consumer (Barnard 1996).

If the Zortman and Landusky mines expansion is approved, Big Flat's revenues would be sustained or even increased because of the mine expansion. Therefore, it is possible that were the powerline to be built in conjunction with Alternative 7, the rate impact to Big Flat customers would be minimal or there may be no rate impact at all.

The powerline upgrade is anticipated to cost Big Flat about $4.1 million (Barnard 1996). A project of this size could involve a contract construction crew of 15 to 20 for a period of about a year. If Big Flat were to use the services of a contractor located within the study area, the local direct and secondary economic impacts of the project could be significant if short lived. Any positive economic impacts of the powerline upgrade that may occur would be a small addition to the economic effect of expansion and continued operation of the Zortman and Landusky mines under Alternative 7.

The cumulative socioeconomic impact of Alternative 7 may be represented in summary fashion in terms of the employment generated by the ZMI's operations in the past and in the future. From 1979 through 1994, ZMI's operations are estimated to have generated 4,840 job-years of full- and part-time direct and secondary employment in Phillips County (see Table 4.10-5), 170 job-years in Blaine County, and 6,930 job-years in Montana as a whole. Alternative 7 would generate an additional 3,480 job-years of employment in Phillips County, 144 job-years in Blaine County, and 5,000 job years in Montana as a whole. Therefore, the cumulative impact of Alternative 7 would be 8,320 job-years of employment in Phillips County, 314 job-years of employment in Blaine County, and 11,930 job years of employment in Montana as a whole.

Over time, the Zortman and Landusky mines also have had a cumulative effect on the social environment of the communities and groups within the study area. Social impacts of ZMI have been significant and beneficial in Malta and Zortman over the past 15 years as mine employees have integrated into and strengthened local social structures. Those beneficial effects would be sustained for an additional 7 years under Alternative 7. This effect would be especially important in the absence of other economic development, delaying the potential for outmigration of employees who are also key members of community social structures. For the Fort Belknap Indian Reservation, delaying the closure and reclamation of the mines under Alternative 7 would prolong the sense that the quality of life for reservation residents is being negatively impacted by ZMI's presence and the effects upon the physical and human environment. Because relatively few employees of the mine reside in Blaine County outside the Fort Belknap Indian Reservation, the cumulative social effect that has occurred in the past or would occur in the future in conjunction with this alternative would be negligible.

4.10.9.3 Unavoidable Adverse Impacts

The impact of Alternative 7 on the social environment on the Fort Belknap Indian Reservation, at least during the extended mining phase, would be significant and generally perceived as adverse. This impact would be unavoidable. All adverse impacts related to the closure and reclamation of the Zortman and Landusky mines under Alternative 7 would be unavoidable, as well. Adverse impacts of closure are loss of employment and earnings, loss of direct tax revenues, adverse impacts to community facilities and services, and adverse impacts to the social well-being of residents of Phillips County.

4.10.9.4 Short-term Use/Long-term Productivity

Under Alternative 7, the productivity of pre-existing and additional existing economic resources such as grazing land would be disturbed in exchange for mining, a significantly more intensive economic development. However, in the long run, assuming the success of reclamation procedures, pre-disturbance uses could be restored to long-term productivity.

4.10.9.5 Irreversible or Irretrievable Resource Commitments

In economic terms, no irreversible or irretrievable commitments of socioeconomic resources have been identified for Alternative 7. Native Americans may view physical impacts upon cultural resource sites important to their lifestyle as an irreversible and irretrievable resource commitment associated with the alternative.

4.11 TRANSPORTATION

4.11.1 Introduction and Methodology

The discussion of transportation-related impacts associated with the various Zortman/Landusky project alternatives focuses on three primary areas:

- Effects of vehicle traffic on local roads and highways, and associated concerns regarding accident potential and safety of local residents. Three types of vehicle trips are considered, including those generated by workers commuting to and from the Zortman and Landusky mines; truck trips associated with the hauling of reclamation materials; and truck trips associated with the hauling of hazardous materials, such as cyanide and diesel fuel. These vehicle trips will be considered according to (a) the context of traffic volumes on local and regional roads, (b) the likelihood that the number of accidents may change on those roads, and (c) the issue of the safety of local residents who live adjacent to those roads. In addition, internal mine truck traffic will be discussed due to potential impacts on wildlife species that use the project area.

  In assessing the significance of traffic-related impacts and assigning an impact level (high, moderate, or low), traffic volumes experienced due to project activities from 1979 - 1994 mining activities, as well as those projected for the future under various project alternatives, will be compared with the actual capacities of the highways and local roads utilized. Based on the Transportation Research Board's Highway Capacity Manual, the project area highways are generally capable of supporting as many as 5,700 trips per day before driving conditions would become congested. If traffic volumes exceed this threshold, traffic congestion increases considerably. Similarly, the local roads used to access the communities of Zortman and Landusky and the mines would be capable of handling as many as 2,850 trips per day each or 356 trips per hour before experiencing traffic congestion. Project-induced exceedances of these capacities or thresholds would be considered to have a high negative impact on the study area transportation system. Project-induced traffic that ranges from 70 percent to 100 percent of these capacities would be rated as moderate negative, impacts ranging from 1 to 70 percent of capacity would be rated as low negative, and where traffic would not increase at all above baseline conditions, impacts would be rated as neutral.

  With respect to accidents, actual numbers of accidents on study area highways will be compared between the period before mining (1970s) and during recent mining activities (1980s) to assess whether or not accidents and accident rates increased as a result of increased traffic due to mining. For potential future accident calculation, the accident rate experienced during recent mining activities (1980 - 1989) will be applied to projected future traffic under the various project alternatives to predict accident numbers. If the calculated number of accidents is greater than 50 percent of the annual average experienced during the recent mining phase, impacts would be rated as high negative. For increases of 25 - 50 percent, impacts would be rated moderate negative, and for increases from 1 - 25 percent, impacts would be rated low negative.

- Potential effects of the project alternatives on vehicle and pedestrian access to various parts of the Little Rocky Mountains, including the areas currently being mined, Saddle Butte, and Goslin, Pony and Alder Gulches.
  In assessing the significance of access-related impacts and assigning an impact level (high, moderate, or low), the extent of the area excluded from public access due to road closures will be compared between baseline (pre-1979) and the present and projected future mining eras. Where project activities result in closure of major areas in the southern Little Rocky Mountains or roads that are important for accessing large areas and these impacts can not be mitigated, the impact is rated as high negative. For impacts to large areas or where important road closures would occur, but mitigation could be applied (permitted access on occasions, alternative roads constructed), impacts would be rated as moderate negative. For closures of small areas, or where road closures do not affect larger areas, or where alternative access roads are available, impacts would be rated as low negative.

- Transportation of hazardous materials to and from the mines, and risks associated with potential accidents and spills.
  According to the Montana Highway Patrol and Montana Department of Transportation, accident rates for hazardous material haul trips have not been calculated to date. Records on the number of accidents involving commercial vehicles hauling hazardous materials are available, however. As an example, there were a total of 14 accidents involving commercial vehicles hauling hazardous materials in 1993 in the entire State of Montana (Montana Highway Patrol 1994). Unfortunately, the State does not track the total number of hazardous material haul trips that are actually taking place each year and therefore can not calculate an accident rate (Montana Department of Transportation 1994). Based on the fact that only 14 accidents occurred in the entire State in 1993, and that there were likely to be hundreds of thousands of such haul trips (e.g., gasoline tankers supplying service stations statewide), one can assume the accident rate is very low in general. For the Zortman and Landusky mines, no hazardous material hauling accidents occurred from 1979 to 1994. For assessing potential future impacts, projected hazardous materials haul trips for all alternatives will be compared with the numbers utilized by the mines from 1979 to 1994.

4.11.2 Impacts From Mining, 1979 to Present

Impacts associated with recent mining activities are evaluated in comparison to the study area transportation network as it existed prior to 1979. General traffic volume and accident data were available from the Montana Department of Transportation and Montana Highway Patrol and were used for comparison of pre-mining conditions with conditions associated with recent mining operations.

Traffic

After commencement of permitted mining activities in 1979, traffic volumes on study area roads increased considerably (Table 3.11-1). Specifically, average daily traffic (ADT) volumes increased by 152 percent on U.S. Highway 191 between Malta and Zortman, 41 percent between Zortman and Lewistown, and 133 percent on Route 66 between Hays and Landusky from 1975 to 1980 (Montana Department of Transportation 1994, 1990, and 1991). These elevated traffic volumes have generally persisted throughout the past 15 years that mining has been carried out. Although this increase may be attributed to a variety of factors, much of it is likely to be associated with commuting mine workers that did not work in the project area prior to 1979. It is estimated that commuting mine workers added an average of approximately 100 roundtrips per day, virtually every day, to the transportation network from 1979 to 1994. Similarly, truck traffic also increased due to mining activities in the project area. It is estimated that roughly 12 truck roundtrips per day or up to 4,200 roundtrips per year were added to the transportation network for hauling of various mining-related supplies from 1979 to 1994.

In terms of assessing the significance of these traffic increases, it is important to consider the fact that traffic volumes on project area highways were very low relative to their actual capacity. In the context of this project, the traffic volume increases experienced from 1979 to 1994 were fairly large when compared with pre-mining conditions, but were small relative to the design capacity of the respective local roads and highways. In fact, over the 15 years that mining has occurred at the Zortman and Landusky mines, ADT values have never exceeded 1,000 for either U.S. Highway 191 or Route 66, the two highways that actually serve the mining area. Thus, even with mining-related traffic, these highways have operated at less than one-fifth of their capacity. Similarly, the local roads used to access the communities of Zortman and Landusky and the mines experienced traffic volumes far below their capacity values. Consequently, the increase in traffic volumes associated with recent mining activities is considered to have had a low negative impact on the transportation network in the study area.

Surprisingly, the number of accidents and accident rate on study area highways actually dropped after 1979, despite the increase in traffic volumes (Table 3.11-1). From 1972 to 1978, U.S. Highway 191 between Malta and Zortman experienced an average of 14 accidents per year, compared with 13 accidents per year from 1980 to 1989, despite a 153 percent increase in traffic volumes. Route 66 and U.S. Highway 2 also experienced reductions in accidents in the 1980s, despite similar increases in traffic volumes after mining commenced. In fact, the number of accidents per year dropped by 61 percent (from 13 to 5) on Route 66 and by 55 percent (from 31 to 14) on U.S. Highway 2. It is difficult to determine why this reduction in accidents occurred. Various factors not related to traffic volume, including weather severity, may have played a role in highway conditions and the number of accidents. Thus, it appears the increase in traffic related to mining in the project area had no impact on accident numbers or accident rates in the study area.

Public Access to the Little Rocky Mountains

One of the more pronounced impacts of mining operations at the Zortman and Landusky mines has been the closure of roads to the public that were historically used for access to the southern Little Rocky Mountains. Prior to 1979, public access and vehicle use of roads in the current mining areas were permitted and those areas were used for a variety of recreational and cultural purposes. Since 1979, the Zortman Mine Access Road, the Zortman to Landusky road, and the Landusky Mine access roads have been closed to the public for safety reasons. Similarly, Mission Canyon Road has been closed below the Landusky Mine, as has the road that extends up Alder Gulch near the Zortman Mine. Altogether, these road closures have had a high negative impact on the local transportation network as it relates to access to the southern Little Rocky Mountains because they have effectively excluded access to a considerable portion of the southern Little Rocky Mountains once available for public use. The specific impacts on recreation and cultural uses of the southern Little Rocky Mountains are described in Sections 4.7 and 4.12 respectively.

At present, public access to Saddle Butte, Goslin Gulch, and Pony Gulch is still available, although permission to cross private property on Goslin Flats is required.

Transportation of Hazardous Materials

As described in Section 3.11, very little transportation of hazardous materials in the local project area occurred prior to 1979. Commencement of mining activities in the Little Rocky Mountains resulted in the transport of large quantities of chemical reagents, motor vehicle fuels, and other regulated hazardous materials to both the Zortman and Landusky mines. Although production rates at the two mines varied from 1979 to 1994, it is estimated that approximately 4,200 truck trips (roundtrips) per year were required to supply the mines with the materials they needed. This transport of regulated hazardous materials created a risk of accidents and potential releases of hazardous materials. Fortunately, over the 15-year operating period, there were no reported accidents associated with the project involving the transport of hazardous materials.

4.11.3 Impacts From Alternative 1

Traffic

Under Alternative 1, reclamation would be quickly completed at the Zortman Mine (ending about 1998) and final mining, leaching, and reclamation would be completed at the Landusky Mine around the year 2000. Under projected employment conditions, this project scenario would result in roughly 95 commuter roundtrips per day in 1996 and would diminish once reclamation is completed (Table 4.11-1). The addition of 95 roundtrips per day would represent an increase above baseline (pre-1979) conditions, but a slight decrease in traffic relative to the 1979 to 1994 mining period (which averaged 100 roundtrips per day).

Similarly, truck traffic to the mines would also diminish as the productive life of the mines ends. Alternative 1 features the least intensive reclamation effort of all project alternatives considered. No truck trips associated with hauling of clay are envisioned as a result (Table 4.11-2).

Five truck trips per day or up to 1,775 (roundtrips) per year would be required for hazardous materials hauling. These materials would consist primarily of reagents required for final heap leaching at the mines. After heap leaching is completed, these trips would decrease and would consist primarily of gasoline and diesel fuel for heavy equipment engaged in reclamation activities (Table 4.11-3) (Figure 4.11-1).

Comparison of hazardous material hauling of 1,775 roundtrips per year, with an average of 4,200 roundtrips per year from 1979 to 1994 indicates that truck traffic would decrease relative to recent mining activities. As described in Section 4.11.2, the traffic volumes associated with mining operations would have a low negative impact on the transportation network in the study area due to the abundance of available road and highway capacity in the study area (Figure 4.11-2).

With respect to accidents, the addition of commuter and truck trips to the transportation system as a whole could result in 1.87 accidents per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be considered a low negative impact.

Residents of the communities of Zortman and Landusky and their pets would be somewhat vulnerable to accidents during commute hours as mine workers arrive or leave during shift changes. Similarly, truck traffic through those communities would also create a risk of

TABLE 4.11-1
SCHEDULE OF COMMUTER TRIPS: ALTERNATIVES 1-7[1]

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Alternative 1	95	15	10	10	10	5	5	5	5	3	0	0	0	0	0	0	0
Alternative 2	95	55	10	10	15	5	5	5	5	3	0	0	0	0	0	0	0
Alternative 3	95	95	10	10	15	5	5	5	5	3	0	0	0	0	0	0	0
Alternative 4	115	135	120	120	120	120	95	95	60	15	20	20	5	5	5	5	5
Alternative 5	115	135	120	120	120	120	95	95	20	20	20	20	5	5	5	5	5
Alternative 6	115	135	120	120	120	95	95	95	20	20	20	5	5	5	5	5	0
Alternative 7	115	135	120	120	120	120	95	95	95	15	20	18	5	5	5	5	5

[1] Commuter trips include both mines and were calculated based on projected employment over the life of the alternatives. Values given are roundtrips.

TABLE 4.11-2
SCHEDULE OF RECLAMATION TRUCK TRIPS[1]

Schedule of Reclamation Trips - Alternative 1	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Zortman Reclamation Trips - Complete																
Landusky Reclamation Trips - Complete																0

Schedule of Reclamation Trips - Alternative 2	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Reclamation Materials																
Zortman Clay Trips	1,300	1,750	1,750	(Through town)												4,800
Reclamation Materials																
Landusky Clay Trips	1,000	1,000	1,500	2,800	4,000	(Through town)										10,300

Schedule of Reclamation Trips - Alternative 3	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Reclamation Materials - Zortman																
Topsoil from Goslin Flats	1,500	1,500	1,310	1,310	(Through town)											5,620
Subsoil from Goslin Flats	2,620	2,620	2,620	2,620	(Through town)											10,480
NAG - Ruby Gulch Tailing	4,000	4,000	0	0	(Not through town)											8,000
NAG - Goslin Flats	0	0	4,000	3,000	(Through town)											7,000
Reclamation Materials - Landusky																
NAG - Existing Stockpiles	1,200	0	0	0	0	0	(Not through town)									1,200
NAG - Montana Gulch Dump	2,000	3,000	5,800	6,000	8,000	8,000	(Not through town)									32,800

TABLE 4.11-2 - SCHEDULE OF RECLAMATION TRUCK TRIPS[1]
(Continued)

Schedule of Reclamation Trips - Alternative 4[2]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Reclamation Materials - Zortman																
Zortman Mine Clay	100	100	100	100	0	0	800	800	800	800	2,000	2000				7,600
Carter Gulch Repos. Clay	100	100	300	300	300	300	300	300	300	400	450	450				3,600
Total/Year	200	200	400	400	300	300	1,100	1,100	1,100	1,200	2,450	2,450	(Through town)			11,200
Zortman Mine/Carter Gulch NAG	2,500	2,500	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	8,000	(Not through town)			58,000
Goslin Flat Clay	5,000	2,000	200	200	200	300	500	500	500	800	800	800	(Not through town)			11,800
Goslin Flat Limestone	1,000	1,000	500	500	500	500	500	500	500	3,100	3,100	3,100	(Not through town)			14,800
Reclamation Materials - Landusky																
Landusky Clay	1,000	1,000	1,000	500	2,000	3,500	4,000	(Through town)								13,000
Landusky Limestone	0	0	0	0	0	350	350	(Not through town)								700
Landusky NAG	5,000	5,000	5,000	5,000	5,000	5,000	10,000	(Not through town)								40,000

Schedule of Reclamation Trips - Alternative 5	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Reclamation Materials - Zortman																
Zortman Mine Clay	500	500	500	500	500	500	500	1,000	1,000	1,000	1,000	1,000				8,500
Alder Gulch LP Clay	3,000	3,000	0	0	0	0	0	500	600	1,000	1,000	1,000				10,100
Carter Gulch Repos. Clay	300	300	300	300	300	300	300	300	300	450	450	400				4,000
Total/Year	3,800	3,800	800	800	800	800	800	1,800	1,900	2,450	2,450	2,400	(Through town)			22,600
Zortman Limestone	0	0	0	0	0	0	0	0	0	4,800	5,000	5,000	(Not through town)			14,800
Zortman NAG	0	1,000	1,000	1,000	1,000	1,000	1,000	2,000	2,000	3,000	4,000	4,800	(Not through town)			21,800
Reclamation Materials - Landusky																
Landusky Clay	1,000	1,000	1,000	2,300	2,600	3,800	4,000	(Through town)								15,700
Landusky Limestone	0	0	0	0	0	350	350	(Not through town)								700
Landusky NAG	3,000	3,500	3,500	3,500	3,500	5,000	10,000	(Not through town)								32,000

TABLE 4.11-2 - SCHEDULE OF RECLAMATION TRUCK TRIPS[1]
(Continued)

Schedule of Reclamation Trips - Alternative 6[2]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Reclamation Materials - Zortman																
Zortman Mine Clay	500	500	500	500	500	500	500	500	1,000	1,500	2,000	(Through town)				8,500
Zortman Mine NAG	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	3,000	3,000	(Not through town)				15,000
Ruby Flats NAG	3,000	3,000	1,000	1,000	1,000	1,000	1,000	1,000	2,000	3,700	5,000	(Not through town)				22,700
Goslin Flat Limestone	1,000	1,000	500	500	500	500	1,000	1,500	1,500	3,400	3,400	(Not through town)				14,800
Goslin Flat Clay	5,000	2,000	0	0	0	0	0	0	0	200	200	(Not through town)				7,400
Ruby Flats Repos. Clay	300	300	300	300	300	300	300	400	450	750	750	(Not through town)				4,450
Reclamation Materials - Landusky																
Landusky Clay	1,000	1,000	1,000	2,300	2,600	3,800	4,000	Through town								15,700
Landusky Limestone	0	0	0	0	0	350	350	(Not through town)								700
Landusky NAG	3,000	3,500	3,500	3,500	3,500	5,000	10,000	(Not through town)								32,000

Schedule of Reclamation Trips - Alternative 7[2]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Reclamation Materials - Zortman																
Topsoil from Goslin Flats	0	0	0	0	0	0	0	0	0	0	2000	1900	(Through town)			3,900
Topsoil from Landusky	0	0	1840	2000	2000	2000	2000	1000	(Not through town)							10,840
Subsoil from Goslin Flats	0	0	1200	1200	1500	1500	1500	2000	2000	2000	2000	2000	(Through town)			16,900
NAG - Ruby Gulch Tailing	0	0	0	0	0	0	0	1500	1500	1500	1500	2000	(Not through town)			8,000
Goslin Flat Clay	5000	2000	(Not through town)													7,000
Reclamation Materials - Landusky																
Subsoil from Goslin Flat via Zortman Mine	0	0	0	0	2980	3000	3000	(Through town of Zortman)								8,980
NAG - Montana Gulch Dump	2000	4000	4000	5000	5000	7000	7800	(Not through town)								34,800

TABLE 4.11-2 - SCHEDULE OF RECLAMATION TRUCK TRIPS[1]
(Concluded)

[1] Values given are roundtrips. Each roundtrip represents delivery of ore load of a reclamation material to its location of use and the return trip to the source location.

[2] NAG to be used at the Goslin Flat Leach Pad and Ruby Flats Waste Rock Repository (Alt. 6 only) would be transported by conveyor. Values given indicate internal mine truck trips required to haul from source to conveyor loading area.

TABLE 4.11-3[1]
HAZARDOUS MATERIAL HAUL TRIPS: ALTERNATIVES 1-7

Annual Hazardous Materials Trips - Alternative 1	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	R	R														
Zortman	275	275														550
Project Phase	L	L	L	L	R											
Landusky	1,500	1,500	1,500	1,500	475											6,475
											Alternative Total - Both Mines					7,025

Annual Hazardous Materials Trips - Alternative 2	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	R	R	R													
Zortman	275	275	275													825
Project Phase	L	L	L	L	R											
Landusky	1,500	1,500	1,500	1,500	475											6,475
											Alternative Total - Both Mines					7,300

Annual Hazardous Materials Trips - Alternative 3	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	R	R	R	R												
Zortman	275	275	275	275												1,100
Project Phase	L	L	L	L	R	R										
Landusky	1,500	1,500	1,500	1,500	475	475										6,950
											Alternative Total - Both Mines					8,050

Project Phases: C = Construction; M = Mining; L = Leaching; R = Reclamation

TABLE 4.11-3 - HAZARDOUS MATERIAL HAUL TRIPS: ALTERNATIVES 1-7 (Continued)

Annual Hazardous Materials Trips - Alternative 4

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	C	C	M	M	M	M	M	L	L	R	R	R				
Zortman	275	275	2,800	2,800	2,800	2,800	2,800	2,450	2,450	275	275	275				20,275
Project Phase - Landusk	M	L	L	L	L	R	R									
Landusky	1,700	1,500	1,500	1,500	1,500	475	475									8,650
Alternative Total - Both Mines																28,925

Annual Hazardous Materials Trips - Alternative 5

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	C	C	M	M	M	M	L	L	L	R	R	R				
Zortman	275	275	2,800	2,800	2,800	2,800	2,450	2,450	2,450	275	275	275				19,925
Project Phase	M	L	L	L	L	R	R									
Landusky	1,700	1,500	1,500	1,500	1,500	475	475									8,650
Alternative Total - Both Mines																28,575

Annual Hazardous Materials Trips - Alternative 6

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	C	C	M	M	M	M	M	L	L	R	R					
Zortman	275	275	2,800	2,800	2,800	2,800	2,800	2,450	2,450	275	275					20,000
Project Phase	M	L	L	L	L	R	R									
Landusky	1,700	1,500	1,500	1,500	1,500	475	475									8,650
Alternative Total - Both Mines																28,650

Project Phases: C = Construction; M = Mining; L = Leaching; R = Reclamation

TABLE 4.11-3 - HAZARDOUS MATERIAL HAUL TRIPS: ALTERNATIVES 1-7
(Concluded)

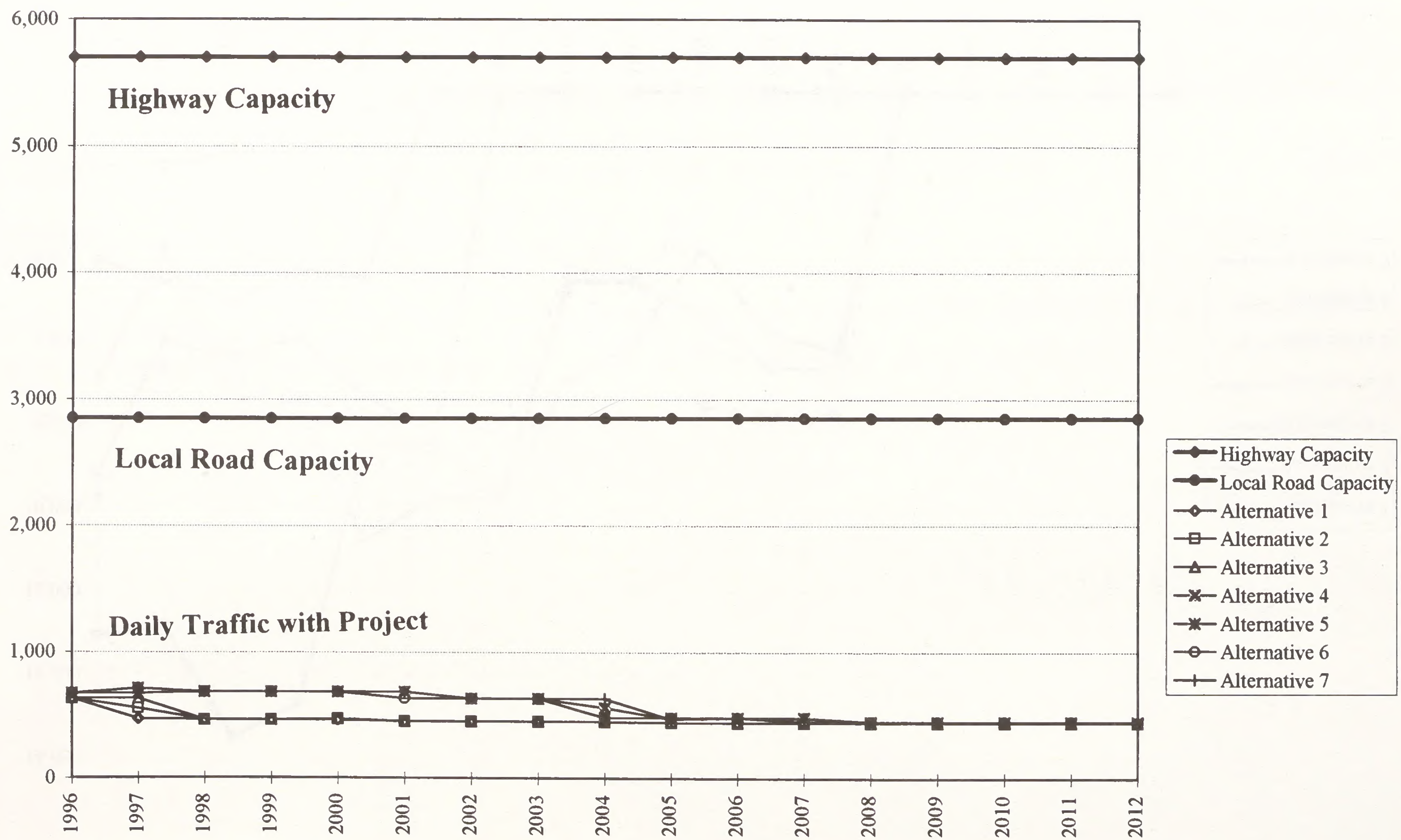
Annual Hazardous Materials Trips - Alternative 7	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Project Phase	C	C	M	M	M	M	M	L	L	R	R	R				
Zortman	275	275	2,800	2,800	2,800	2,800	2,800	2,450	2,450	275	275	275				20,275
Project Phase	M	L	L	L	L	R	R									
Landusky	1,700	1,500	1,500	1,500	1,500	475	475									8,650
Alternative Total - Both Mines																28,925

[1] Values given are roundtrips. Each roundtrip represents one loaded delivery to the mine and the empty return trip back to the point of origin.

Project Phases:
- C = Construction of new facilities related to extension
- M = Mining (includes concurrent leaching and reclamation activities)
- L = Leaching (includes concurrent reclamation activities)
- R = Reclamation (reclamation only)

Figure 4.11-1. Total Annual Truck Trips

Figure 4.11-2. Total Daily Traffic



accidents. This increased risk of accidents is considered to be a low negative impact on the communities, since truck traffic volumes would be very low.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels, resulting in a neutral impact over the long-term.

Public Access to the Little Rocky Mountains

With respect to public access to the southern Little Rocky Mountains, the No Action Alternative would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2000. After closure of the mines is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional five years under the No Action Alternative, with shipments tapering off after the mines go out of production, leaching of ore ceases, and reclamation is completed (around 2000). Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the maximum number of roundtrips per year (1,775) would be below the number utilized from 1979 to 1994 (4,200).

Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, the No Action Alternative would have a low negative impact on local residents. After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Thus, over the long-term, a neutral impact would be anticipated.

4.11.3.1 Cumulative Impacts

Impacts for both the Zortman and Landusky mines are described above for the life of the project under Alternative 1 and post-closure. Since there are no reasonably foreseeable developments associated with this alternative, no additional impacts have been identified for cumulative impacts discussion.

4.11.3.2 Unavoidable Adverse Impacts

Restriction of public access to the southern Little Rocky Mountains would be considered an unavoidable adverse impact. This impact could not be mitigated because, by their nature, mining operations are hazardous and incompatible with public activities, such as hiking or hunting. By necessity, public access must be restricted from mining areas. This impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around the year 2000).

4.11.3.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. Although a variety of impacts would be experienced under this alternative, they would be relatively short-term in nature as opposed to permanent. After final reclamation were completed, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.3.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project areas roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.11.4 Impacts From Alternative 2

Traffic

Under Alternative 2, reclamation efforts would require considerable hauling of clay to both mines. These additional reclamation activities would also increase commute roundtrips by mine workers to a small extent over the life of the alternative. Under projected employment conditions, this project scenario would result in roughly 95 commuter roundtrips per day in 1996 and would diminish as reclamation is completed (Table 4.11-1). The addition of 95 trips per day would represent an increase above baseline (pre-1979) conditions, but a decrease in traffic relative to the 1979 to 1994 mining period (which averaged 100 roundtrips per day).

At the Zortman Mine, reclamation would include clay capping of numerous facilities that would not be completed until approximately 1998. This clay capping would require a total of 4,800 truck trips (roundtrips) over the 3 year duration of the alternative (Table 4.11-2). Clay haul trips would be routed from the Seaford clay pit up Seven Mile Road through the community of Zortman and up the mine access road to the Zortman Mine. Clay hauling would be carried out by convoys of 9-15 Caterpillar 777 trucks hauling 50-85 tons of clay each. These convoys would be escorted by a lead car from the clay pit to the mine with convoy speeds reduced as they pass through town. It is estimated that 8-10 convoy roundtrips per day would be required over a period of up to 12 days from 1996 to 1998 under Alternative 2.

At the Landusky Mine, reclamation would feature more extensive clay capping than described under Alternative 1. This additional capping would require a total of 10,300 truck roundtrips over the 5 year duration of the alternative which would be completed around the end of 2000. These trips would extend from the Williams clay pit through the community of Landusky via Landusky Road. As described for the Zortman Mine, clay hauling would utilize Caterpillar 777 truck convoys escorted by a pilot car. For reclamation of the Landusky Mine, this transportation of clay would last up to 27 days during the peak year of reclamation (year 2000).

In addition, an estimated total of 7,300 truck trips would be required for hazardous materials (five roundtrips per day or up to 1,775 trips annually). These trips would primarily consist of reagents required for heap leaching at the Landusky Mine. After leaching is completed, these trips would decrease and would consist primarily of gasoline and diesel fuel for heavy equipment engaged in reclamation activities.

The combination of reclamation and hazardous material hauling would comprise up to 5,500 truck trips per year (up to 155 roundtrips daily), compared with an average of 4,200 truck trips per year from 1979 to 1994 (Figure 4.11-1). Despite this modest increase, traffic volumes under this alternative would still remain far below the capacity of the transportation system in the project area and would therefore have a low negative impact (Figure 4.11-2).

With respect to accidents, the addition of commuter and truck trips to the transportation system as a whole could result in 1.99 accidents per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be rated as a low negative impact.

Residents of the communities of Zortman and Landusky and their pets would be somewhat vulnerable to accidents during commute hours as mine workers arrive or leave during shift changes. Moreover, reclamation-related truck convoys passing through those communities would also create a risk of accidents. This increased risk of accidents associated with truck traffic (up to 155 roundtrips or 310 one-way trips through town per day) is considered to be a moderate negative impact on the local communities, due to the large size and lack of maneuverability of haul trucks, the presence of residences adjacent to the haul roads and the presence of children and other pedestrians. The use of a lead car and reduction of speed through the communities should reduce the risk of accidents to some extent.

With respect to creation of higher risk accident locations, the addition of truck traffic for hauling of clay from the Seaford clay pit to the Zortman Mine would likely increase the risk of accidents at two locations. For the Zortman clay haul trips, the Seaford clay pit road intersects U.S. Highway 191 directly across from Seven Mile Road. Therefore, clay haul trucks would have to cross U.S. Highway 191 to access Seven Mile Road. Potential safety hazards could arise if clay haul convoys do not stop and/or look for approaching traffic on U.S. Highway 191. Similarly, travelers on the highway may not be aware that truck traffic would cross the highway on a regular basis.

In addition, the junction of Seven Mile Road and Bear Gulch Road could also become more hazardous with the addition of clay haul convoys because traffic destined for the town of Zortman and/or the mine merges there.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels, resulting in a neutral impact over the long-term.

Public Access to the Little Rocky Mountains

As described previously, Alternative 2 would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2000. After closure of the mines is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional five years, with shipments tapering off as reclamation is completed (around 2000). Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the maximum number of roundtrips per year (1,775) would be below the number utilized from 1979 to 1994 (4,200). Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, Alternative 2 would have a low negative impact on local residents. After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Thus, over the long-term, a neutral impact would be anticipated.

4.11.4.1 Cumulative Impacts

Impacts for both the Zortman and Landusky mines are described above for the life of the project under Alternative 2 and post-closure. Since there are no reasonably foreseeable developments associated with this alternative, no additional impacts have been identified for cumulative impacts discussion.

4.11.4.2 Unavoidable Adverse Impacts

As described previously for Alternative 1, restriction of public access to the southern Little Rocky Mountains would be considered an unavoidable adverse impact. This impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around 2000).

4.11.4.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. After final reclamation were completed, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.4.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project area roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.11.5 Impacts From Alternative 3

Traffic

This alternative would feature the most intensive reclamation efforts of any of the non-expansion alternatives. Consequently, the number of truck trips that would be generated to haul the required volume of reclamation materials is considerably larger than under Alternatives 1 or 2. Internal mine hauling of NAG waste for reclamation purposes would also be required. Under projected employment conditions, this project scenario would result in roughly 95 commuter roundtrips per day in 1996 and would diminish as reclamation is completed (Table 4.11-1). The addition of 95 trips per day would represent an increase above baseline (pre-1979) conditions, but a decrease in traffic relative to the 1979 to 1994 mining period (which averaged 100 roundtrips per day).

At the Zortman Mine, reclamation would include water balance capping of numerous facilities that would not be completed until approximately 1999. This capping would require a total of 23,100 truck trips by reclamation material haul convoys through the town of Zortman over the 4 year duration of the alternative (up to 150 roundtrips per day for up to 52 days per year) (Table 4.11-2). These convoys would be escorted by a pilot car with convoy speeds reduced to 15 mph as they pass through town.

There would be no hauling of reclamation materials through the town of Landusky under this alternative.

In addition, an estimated total of 8,050 truck trips would be required for hauling hazardous materials (five trips per day or up to 1,775 trips annually). These trips would primarily consist of reagents required for heap leaching at the Landusky Mine. After leaching is completed, these trips would decrease and would consist primarily of gasoline and diesel fuel for heavy equipment engaged in reclamation activities.

The combination of reclamation trips and hazardous material trips would comprise up to 15,475 truck trips per year (up to 155 roundtrips daily), compared with an average of 4,200 trips per year from 1979 to 1994 (Figure 4.11-1). Despite this increase, traffic volumes under this alternative would still remain far below the capacity of the transportation system in the project area and would therefore have a low negative impact (Figure 4.11-2).

The hauling of reclamation materials would not impact the public transportation network, but could impact wildlife and other resources, such as air quality due to dust generation.

With respect to accidents, the addition of commuter and truck trips to the transportation system as a whole could result in 2.02 accident per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be rated as a low negative impact. However, the increased risk of accidents related to truck convoys (up to 155 roundtrips or 310 one-way trips through town per day) is considered to be a moderate negative impact on the local communities, due to the large size and lack of maneuverability of haul trucks, the presence of residences adjacent to the haul roads and the presence of children and other pedestrians. The use of a lead car and reduction of speed to 15 mph through the communities should reduce the risk of accidents.

As described previously, the potential for increased accidents could arise from additional truck traffic associated with hauling of clay at certain locations. These locations include the junction of U.S. Highway 191 and Seven Mile Road/Seaford clay pit access road, and the intersection of Seven Mile Road and Bear Gulch Road.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels, resulting in a neutral impact over the long-term.

Public Access to the Little Rocky Mountains

Alternative 3 would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2001. Thus, this alternative would extend this impact an additional year, relative to Alternatives 1 and 2. After closure of the mines is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional six years with shipments tapering off as reclamation is completed (around the end of 2001). Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the maximum number of roundtrips per year (1,775) would be below the number utilized from 1979 to 1994 (4,200). Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, Alternative 3 would have a low negative impact on local residents. After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Over the long-term, impact would be reduced to insignificant.

4.11.5.1 Cumulative Impacts

Impacts for both the Zortman and Landusky mines are described above for the life of the project under Alternative 3 and post-closure. Since there are no reasonably foreseeable developments associated with this alternative, no additional impacts have been identified for cumulative impacts discussion.

4.11.5.2 Unavoidable Adverse Impacts

As described previously for Alternatives 1 and 2, restriction of public access to the southern Little Rocky Mountains would be considered a significant, unavoidable adverse impact. This impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around the end of 2001).

4.11.5.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. After final reclamation were completed, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.5.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project areas roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.11.6 Impacts From Alternative 4

Traffic

Under Alternative 4, the Company Proposed Action, the productive lives of the Zortman and Landusky mines would be extended beyond what is currently permitted. This extended period of ore production and related heap leaching would be followed by a period of fairly extensive reclamation activity. As a result, the number of commuter trips, reclamation haul trips, and hazardous material haul trips would all be considerably greater than under Alternatives 1, 2, and 3, which do not extend mine life.

Under projected employment conditions, this project scenario would result in as many as 135 commuter roundtrips per day in 1997 and would diminish as mining, leaching, and reclamation are completed (Table 4.11-1). The addition of 135 trips per day would represent both an increase above baseline (pre-1979) and the 1979 to 1994 mining period (which averaged 100 roundtrips per day). After approximately 2001, however, the number of commuter trips would drop below 1979 - 1994 levels.

At the Zortman Mine, reclamation would also include clay capping of existing leach pads and waste rock dumps and facilities associated with the proposed extension, including the expanded mine pit area, the Carter Gulch waste rock repository, and the Goslin Flats leach pad. Although considerable reclamation work would be carried out concurrently with mining, a great deal would occur after mining and leaching were completed. Thus, final reclamation would not be completed until approximately the end of 2007. Unlike the alternatives that would deny mine extensions, Alternative 4 would require the hauling of clay to Goslin Flats for construction and reclamation of the Goslin Flats leach pad.

Clay capping would require a total of 11,200 truck trips (roundtrips) through the community of Zortman over the 12 year duration of the alternative (up to 150 roundtrips per day for up to 17 days per year) for reclamation of the Zortman Mine and Carter Gulch waste rock repository (Table 4.11-2). For construction and reclamation of the Goslin Flats leach pad, clay haul trips would not pass through the community of Zortman (11,800 roundtrips), but would require use of Seven Mile Road. Any limestone that would be used in reclamation of the leach pad would be transported from the source to the conveyor by truck and transported to the leach pad by conveyor. Truck convoys would be escorted by a lead car and trips passing through town would be conducted at reduced speeds.

At the Landusky Mine, reclamation capping would require a total of 13,000 clay haul truck trips over the 7 year duration of the alternative (up to 150 roundtrips per day for up to 27 days), which would be completed around the end of 2002. These trips would extend from the Williams clay pit through the community of Landusky and would feature a lead car and reduced speeds through town.

An estimated total of 28,925 truck trips would be required for hazardous material hauling, which is more than three times as many trips through Zortman and Landusky as would be required under Alternatives 1, 2, or 3. Additional mining (ammonium nitrate), and associated heap leaching (lime, cyanide, etc), as well as increased reclamation material hauling (diesel, lubricants, etc.) are all responsible for this substantial increase in use of these materials and necessary haul trips. At the Zortman Mine, roughly 20,000 trips would be required over the 12 year life of the project (up to 8 roundtrips per day or 2,800 roundtrips annually through Zortman). For the Landusky Mine, roughly 8,650 trips would be required over the 7 year life of the project (up to 5 roundtrips per day or 1,700 roundtrips annually through Landusky).

The combination of reclamation and hazardous material hauling would comprise up to 11,500 truck trips per year for both mines (up to 165 roundtrips daily), compared with an average of 4,200 trips per year from 1979 to 1994 (Figure 4.11-1). Despite this increase, traffic volumes under this alternative would still remain far below the capacity of the transportation system in the project area and would therefore have a low negative impact (Figure 4.11-2).

With the extensions of mine life, the additional mining and associated hauling of ore to leach pads and waste rock to repositories or reclamation activities would generate considerable internal mine truck traffic. Future mining at the Zortman Mine would require approximately 240,000 internal mine truck trips per year (680 roundtrips daily) for hauling of ore from the mine pit complex to the crusher/conveyor loading area over a five year time frame. Hauling of waste rock would require an estimated 180,000 truck trips per year (500 roundtrips daily) over the same five year period. All potentially acid-generating waste rock would be hauled from the pit complex to the Carter Gulch waste rock repository, while the non-acid generating (NAG) waste would be stockpiled or hauled for use in reclamation activities by truck or conveyor (Goslin Flats leach pad). In addition, approximately 14,800 truck trips (roundtrips) would be required for hauling limestone from the LS-1 quarry to the conveyor loading area for reclamation activities at the Goslin Flats leach pad. These truck trips would not pass through Zortman or affect public roads or highways.

At the Landusky Mine, the proposed mine life extension would last roughly one year and would feature the same volume of internal truck traffic over its duration as described in Alternative 1 (180,000 roundtrips per year or 500 per day for ore and 90,000 roundtrips per year or 250 per day for waste rock).

With respect to accidents, the addition of commuter and truck trips to the transportation system as a whole could result in 2.68 accidents per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be rated as a low negative impact.

Residents of the communities of Zortman and Landusky and their pets would be somewhat vulnerable to accidents during commute hours as mine workers arrive or leave during shift changes. Moreover, truck traffic through those communities would also create a risk of accidents due to clay haul convoys. This increased risk of accidents due to as many as 150 roundtrips or 300 one-way trips through town per day is considered to be a moderate negative impact on the communities, due to the large size and lack of maneuverability of haul trucks, the presence of residences adjacent to the haul roads and the presence of children and other pedestrians. The use of a lead car and reduction of speed through the communities should reduce the risk of accidents.

As described previously, the potential for increased accidents at certain locations could arise from additional truck traffic associated with hauling of clay. These locations include the junction of U.S. Highway 191 and Seven Mile Road/Seaford clay pit access road, and the intersection of Seven Mile Road and Bear Gulch Road.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels resulting in a neutral impact over the long-term.

<u>Public Access to the Little Rocky Mountains</u>

Due to continued closure of the mining area portions of the Little Rocky Mountains and associated access roads, Alternative 4 would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2007.

In addition, Alternative 4 would also include construction and use of an overland conveyor for transportation of ore from the Zortman Mine to the Goslin Flats heap leach pad. With few exceptions, access to the Little Rocky Mountains would generally be eliminated over the 11,000-foot length of the conveyor for pedestrians and vehicles approaching from the east, since the conveyor would have low clearance and would be fenced. Two important exceptions would be where the conveyor crosses Alder and Pony gulches. At these crossings, the conveyor would be constructed on bridge structures with sufficiently high clearance to allow passage of pedestrians and vehicles. Access across privately owned land to Goslin Gulch and Saddle Butte would no longer be available on the Goslin Gulch Road, since construction of the Goslin Flats Heap leach pad would physically block the road. Restriction of vehicle access to Goslin Gulch and pedestrian access to a much broader portion of the Little Rocky Mountains would be considered a low negative impact. This impact is rated as low because it would affect only a limited number of individuals who have historically had to obtain permission from the landowner/leaseholder to access Goslin Gulch from Goslin Flats. Since the terrain of the conveyor area is generally rugged and impassable for vehicles (except along existing roads), construction of the overland conveyor would not drastically limit vehicle access to the Little Rocky Mountains. As mentioned above, the roads that allow vehicle access to Pony and Alder gulches would not be affected by the conveyor. The only road that would be blocked off by the proposed conveyor would be Goslin Gulch Road.

Although the access impact associated specifically with the Goslin Flats leach pad and conveyor is rated as low, the combined impact of closure of the mining areas, their associated access roads, and the Goslin Flats/ Gulch area on public access, is high negative under this alternative.

After closure of the mines and reclamation is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional 12 years with shipments tapering off as reclamation is completed (around the end of 2007). Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the number of hazardous material haul trips would be roughly the same as experienced from 1979 to 1994. Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, Alternative 4 would have a low negative impact on local residents.

For the Zortman operation, it is important to note that the majority of hazardous materials trips would terminate at the Goslin Flats leach pad/treatment plant for use in heap leaching. Only a fraction of the trips (e.g., diesel, ammonium nitrate) would pass through Zortman on route to the Zortman Mine. The risk of accidents and spills is lower under this alternative relative to Alternative 5, which would feature extended heap leaching in Upper Alder Gulch, thereby requiring that all hazardous materials trips pass through town and terminate at the mine.

After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Thus, over the long-term, a neutral impact would be anticipated.

4.11.6.1 Cumulative Impacts

As reasonably foreseeable actions, additional mining in Pony Gulch in the Zortman area and at the Landusky Mine would result in additional impacts beyond those described for Alternative 4. To the extent mining is extended by these actions, traffic impacts similar to those described above would be extended as well. Commuters, hazardous material use and hauling, and reclamation material hauling would continue to add traffic to local and regional roads for the life of these actions. As described previously, this impact is low negative because local roads and regional highways would have adequate capacity to support this extended period of additional traffic, assuming traffic volumes are not substantially higher than described for Alternative 4. Reclamation activities at the Zortman Mine, the foreseeable Pony Gulch Mine, and the Landusky Mine that would require hauling by convoy through the local communities would result in a moderate negative impact on the community during the duration of hauling.

In addition, the reasonably foreseeable action at Pony Gulch would almost certainly require closure of Pony Gulch to the public for safety reasons. Closure of vehicle and pedestrian access to Pony Gulch would be considered a high negative impact, as recreational opportunities in and around Pony Gulch would be adversely affected for the life of the mine. The impacted is rated as high because Pony Gulch would be one of the few remaining access points for the southern Little Rocky Mountains under Alternative 4. Cumulatively, and with few exceptions, closure of the Pony Gulch access road would result in virtual elimination of vehicle access to the southern Little Rocky Mountains. Areas and roads closed to the public would remain closed until final reclamation is completed at some time in the future.

For the Zortman Mine, hazardous material hauling would be directed primarily to the Goslin Flats leach pad and processing plant for heap leaching activities. Additional mining at Landusky would require continued hauling of hazardous materials through the town of Landusky. As described previously, since the small risk of accidents and spills would remain along local and regional roads over the duration of this action, reasonably foreseeable mining at the Zortman and Landusky mines would have a low negative impact on local residents.

Exploration activities would also add commuter trips and may add a small number of hazardous materials trips (vehicle fuel for trucks, road grading, drill rigs, etc.). The addition of new exploration roads could have a positive impact on public access to the Little Rocky Mountains, however, assuming the roads are open to the public.

4.11.6.2 Unavoidable Adverse Impacts

As described previously, restriction of public access to the southern Little Rocky Mountains would be considered an unavoidable adverse impact. With the exception of new access restrictions near the conveyor and adjacent to Goslin Flats, this impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around the end of 2007).

4.11.6.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. After completion of final reclamation, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.6.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project areas roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.11.7 Impacts From Alternative 5

Traffic

Since this alternative also features extended mining activities, the number of commuter trips, reclamation haul trips, and hazardous material haul trips would all be considerably greater than under Alternatives 1, 2, and 3, which deny mine life extensions.

Under projected employment conditions, this project scenario would result in as many as 135 commuter roundtrips per day in 1997 and would diminish as mining, leaching, and reclamation are completed (Table 4.11-1). The addition of 135 trips per day would represent both an increase above baseline (pre-1979) and the 1979 to 1994 mining period (which averaged 100 roundtrips per day). After approximately 2001, however, the number of commuter trips would drop below 1979 - 1994 levels.

At the Zortman Mine, reclamation would also include capping of numerous facilities associated with the proposed extension, including the expanded mine pit area, the Carter Gulch waste rock repository, and the Upper Alder Gulch leach pad. Although considerable reclamation work would be carried out concurrently with mining, a great deal would occur after mining and leaching were completed. Thus, final reclamation would not be completed until approximately the end of 2007.

Transportation of clay to various facilities for construction and reclamation would require a total of roughly 22,600 truck trips (roundtrips) through the community of Zortman over the 12 year duration of the alternative (up to 150 roundtrips per day for up to 25 days) (Table 4.11-2). Since heap leaching would take place adjacent to the mine in Alder Gulch, instead of on Goslin Flats, all of the clay haul trips would have to pass through the town of Zortman. In addition, the more intensiveness of the reclamation effort required under this alternative also contributes to the substantial increase in clay haul trips through town required, relative to Alternative 4.

At the Landusky Mine, reclamation capping would require a total of 15,700 truck trips (roundtrips) over the 7 year duration of the alternative (up to 150 roundtrips per day for up to 27 days), which would be completed around the end of 2002. These trips would extend from the Williams clay pit through the community of Landusky. It is important to note that the clay volume and associated haul trips required through Landusky would be greater than described for Alternative 4 because of the use of a thicker clay cap on surfaces requiring Reclamation Cover C.

In addition, an estimated total of 28,575 truck trips would be required for hazardous material hauling. At the Zortman Mine, roughly 19,925 roundtrips would be required over the 12 year life of the project (up to 8 trips per day or 2,800 trips annually). For the Landusky Mine, roughly 8,650 roundtrips would be required over the 7 year life of the project (up to 5 roundtrips per day or 1,700 trips annually).

The combination of reclamation and hazardous material haul trips would comprise up to 9,100 truck trips through local communities per year, compared with an average of 4,200 trips per year from 1979 to 1994 (Figure 4.11-1). Despite this increase, traffic volumes under this alternative would still remain far below the capacity of the transportation system in the project area and would therefore have a low negative impact (Figure 4.11-2).

Internal mine truck traffic associated with ore and waste rock hauling would be the same as described for Alternative 4 in terms of the number of trips, although ore would be hauled to the Upper Alder Gulch leach pad instead of the conveyor loading area.

With respect to accidents, the addition of commuter and truck trips to the transportation system as a whole could result in 2.86 accidents per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be rated as a low negative impact.

Residents of the communities of Zortman and Landusky and their pets would be somewhat vulnerable to accidents during commute hours as mine workers arrive or leave during shift changes. Moreover, truck convoys passing through those local communities would also create a risk of accidents. This increased risk of accidents due to as many as 150 roundtrips or 300 one-way trips through town per day is considered to be a moderate negative impact on the communities, due to the large size and lack of maneuverability of haul trucks, the presence of residences adjacent to the haul roads and the presence of children and other pedestrians. The use of a lead car and reduction of speed to 15 mph through the communities should reduce the risk of accidents.

As described previously, the potential for increased accidents at certain locations could arise from additional truck traffic associated with hauling of clay. These locations include the junction of U.S. Highway 191 and Seven Mile Road/Seaford clay pit access road, and the intersection of Seven Mile Road and Bear Gulch Road.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels, resulting in a neutral impact over the long-term.

Public Access to the Little Rocky Mountains

Alternative 5 would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2007. An ore conveyor to Goslin Flats would not be utilized under this alternative. Thus, access-related impacts would remain confined to the same area that has historically (1979 - 1994) been impacted and would not expand. Use of the Upper Alder Gulch leach pad site would not increase the area of public closure, since Alder Gulch Road is already closed to the public roughly ¼ mile above its junction with Pony Gulch road.

After closure of the mines is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional 12 years, with shipments tapering off as reclamation is completed (around the end of 2007). It is important to note that all hazardous material haul trips for the Zortman Mine would pass through the town of Zortman, compared with Alternatives 4, 6, and 7 where the majority of these trips would terminate at the Goslin Flats leach pad and not pass through town. Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the number of hazardous material haul trips would be roughly the same as experienced from 1979 to 1994. Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, Alternative 5 would have a low negative impact on local residents.

After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Over the long-term, impact would be reduced to insignificant.

4.11.7.1 Cumulative Impacts

Based on reasonably foreseeable actions described for this alternative, cumulative impacts would be similar to those described for Alternative 4. However, impacts associated with mining in Pony Gulch, use of a conveyor, and heap leaching on Goslin Flats would not occur.

4.11.7.2 Unavoidable Adverse Impacts

As described previously, restriction of public access to the southern Little Rocky Mountains would be considered an unavoidable adverse impact. This impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around the end of 2007).

4.11.7.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. After final reclamation were completed, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.7.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project areas roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.11.8 Impacts From Alternative 6

Alternative 6 would require realignment of a portion of Seven Mile Road due to construction of the Ruby Flats waste rock repository on the present road alignment.

Re-routing of Seven Mile Road would require a 90 degree turn to the east at the south end of the repository. The road would then follow the southern and eastern edges of the repository and intersect with Bear Gulch Road near the Zortman airstrip (Figure 2.11-2). This modification is not expected to impact road capacity, traffic flow or safety, assuming new curves in the road are properly signed to alert drivers as they approach.

Traffic

As described for Alternatives 4 and 5, this alternative also features extended mining activities, and related increases in the number of commuter trips, reclamation haul trips, and hazardous material haul trips. Under projected employment conditions, this project scenario would result in as many as 135 commuter roundtrips per day in 1997 and would diminish as mining, leaching, and reclamation are completed (Table 4.11-1). The addition of 135 trips per day would represent both an increase above baseline (pre-1979) and the 1979 to 1994 mining period (which averaged 100 roundtrips per day). After approximately 2000, however, the number of commuter trips would drop below 1979 - 1994 levels.

At the Zortman Mine, reclamation would also include capping of numerous facilities associated with the proposed extension, including the expanded mine pit area, the Ruby Flats waste rock repository, and the Goslin Flats leach pad. Although considerable reclamation work would be carried out concurrently with mining, a great deal would occur after mining and leaching were completed. Thus, final reclamation would not be completed until approximately the end of 2006. Unlike the alternatives that would deny mine extensions or Alternative 5, Alternative 6 would require the hauling of clay to Goslin Flats for construction and reclamation of the Goslin Flats leach pad and Ruby Flats waste rock repository.

Reclamation capping with clay would require a total of 8,500 truck trips in convoys through the community of Zortman over the 11 year duration of the alternative (up to 150 roundtrips per day for up to 14 days) (Table 4.11-2) for reclamation of the Zortman Mine. For reclamation of the Goslin Flats leach pad and Ruby Flats waste rock repository, clay haul trips would not pass through the community of Zortman, but would require use of Seven Mile Road (11,850 roundtrips).

At the Landusky Mine, additional capping would require a total of 15,700 truck trips over the 11 year duration of the alternative (up to 150 roundtrips per day for up to 27 days), which would be completed around the end of 2002. These trips would extend from the Williams clay pit through the community of Landusky.

In addition, an estimated total of 28,650 truck trips would be required for hazardous material hauling. At the Zortman Mine, nearly 20,000 roundtrips would be required over the 11 year life of the project (up to 8 roundtrips per day or 2,800 trips annually). For the Landusky Mine, roughly 8,650 roundtrips would be required over the 7 year life of the project (up to 5 roundtrips per day or 1,700 trips annually).

The combination of reclamation and hazardous material haul trips would comprise up to 12,100 truck trips per year (up to 165 roundtrips daily), compared with an average of 4,200 trips per year from 1979 to 1994 (Figure 4.11-1). Despite this increase, traffic volumes under this alternative would still remain far below the capacity of the transportation system in the project area and would therefore have a low negative impact (Figure 4.11-2).

Internal mine truck traffic associated with ore and waste rock hauling would be the same as described for Alternative 4 in terms of the number of trips, although waste rock would be hauled to the conveyor loading area instead of the Carter Gulch waste rock repository.

With respect to accidents, the addition of commuter and truck trips to the transportation system as a whole could result in 2.60 accidents per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be rated as a low negative impact.

Residents of the communities of Zortman and Landusky and their pets would be somewhat vulnerable to accidents during commute hours as mine workers arrive or leave during shift changes. Moreover, truck convoys passing through those communities would also create a risk of accidents. This increased risk of accidents due to as many as 150 roundtrips or 300 one-way trips through town per day is considered to be a moderate negative impact on the communities, due to the large size and lack of maneuverability of haul trucks, the presence of residences adjacent to the haul roads and the presence of children and other pedestrians. The use of a lead car and reduction of speed to 15 mph through the communities should reduce the risk of accidents.

As described previously, the potential for increased accidents at certain locations could arise from additional truck traffic associated with hauling of clay. These locations include the junction of U.S. Highway 191 and

Seven Mile Road/Seaford clay pit access road, and the intersection of Seven Mile Road and Bear Gulch Road.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels, resulting in a neutral impact over the long-term.

Public Access to the Little Rocky Mountains

Due to continued closure of the mining area portions of the Little Rocky Mountains and associated access roads, Alternative 6 would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2006.

Alternative 6 would also include construction and use of an overland conveyor for transportation of ore, limestone, and NAG waste from the Zortman Mine to the Goslin Flats Heap leach pad and Ruby Flats waste rock repository. Impacts to access associated with the conveyor would be the same as those described for Alternative 4. With the addition of impacts to the Goslin Flats and conveyor areas, Alternative 6 (as well as Alternatives 4 and 7) represents the worst-case project scenario from an access impact standpoint because Alternatives 1 - 3 and 5 would not feature facilities on Goslin Flats and would not create any additional access impacts in that portion of the Little Rocky Mountains.

After closure of the mines and reclamation is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional 11 years, with shipments tapering off as reclamation is completed (around the end of 2006). Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the number of hazardous material haul trips would be roughly the same as experienced from 1979 to 1994. Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, Alternative 6 would have a low negative impact on local residents.

For the Zortman operation, it is important to note that the majority of hazardous materials trips would terminate at the Goslin Flats leach pad/treatment plant for use in heap leaching. Only a fraction of the trips (e.g., diesel, ammonium nitrate) would pass through Zortman en route to the Zortman Mine. Therefore, the risk of accidents and spills is lower under this alternative, relative to Alternative 5, which would feature extended heap leaching in Upper Alder Gulch.

After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Thus, over the long-term, a neutral impact would be anticipated.

4.11.8.1 Cumulative Impacts

Cumulative impacts would be the same as those described for Alternative 4.

4.11.8.2 Unavoidable Adverse Impacts

As described previously, restriction of public access to the southern Little Rocky Mountains would be considered an unavoidable adverse impact. With the exception of new access restrictions near the conveyor and adjacent to Goslin Flats, this impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around the end of 2006).

4.11.8.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. After final reclamation were completed, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.8.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project areas roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.11.9 Impacts From Alternative 7

Alternative 7 would be similar to Alternatives 4 and 6 because it would also feature a leach pad on Goslin Flats. Alternative 7 has two unique features that influence the number and type of truck trips: disposal of waste rock on the pit complex and more extensive use of soil as a reclamation cover.

Traffic

As described for Alternatives 4, 5, and 6, this alternative also features extended mining activities, and related increases in the number of commuter trips, reclamation haul trips, and hazardous material haul trips. Under projected employment conditions, this project scenario would result in as many as 135 commuter roundtrips per day in 1997 and would diminish as mining, leaching, and reclamation are completed (Table 4.11-1). The addition of 135 trips per day would represent both an increase above baseline (pre-1979) and the 1979 to 1994 mining period (which averaged 100 roundtrips per day). After approximately 2001, however, the number of commuter trips would drop below 1979 - 1994 levels.

At the Zortman Mine, reclamation would also include water balance capping of numerous facilities associated with the proposed extension, including the expanded mine pit area, the waste rock repository, and the Goslin Flats leach pad. Although considerable reclamation work would be carried out concurrently with mining, a great deal would occur after mining and leaching were completed. Thus, final reclamation would not be completed until approximately the end of 2007.

Reclamation capping would require a total of 20,800 convoyed truck trips (roundtrips) hauling soil through the community of Zortman over the 12 year duration of the alternative (up to 120 roundtrips per day for up to 42 days) (Table 4.11-2) for reclamation of the Zortman Mine pit complex and waste rock repository. For reclamation of the Goslin Flats leach pad, all materials required would be available at Goslin Flats.

At the Landusky Mine, additional capping would not require clay. In general, reclamation materials required (NAG, soil, limestone) would be obtained at the mine or from the adjacent Montana Gulch limestone quarry. Therefore, no truck trips through Landusky would be required for reclamation purposes. In addition, roughly 9,000 truck trips may be required for hauling subsoil from Goslin Flats to the Landusky Mine due to a lack of suitable material at the Landusky Mine. These 9,000 trips would pass through the town of Zortman.

In addition, an estimated total of 28,925 truck trips would be required for hazardous material hauling. At the Zortman Mine, nearly 20,275 trips would be required over the 12 year life of the project (up to 8 roundtrips per day or 2,800 trips annually). For the Landusky Mine, roughly 8,650 trips would be required over the 7 year life of the project (up to 5 roundtrips per day or 1,700 trips annually).

The combination of reclamation and hazardous material haul trips would comprise up to 10,800 truck trips per year (up to 125 daily), compared with an average of 4,200 trips per year from 1979 to 1994 (Figure 4.11-1). Despite this increase, traffic volumes under this alternative would still remain far below the capacity of the transportation system in the project area and would therefore have a low negative impact (Figure 4.11-2).

Internal mine truck traffic associated with ore and waste rock hauling would be the same as directed for Alternative 4 in terms of magnitude, although waste rock would be hauled to different areas in the mine complex for disposal instead of the Carter Gulch waste rock repository.

With respect to accidents, the addition of commuter and truck trips to the transportation system could result in 2.52 accidents per year, based on the 1980 - 1989 accident rates for the project area highways during the peak period of the project. This would be rated as a low negative impact.

Residents of the communities of Zortman and Landusky and their pets would be somewhat vulnerable to accidents during commute hours as mine workers arrive or leave during shift changes. Moreover, reclamation truck convoys passing through the town of Zortman would also create a risk of accidents. This increased risk of accidents due to as many as 120 roundtrips or 240 one-way trips through town per day is considered to be a moderate negative impact on the community, due to the large size and lack of maneuverability of haul trucks, the presence of residences adjacent to the haul roads, and the presence of children and other pedestrians. The use of a lead car and reduction of speed to 15 mph through town should reduce the risk of accidents.

After closure of the Zortman and Landusky mines is completed, traffic volumes would diminish to approximately baseline or historic levels, resulting in an insignificant impact over the long-term.

Public Access to the Little Rocky Mountains

Due to continued closure of the mining area portions of the Little Rocky Mountains and associated access roads, Alternative 7 would result in a continuation of the high negative impacts experienced from 1979 to 1994 over the short-term. Areas and roads closed to the public would remain closed until final reclamation is completed around the end of 2007.

In addition, Alternative 7 would also include construction and use of an overland conveyor for transportation of ore from the Zortman Mine to the Goslin Flats heap leach pad. Impacts to access associated with the conveyor would be the same as those described for Alternatives 4 and 6. With the addition of impacts to the Goslin Flats and conveyor areas, Alternative 7 (as well as Alternatives 4 and 6) represents the worst-case project scenario from an access impact standpoint because Alternatives 1 - 3 and 5 would not feature facilities on Goslin Flats and would not create any additional access impacts in that portion of the Little Rocky Mountains.

After closure of the mines and reclamation is completed, public access would be restored to many areas, and baseline conditions would once again be experienced with respect to transportation. Access to privately-owned lands in the Little Rocky Mountains would require permission of the landowner, however.

Transportation of Hazardous Materials

Transportation of hazardous materials would continue for an additional 12 years, with shipments tapering off as reclamation is completed (around the end of 2007). Historically, there have been no documented accidents involving trucks transporting hazardous materials to the Zortman and Landusky mines. Under this alternative, the number of hazardous material haul trips would be roughly the same as experienced from 1979 to 1994. Since the small risk of accidents and spills would remain along local and regional roads over the duration of this alternative, Alternative 7 would have a low negative impact on local residents.

For the Zortman operation, it is important to note that the majority of hazardous materials trips would terminate at the Goslin Flats leach pad/treatment plant for use in heap leaching. Only a fraction of the trips (e.g., diesel, ammonium nitrate) would pass through Zortman en route to the Zortman Mine. Therefore, the risk of accidents and spills is lower under this alternative, relative to Alternative 5, which would feature extended heap leaching in Upper Alder Gulch, thereby requiring that all hazardous materials trips pass through town and terminate at the mine.

After closure of the mines is completed, hazardous material haul trips would drop back to extremely low baseline levels. Over the long-term, impact would be reduced to insignificant.

4.11.9.1 Cumulative Impacts

As reasonably foreseeable actions, additional mining in Pony Gulch in the Zortman area and at the Landusky Mine would result in additional impacts beyond those described for Alternative 7. To the extent mining is extended by these actions, traffic impacts similar to those described above would be extended as well. Commuters, hazardous material use and hauling, and reclamation material hauling would continue to add traffic to local and regional roads for the life of these actions. As described previously, this impact is low negative because local roads and regional highways would have adequate capacity to support this extended period of additional traffic, assuming traffic volumes are not substantially higher than described for Alternative 7. Reclamation activities at the Zortman Mine, the foreseeable Pony Gulch Mine, and the Landusky Mine that would require hauling by convoy through the local communities would result in a moderate negative impact on the community during the duration of hauling.

In addition, the reasonably foreseeable action at Pony Gulch would almost certainly require closure of Pony Gulch to the public for safety reasons. Closure of vehicle and pedestrian access to Pony Gulch would be considered a high negative impact, as recreational opportunities in and around Pony Gulch would be adversely affected for the life of the mine. The impacted is rated as high because Pony Gulch would be one of the few remaining access points for the southern Little Rocky Mountains under Alternative 7. Cumulatively, and with few exceptions, closure of the Pony Gulch access road would result in virtual elimination of vehicle access to the southern Little Rocky Mountains. Areas and roads closed to the public would remain closed until final reclamation is completed at some time in the future.

For the Zortman Mine, hazardous material hauling would be directed primarily to the Goslin Flats leach pad and processing plant for heap leaching activities. Additional mining at Landusky would require continued hauling of hazardous materials through the town of Landusky. As described previously, since the small risk of accidents and spills would remain along local and regional roads over the duration of this action, reasonably foreseeable mining at the Zortman and Landusky mines would have a low negative impact on local residents.

Exploration activities would also add commuter trips and may add a small number of hazardous materials trips (vehicle fuel for trucks, road grading, drill rigs, etc.). The addition of new exploration roads could have a positive impact on public access to the Little Rocky Mountains, however, assuming the roads are open to the public.

4.11.9.2 Unavoidable Adverse Impacts

As described previously, restriction of public access to the southern Little Rocky Mountains would be considered an unavoidable adverse impact. With the exception of new access restrictions near the conveyor and adjacent to Goslin Flats, this impact would essentially be a continuation of an existing impact, dating back to 1979, until reclamation would be completed (around the end of 2007).

4.11.9.3 Short-term Use/Long-term Productivity

Short-term use of the project area for mining would not compromise the long-term productivity of the transportation network. After final reclamation were completed, the impacts would cease to occur and the study area would likely return to baseline conditions with respect to transportation.

4.11.9.4 Irreversible or Irretrievable Resource Commitments

With respect to transportation, this alternative would result in no irreversible or irretrievable resource commitments. Project areas roads and highways would continue to exist and be accessible as they were under baseline conditions prior to 1979.

4.12 CULTURAL RESOURCES

4.12.1 Methodology

Prehistoric and Historic Cultural Resources

Regulations at 36 CFR 800 are used as guidance for assessing effects to historic properties. Historic properties are those archaeological, historic, and ethnographic sites that are listed on or have been determined to be eligible for listing on the National Register of Historic Places (36 CFR 60.4). The BLM and SHPO consult to determine site eligibility; the Keeper of the National Register is consulted if there is disagreement.

Properties are impacted if the criteria that caused them to be determined eligible are affected. To be determined eligible, all sites must demonstrate integrity of their significant features. This includes integrity of location, setting, and feeling - if those features contribute to the site's significance.

For archaeological and historic sites that are determined eligible under criterion (d) of 36 CFR 60.4, impacts would include the loss of information (scientific data) that could add to our knowledge of Native American and Euro-American history. Impacts to historic sites or districts eligible under criterion (a) may include a change in the setting or a loss of feeling or association with the historic event. For traditional cultural properties, the loss of setting and feeling that were important aspects of the sites' significance may be as important as the physical impact.

Impacts to cultural properties can be direct or secondary. Direct impacts include destruction of the property or destruction of the features that contribute to the property's significance. Secondary impacts may include increased access to an area, increased site vandalism, and/or restricted access. Mitigation of impacts is discussed in the Programmatic Agreement (Appendix E).

Measures to mitigate effects on historic properties (National Register eligible) for all alternatives have been developed in a Programmatic Agreement (PA) executed by the BLM, Montana State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (Advisory Council) (see Appendix E). Other interested parties such as the Bureau of Indian Affairs, Zortman Mining, Inc., and the Fort Belknap Community Council were invited to participate in the preparation of the PA. A series of public meetings were held to solicit public input. The PA was prepared in accordance with the requirements of 36 CFR 800 (see also Section 3.12.1).

The PA provides for the preparation of treatment plans in the event that Alternative 4, 5, 6, or 7 is selected. The treatment plans would be designed to eliminate or reduce impacts to prehistoric, historic, and Native American cultural resources as a result of mining activities. The treatment plans would be developed according to the implementing guidelines (36 CFR 800) of Section 106 of the National Historic Preservation Act and would be consistent with the Secretary of the Interior's Standards and Guidelines (48 FR 44716-44742), the Advisory Council on Historic Preservations's Handbook, Treatment of Archaeological Properties, A Handbook, National Register Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties, and any other applicable guidelines and regulations. The treatment plan for the Little Rocky Mountains TCP District would consist of provisions to provide for the preservation through recordation and study of the historic/traditional associations of the Little Rocky Mountains.

Signatories to the PA include the Advisory Council on Historic Preservation, Bureau of Land Management, Montana State Historic Preservation Officer (consulting parties), and Zortman Mining, Inc. (concurring party). The Fort Belknap Community Council was consulted, but declined to sign as an additional concurring party. Execution and implementation of the PA evidence that BLM has afforded the Advisory Council the opportunity to comment on the proposed reclamation plan modifications and mine expansions and its effects on historic properties, and that the BLM has taken into account the effects of the undertaking on historic properties.

Native American Cultural Resources

Project impacts were assigned based on the potential for physical, visual, and aural (noise or sound) impacts to Native American cultural resources which represent contemporary or heritage significance. Heritage significance is a measure of the relative importance of a site or area to Native Americans, as measured by the level of concern expressed for particular cultural resources or classes of cultural resources.

No systematic data were collected to specifically address the level of contemporary or heritage significance of the inventoried sites or areas to Native Americans. On the other hand, Deaver and Kooistra (1992) interviewed numerous Native Americans about their concerns for particular resources. Additionally, comments from

Native Americans were received at the series of public meetings that have been held regarding this project. Most notably, the fact that most of the inventoried sites are of a spiritual or religious nature clearly indicates that all of these sites or areas should be assigned a high level of heritage significance. This measure is, therefore, a constant for the present analysis.

Physical impacts are those which would alter or otherwise affect the physical integrity of a site or area possessing heritage significance to Native Americans; visual impacts are those which would affect the view from or modify the visual integrity of a site or area possessing heritage significance to Native Americans; aural impacts are those which would affect the aural integrity of a site or area possessing heritage significance to Native Americans.

Impacts are commonly of a negative nature in that they produce a negative effect on the resource. However, an impact can also be positive, producing an effect which is beneficial to the resource. Reclamation efforts which improve the resource or the resource setting, for example, may have long-term positive effects.

Physical impacts involve actual ground or structure disturbance. Impact levels for physical impacts were determined by the distance between Native American sites or resources and existing or new mining activities as actual or high (0.0-0.2 miles), none or neutral (0.2+ miles), and in the special situations described below, as unknown. High impacts were measured at 0.0-0.2 miles because sites boundaries of a resource of this type are not always known. Furthermore, mapping was done from USGS quad maps; no field inspections were conducted to verify individual boundaries.

In several instances, the actual location and extent of the resources identified in the Little Rocky Mountains study area are unknown. For example, literature sources and Native Americans have reported burial practices in the Little Rocky Mountains (Little Rocky Mountains Burials in Table 4.12.1) but actual burial locations have not been identified. And while Coming Day's Route probably passed through or near the mining areas, the actual location of any cultural sites or other resources associated with this historic event have not been identified. Impacts to these activities are, therefore, assigned as unknown (unidentified). On the other hand, impacts are assigned to Little Rocky Mountains resource procurement activities since it can be safely assumed that many of the resources associated with this activity existed throughout the Little Rocky Mountains, including the Zortman and Landusky mining areas.

Visual impacts were measured from the highest elevation of a place used for vision questing (see discussion in Section 3.12) to the closest visible mining activity at the Zortman and Landusky mines. The viewshed was based primarily upon the visual analysis and simulations conducted for the Visual Resources Studies (Section 4.8). Other sources consulted for this determination included discussions with professionals who had visited the study area, and a non-computerized analysis of study area using USGS 7.5' topographic quadrangles and aerial photographs. Visual impact levels were determined by the distance between the ethnographic site and mining activities as high (0.0-3.0 miles), medium (3.0-6.0 miles), low (6.0-9.0 miles), no or neutral (9+ miles or not visible), or unknown impact. These levels were determined in consultation with the visual resources specialists.

Aural impacts (noise) emanating from sources such as blasting, use of machinery, and vehicular traffic, were also determined by distance between the ethnographic site and mining activities as high (0.0-2.0 miles), medium (2.0-4.0 miles), low (4.0-6.0 miles), no or neutral (6.0+ miles or not audible), or unknown impact. These levels were determined in consultation with the noise specialists.

Duration, or the anticipated length of time the impact would occur, and incidence, or the frequency of impact occurrence, are also significant factors in assessing impacts to Native American cultural resources. Duration and incidence of impact are discussed in evaluating project effects for each of the alternatives.

Considering the data limitations described in Section 3.12.3.2, the impact assessment is based upon a preliminary and incomplete sample of the sites and associated Native American values present in the Little Rocky Mountains TCP Historic District, and employs both quantitative and qualitative data. The analysis should not be considered as exhaustive. Even considering these limitations, however, the analysis should be considered adequate for the purposes of an assessment of impacts to Native American cultural resources associated with the various alternatives within the Area of Potential Effect.

By way of summary, the model used to assign impact levels to Native American resources is shown below.

IMPACT MODEL

Impact Type	Impact Level			
	High	Medium	Low	Neutral
Physical (P)	0.0-0.2 miles	NA	NA	0.2+ miles
Visual (V)	0.0-3.0 miles	3.0-6.0 miles	6.0-9.0 miles	9.0+ miles
Aural (A)	0.0-2.0 miles	2.0-4.0 miles	4.0-6.0 miles	6.0+ miles

4.12.2 Impacts from Mining-1979 to Present

Prehistoric and Historic Cultural Resources

Eight recorded historic sites have been directly impacted by mining operations since 1979. The following sites had been determined not eligible for the National Register of Historic Places: 24PH254, 24PH256, 24PH257, 24PH2184, 24PH2296, and 24PH2297. Eligibility had not been determined for site 24PH2774. The Ruby Mill and townsite (24PH255) was recorded in 1978 and determined to be not eligible at the time. Much of the townsite has since been destroyed; however, the mill remains standing and has since been determined eligible for the National Register. There may have been secondary impacts to the Ruby Mill (vandalism, blasting effects), but these are not documented. Additionally, since standards for consideration of historic sites for National Register eligibility have changed somewhat since 1979, some of the sites that were not afforded protection may have been considered eligible by 1994 standards. These sites include the Gold Bug Mine (24PH254), the August Mine (24PH256), the Little Ben Mine (24PH257) and all or parts of the Ruby townsite. Other mining-related sites such as portals, shafts, cabin foundations, "glory holes", adits, trash dumps, and other structures were recorded as isolated finds in 1978 (Hogan and Fredlund 1978). These too have been impacted or destroyed by mining activity since 1979. By 1994 standards, these resources would be recorded as sites and their National Register eligibility assessed. Additionally, mining activity since the 19th century has probably impacted unrecorded prehistoric sites.

Native American Cultural Resources

Existing impacts are displayed in Table 4.12-1. The purpose is to show existing impacts to the sample of 41 Native American sites identified from literature and other sources for the period of surface mining, from 1979 to 1995. These sites are all within the working boundaries of the TCP Historic District. Impacts from previous periods of mining within the Zortman and Landusky Project areas were existent prior to 1979 and carry over into the present period. Table 4.12-1 shows that the existing impacts for physical, visual, and aural impacts associated with the Zortman Mine site are all high, yielding an overall impact assessment of high. Similarly, the existing impacts for physical, visual, and aural impacts associated with the Landusky Mine site are all high, yielding an overall impact assessment of high. It follows that the combined existing impacts of both mining operations to Native American cultural resources are also high.

The impacts shown in Table 4.12-1 are all assumed to be negative and represent the existing condition, or threshold, for the assessment of each of the proposed alternatives which follows. It is important to note, however, that this threshold represents only a sample of the Native American cultural resources in the Little Rocky Mountains. Other considerations, such as the effects of the alternative mining plans on the larger TCP District and associated Native American values, are also factored into the assessment, albeit in a less quantitative manner.

In assessing the various alternatives, the effects of existing impacts must be taken into account. As noted in Section 3.12.3.6, prior to 1979, significant physical disturbance had occurred in Montana Gulch, Beaver Creek, and Pony Gulch. Mill tailing had been deposited in King Creek, Alder Gulch, and Ruby Gulch. Since 1979, there has been additional disturbance to these areas and extensive new physical disturbance associated with Antoine Butte and Shell Butte (Zortman), and Gold Bug Butte and Mission Peak (Landusky). As shown in Table 4.12-1, existing visual and aural impacts are also significant, ranging from neutral to high, depending upon visibility and distance from mining activities.

Impacts to Native American cultural resources include impacts to the National Register eligible TCP Historic District, individual cultural properties identified within the District, and the associated traditional Native American values. As long as the mines continue to operate, these impacts remain a significant and serious issue for Native American traditionalists. This conclusion follows from the literature review (see Section 3.12.3); comments from Native Americans presented at the many public meetings; and the sworn testimony of Virgil McConnell before the State of Montana (1990). Additionally, this conclusion is supported by PA consultation meetings and public

TABLE 4.12-1
NATIVE AMERICAN CULTURAL RESOURCES: EXISTING IMPACTS

			Visibility		Distance		Zortman			Landusky		
No.	Site Type (Primary)	Site Activity (Primary)	Zortman	Landusky	Zortman	Landusky	P	V	A	P	V	A
01.	Religion & Ritual	Vision Questing	yes	no	2.0	4.0	N	H	H	N	N	M
02.	Religion & Ritual	Vision Questing	no	yes	2.2	0.0	N	N	M	H	H	H
03.	Religion & Ritual	Vision Questing	yes	no	1.0	3.1	N	H	H	N	N	M
04.	Religion & Ritual	Fasting	yes	yes	2.7	1.7	N	H	M	N	H	H
05.	Religion & Ritual	Fasting	no	no	1.5	3.5	N	N	H	N	N	M
06.	Religion & Ritual	Vision Questing	yes	yes	2.2	3.1	N	H	M	N	M	M
07.	Religion & Ritual	Vision Questing	yes	yes	0.4	1.0	N	H	H	N	H	H
08.	Religion & Ritual	Vision Questing	yes	no	0.2	2.2	H	H	H	N	N	M
09.	Religion & Ritual	Vision Questing	yes	no	5.8	7.8	N	M	L	N	N	N
10.	Religion & Ritual	Vision Questing	no	yes	2.8	0.2	N	N	M	H	H	H
11.	Religion & Ritual	Vision Questing	no	yes	5.5	2.8	N	N	L	N	H	M
12.	Religion & Ritual	Fasting	no	yes	4.0	0.7	N	N	M	N	H	H
13.	Religion & Ritual	Vision Questing	yes	yes	4.4	2.7	N	M	L	N	H	M
14.	Religion & Ritual	Vision Questing	yes	no	3.4	5.7	N	M	M	N	N	L
15.	Religion & Ritual	Vision Questing	no	no	7.2	4.4	N	N	N	N	N	L
16.	Religion & Ritual	Vision Questing	no	no	4.0	6.0	N	N	M	N	N	L
17.	Religion & Ritual	Vision Questing	no	yes	7.4	4.0	N	N	N	N	M	M
18.	Religion & Ritual	Vision Questing	yes	no	7.8	9.6	N	L	N	N	N	N
19.	Religion & Ritual	Fasting	no	no	6.4	7.2	N	N	N	N	N	N
20.	Religion & Ritual	Vision Questing	no	yes	6.6	8.4	N	N	N	N	L	N
21.	Religion & Ritual	Offering Area	no	no	3.7	1.4	N	N	M	N	N	H
22.	Religion & Ritual	Fasting	no	yes	2.6	0.6	N	N	M	N	H	H
23.	Religion & Ritual	Vision Questing	yes	yes	3.4	3.3	N	M	M	N	M	M
24.	Religion & Ritual	Vision Questing	yes	no	3.9	3.8	N	M	M	N	N	M
25.	Religion & Ritual	Vision Questing	yes	no	1.2	3.0	N	H	H	N	N	M
26.	Rock Art	Prehistoric Site	no	no	2.3	2.6	N	N	M	N	N	M
27.	Rock Art	Prehistoric Site	no	no	2.4	2.3	N	N	M	N	N	M

TABLE 4.12-1 - NATIVE AMERICAN CULTURAL RESOURCES: EXISTING IMPACTS (Concluded)

No.	Site Type (Primary)	Site Activity (Primary)	Visibility Zortman	Visibility Landusky	Distance Zortman	Distance Landusky	Zortman P	Zortman V	Zortman A	Landusky P	Landusky V	Landusky A
28.	Rock Art	Prehistoric Site	no	no	3.2	2.3	N	N	M	N	N	M
29.	Rock Art	Prehistoric Site	no	no	2.3	2.7	N	N	M	N	N	M
30.	Burial	Burial	no	no	7.0	4.2	N	N	N	N	N	L
31.	LRM Burials	Burial	?	?	?	?	U	U	U	U	U	U
32.	Healing	Medicinal Spring	no	no	4.3	2.4	N	N	L	N	N	M
33.	Healing	Healing Waters	no	no	6.3	8.3	N	N	N	N	N	N
34.	Sundance	Sundance Site	no	no	4.3	3.3	N	N	L	N	N	M
35.	Sundance	Sundance Site	no	yes	3.2	1.8	N	N	M	N	H	H
36.	Resource Procurement	Fossil Gathering	no	no	3.4	5.4	N	N	M	N	N	L
37.	LRM Resource Procurement	Plant Gathering	yes	yes	0.0	0.0	H	H	H	H	H	H
38.	Historic Event	Historic Battle Site	no	no	4.9	2.8	N	N	L	N	N	M
39.	Historic Event	Coming Day's Route	?	?	?	?	U	U	U	U	U	U
40.	Pipe Offering	Flat Pipe Offering	no	no	7.0	4.2	N	N	N	N	N	L
41.	Powwow	Pow Wow Grounds	no	no	3.6	1.6	N	N	M	N	N	H
						Impact Score	3.00	2.53	2.03	3.00	2.61	2.12
						Impact Level	High	High	High	High	High	High
										IMPACT TOTALS		
										Zortman		High
										Landusky		High
										Combined Total		High

P = Physical Impact, V = Visual Impact, A = Aural Impact; H = High Impact, M = Moderate Impact, L = Low Impact, N = No Impact, U = Unknown Impact; High = 3, Moderate = 2, Low = 1.

To compute impact scores, the individual impact scores are summed and then divided by the number of individual impacts. Situations of No, Neutral, or Unknown impact are not used in computing impact scores. Low impacts are represented by a score of 0.0 - 1.0, Moderate impacts be a score of 1.0 - 2.0, and High impacts by a score of 2.0 - 3.0.

comment received during review of the Draft EIS. All of this information supports the perception to traditionalists that more sites and areas would be rendered unavailable, unacceptable, or less desirable with the continuation of mining in the Little Rocky Mountains.

4.12.3 Impacts from Alternative 1

Under the No Action Alternative, there would be no expansion at either the Zortman or Landusky mines. Previously permitted operations and activities including ore leaching, facility reclamation, revegetation, and other closure activities would continue. Reclamation measures under this alternative may not be as effective as those proposed under the other alternatives.

Prehistoric and Historic Cultural Resources

There would be no additional impacts to significant archaeological or historic sites.

Native American Cultural Resources

For Alternative 1, the existing impacts are reduced from high to moderate for Native American cultural resources. This reduction from existing impact levels reflects not approving mine expansions, proposed reclamation measures, and mine closure, all of which should lead to the cessation of mining in the Little Rocky Mountains and reclamation of the land to its pre-mining state. As such, the provisions of Alternative 1 should eventually result in the preservation and protection of Native American cultural resources, and their use by the Native population for contemporary and traditional cultural practices. The impact level assigned also recognizes the observation that reclamation procedures proposed under this alternative are not fully protective of the environment.

4.12.3.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources

There would be no additional impact to the eight known historic sites and corresponding historic information already lost to mining operations.

Native American Cultural Resources

Under the No Action Alternative, existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure. The cumulative impact is approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains.

4.12.3.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources

There would be no adverse impacts to known resources.

Native American Cultural Resources

Previous impacts to Native American cultural resources, including high levels of physical disturbance to sacred places, such as Shell Butte (Zortman) and Gold Bug Butte (Landusky), are permanent and unavoidable under any of the alternatives. The physical, visual, and aural disturbance associated with mine operation, reclamation, and closure, are also unavoidable under all the alternatives.

4.12.3.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources

Current and historic mining practices have disturbed cultural sites. Although the mine activities are relatively short-term, the impacts to cultural and historic sites are long-term or even permanent.

Native American Cultural Resources

Mining operations and related activities in the Little Rocky Mountains continue to have an adverse effect on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse effects lessen, thereby encouraging the use of Native American cultural resources in the Little Rocky Mountains by the Native populations. Alternatives 1 through 3, the no expansion alternatives, represent the least amount of time for this transition to take place.

4.12.3.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources

Although no additional sites would be committed, the existing impacts to cultural or historic sites are irreversible and irretrievable.

Native American Cultural Resources

The irreversible and irretrievable effects of mining operations would be limited largely to existing impacts and those associated with already permitted operations.

Some Native Americans have asserted that mining amounts to desecration, and reclamation cannot undo this damage. Still, one may assume that the Gros Ventre and Assiniboine would prefer reclamation over the continued mine operation or expansion. During the public meetings, for example, several tribal members mentioned the lack of effective reclamation and the need to enforce reclamation requirements.

4.12.4 Impacts from Alternative 2

Under this alternative, expansion of the Zortman and Landusky mines would not be approved although already permitted activities, including ore rinsing and leaching, would continue. Reclamation procedures currently in use would be modified to reduce the potential for acid rock drainage.

Prehistoric and Historic Cultural Resources

There would be no impacts to significant archaeological or historic sites.

Native American Cultural Resources

The impacts would be similar to Alternative 1, and for the same reasons, the existing impacts of high are reduced to moderate for Native American cultural resources under Alternative 2. This reduction from existing impact levels reflects not approving mine expansions, proposed reclamation measures, and mine closure, all of which should lead to the cessation of mining in the Little Rocky Mountains and reclamation of the land to its pre-mining state. As such, the provisions of Alternative 2 should eventually result in the preservation and protection of Native American cultural resources, and their use by the Native population for contemporary and traditional cultural practices. The impact level assigned also recognizes the observation that reclamation procedures proposed under this alternative are not fully protective of the environment.

4.12.4.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources

There would be no additional impact to the eight known historic sites and corresponding historic information already lost to mining operations.

Native American Cultural Resources

Under this alternative, existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure. The cumulative impact is approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains.

4.12.4.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources

There would be no additional adverse impacts to known resources.

Native American Cultural Resources

Previous impacts to Native American cultural resources, including high levels of physical disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky), are permanent and unavoidable under any of the alternatives. The physical, visual, and aural disturbance associated with existing mine operations, reclamation, and closure, are also unavoidable under all the alternatives.

4.12.4.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources

Current and historic mining practices have disturbed cultural sites. Although the mine activities are relatively short-term, the impacts to cultural and historic sites are long-term or even permanent.

Native American Cultural Resources

Mining operations and related activities in the Little Rocky Mountains continue to have an adverse effect on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse effects lessen, thereby encouraging the use of Native American cultural resources in the Little

Rocky Mountains by the Native populations. Alternatives 1, 2, and 3, the no expansion alternatives, represent the least amount of time for this transition to take place.

4.12.4.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources
Although no additional sites would be committed, the existing impacts to cultural or historic sites are irreversible and irretrievable.

Native American Cultural Resources
The irreversible and irretrievable effects of mining operations would be limited largely to existing impacts and those associated with already permitted operations.

Some Native Americans have asserted that mining amounts to desecration, and reclamation cannot undo this damage. Still, one may assume that the Gros Ventre and Assiniboine would prefer reclamation over the continued mine operation or expansion. During the public meetings, for example, several tribal members mentioned the lack of effective reclamation and the need to enforce reclamation requirements.

4.12.5 Impacts from Alternative 3

Under this alternative, expansion of the Zortman and Landusky mines would not be approved although already permitted activities, including ore leaching and rinsing, would continue. Reclamation procedures already in place would be modified to incorporate changes developed to reduce environmental impacts and enhance the potential for reclamation success.

Prehistoric and Historic Cultural Resources
There would be no additional impacts to significant archaeological or historic sites.

Native American Cultural Resources
The impacts to Native American cultural resources under this alternative are similar to those identified for Alternatives 1 and 2, although the incorporation of more effective reclamation procedures developed should result in more effective restoration of the heavily disturbed portions of the Little Rocky Mountains. As such, the existing impacts of high are reduced to low for Alternative 3 in recognition of these additional potentially favorable benefits to restoration of the Little Rocky Mountains. As with Alternatives 1 and 2, mining operations under Alternative 3 would continue at the same level until closure, and although reclamation activities are more extensive, the positive benefits to the resource base in the long run outweigh the resulting extension of impacts over time to complete reclamation.

4.12.5.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources
There would be no additional impacts to the eight known historic sites and corresponding historic information already lost to mining operations.

Native American Cultural Resources
Under this alternative, existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure. The cumulative impact is approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains.

4.12.5.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources
There would be no adverse impacts to known resources.

Native American Cultural Resources
Previous impacts to Native American cultural resources, including high levels of physical disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky), are permanent and unavoidable under any of the alternatives. The physical, visual, and aural disturbance associated with mine operation, reclamation, and closure are also unavoidable under all the alternatives.

4.12.5.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources
Current and historic mining practices have disturbed cultural sites. Although the mine activities are relatively short-term, the impacts to cultural and historic sites are long-term or even permanent.

Native American Cultural Resources

Mining operations and related activities in the Little Rocky Mountains continue to have an adverse effect on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse effects lessen, thereby encouraging the use of Native American cultural resources in the Little Rocky Mountains by the Native populations. Alternatives 1, 2, and 3, the no expansion alternatives, represent the least amount of time for this transition to take place.

4.12.5.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources

Although no additional sites would be committed, the existing impacts to cultural or historic sites are irreversible and irretrievable.

Native American Cultural Resources

The irreversible and irretrievable effects of mining operations would be limited largely to existing impacts and those associated with already permitted operations.

Some Native Americans have asserted that mining amounts to desecration, and reclamation cannot undo this damage. Still, one may assume that the Gros Ventre and Assiniboine would prefer reclamation over the continued mine operation and expansion. During the public meetings, for example, several tribal members mentioned the lack of effective reclamation and the need to enforce reclamation requirements.

4.12.6 Impacts from Alternative 4

The company proposed action (CPA) would permit expanded operations at both the Zortman and Landusky mines along with implementation of modified reclamation plans. At the Zortman Mine this would include: lateral expansion and deepening of the pit complex, construction and operation of a heap leach facility at Goslin Flats, construction of an ore conveyor system through Alder Gulch to Goslin Flats, construction of a new waste rock repository in Carter Gulch, and development of a limestone source south of Green Mountain for uses associated with reclamation. At the Landusky Mine, activities would include deepening of the August pit and the South Gold Bug pit to extract 7.6 million additional tons of ore, expansion of the 87/91 leach pad, and development of a quarry in the King Creek drainage to mine limestone for use in reclamation.

Prehistoric and Historic Cultural Resources

The Alder Gulch Historic District, eligible under criteria (a) and (d) of 36 CFR 60.4, would be impacted by construction of the conveyor system. One site in the district (24PH2863, a lime kiln) would be directly impacted. The remainder of the sites that comprise the Alder Gulch Historic District would not be directly impacted by this alternative. However, the setting and feeling of the District would be changed with the construction and operation of the conveyor system. Direct impacts would be low negative, with mitigation measures. Duration would be permanent. Because the conveyor system does not impact the entire District, secondary impacts would also be low negative. Duration would be for life-of-mine, since reclamation includes removal of the conveyor.

One archaeological site (24PH2905, outside the leach pad limits) may be impacted in the land application area.

Native American Cultural Resources

Under this alternative, the existing high impacts would continue while there would be additional aural, physical, and visual impacts to the Little Rocky Mountains TCP. As a result, the impact level for Native American cultural resources remains high. At the Zortman Mine site, impacts to Shell and Antoine Buttes and the surrounding area would continue and accelerate with (a) increased ore extraction, (b) removal of the waste rock dump in Alder Gulch, (c) construction and operation of a new waste rock dump in Carter Gulch, and (d) the addition of new facilities. Construction and operation of the conveyor system in Alder Gulch and the leach pad in Goslin Flats would add new impacts to Saddle Butte and the surrounding area. At the Landusky Mine, impacts to Gold Bug Butte, Mission Peak, and the surrounding area would continue and accelerate with new ore extraction activities. Construction and operation of the limestone quarry in the King Creek drainage would add impact to the area and to Damon Hill. Many of the physical impacts are permanent and would remain post-reclamation.

4.12.6.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources

Implementation of this alternative would result in no known additional impacts to prehistoric resources, but the cumulative effect and significance of past impacts to prehistoric resources is not known since there was no requirement to record sites during the earlier periods of mining.

Low, negative impacts from this alternative would contribute to the cumulative impact on certain historic sites. Of these, one site (24PH2863) has been determined to be eligible for the National Register.

Mining in the Pony Gulch area would increase the impacts to the Alder Gulch Historic District. Eastward extension of the Goslin Flats leach pad could impact site 24PH2905, a stone circle site. The exploration could also impact previously unrecorded sites. Standard archaeological survey methods would be employed to locate significant sites prior to project development.

The 69 kV transmission line from Malta to Goslin Flats is a reasonably foreseeable development which could affect significant historical or prehistorical archaeological sites, or sites significant to Native American culture. The powerline would cross private and federal lands, although the route likely to be proposed by Big Flat Electric Cooperative would not cross the Fort Belknap Indian Reservation.

It is likely impacts to significant sites could be avoided by modification to the transmission line structure or change in the route. Other mitigation could include data recovery. The line would add visual impacts to the Little Rocky Mountains Historic District that has been determined eligible for the National Register. However, impacts to the eligible district from implementation of Alternative 7 and other expansion alternatives are already considered to be high; the powerline would increase the impact, but not significantly change the magnitude of impact.

If the transmission line is proposed for construction, BLM will review the survey report and consult with the appropriate agencies according to 36 CFR 800 regarding mitigating measures.

Native American Cultural Resources

Under this alternative, existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure as with the other alternatives discussed. The magnitude, intensity, incidence, and duration of impacts, however, would greatly increase over current conditions.

All of the reasonably foreseeable activities would increase the magnitude, incidence, and duration of the impacts to Native American cultural resources. There would be additional permanent physical impacts to the Little Rocky Mountains.

4.12.6.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources

Cultural resources have already been adversely impacted by mining activities. Under 36 CFR 800, adverse project effects can be mitigated. While there would be some loss of individual sites and a change in the setting of the Alder Gulch Historic District, Alternative 4 would not have an adverse effect on prehistoric and historic resources with the implementation of the mitigation measures described in Appendix E.

Native American Cultural Resources

Previous impacts to Native American cultural resources, including high levels of physical disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky), are permanent and unavoidable under any of the alternatives. The physical, visual, and aural disturbance associated with mine operation, reclamation, and closure, are also unavoidable under all the alternatives. Unavoidable adverse impacts to the Little Rocky Mountains TCP District, individual cultural properties, and associated Native American values would greatly increase under Alternative 4.

4.12.6.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources

The loss of sites is a long-term impact. The loss of setting or feeling in the Alder Gulch Historic District is relatively short-term.

Native American Cultural Resources

Mining operations and related activities in the Little Rocky Mountains continue to have an adverse impact on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse impacts lessen, thereby encouraging the use of Native American cultural resources in the Little Rocky Mountains by the Native populations. Alternative 4 would significantly increase the amount of time for this transition to take place.

4.12.6.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources
Loss of archaeological sites is irreversible and irretrievable. Implementation of this alternative would require a minor commitment of resources.

Native American Cultural Resources
Under this alternative, existing impacts would continue and new impacts would be added, so that the irreversible and irretrievable impacts to Native American cultural resources would increase. Locations of Native American activities have previously been irreversibly committed (e.g., Gold Bug Butte). This alternative would irreversibly commit additional undisturbed land.

4.12.7 Impacts from Alternative 5

With Alternative 5, the Zortman and Landusky mines would be expanded. At Zortman the heap leach facility would be constructed in Upper Alder Gulch instead of Goslin Flats and the conveyer system would not be built. At Landusky, the rock fill would be removed from the head of King Creek and the pits would be backfilled to a minimum elevation required to create a surface which would freely drain into King Creek.

Prehistoric and Historic Cultural Resources
Without the conveyor system through Alder Gulch and the leach pad at Goslin Flats, no significant historic or prehistoric sites would be impacted.

Native American Cultural Resources
As with Alternative 4, the existing high impacts would continue, while there would be additional aural, physical, and visual impacts to the Little Rocky Mountains TCP. As a result, the impact level for Native American cultural resources remains high. At the Zortman Mine site, impacts to Shell and Antoine Buttes and the surrounding area would continue and accelerate with increased ore extraction, removal of the waste rock dump in Alder Gulch, construction and operation of a new waste rock dump in Carter Gulch, and the addition of new facilities. Since construction and operation of the conveyor system in Alder Gulch and the leach pad in Goslin Flats would not take place, impacts to Saddle Butte and the surrounding area would be less than under Alternative 4, but Alternative 5 would not significantly reduce the overall impacts compared to Alternative 4, 6, or 7. At the Landusky Mine, impacts to Gold Bug Butte, Mission Peak, and the surrounding area, would continue and accelerate with new ore extraction activities. Construction and operation of the limestone quarry in the King Creek drainage would add impacts to the Damon Hill area.

4.12.7.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources
Implementation of this alternative would result in no additional impacts to prehistoric resources, but the cumulative effect and significance of impacts to prehistoric resources is not known since there was no requirement to record sites during the earlier periods of mining.

Additional impact would result from construction of the 69 kV powerline, identified as a reasonably foreseeable development in Section 2.9.4.1. These impacts would be as described in Section 4.12.6.1, although the powerline would not likely end at Goslin Flats, but continue up through the town of Zortman to the Zortman Mine facilities.

Native American Cultural Resources
Existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure as with the other alternatives. The magnitude, intensity, incidence, and duration of impacts, however, would greatly increase over current conditions. The cumulative impact is approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains. The deletion of the conveyor system through Alder Gulch and the leach pad at Goslin Flats would lessen the overall cumulative impacts relative to Alternative 4.

All of the reasonably foreseeable activities would increase the magnitude, incidence, and duration of the impacts to Native American cultural resources. There would be additional permanent physical impacts to the Little Rocky Mountains TCP.

4.12.7.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources
There would be no adverse impacts due to implementation of Alternative 5.

Native American Cultural Resources
Previous impacts to Native American cultural resources, including high levels of physical disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky), are permanent and unavoidable under

any of the alternatives. The physical, visual, and aural disturbance associated with mine operation, reclamation, and closure are unavoidable under all the alternatives. Unavoidable adverse impacts to the Little Rocky Mountains TCP, individual cultural properties, and associated Native American values, however, would greatly increase under Alternative 5, although not to the degree associated with Alternative 4.

4.12.7.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources
There is no removal of resources under Alternative 5.

Native American Cultural Resources
Mining operations and related activities in the Little Rocky Mountains would continue to have an adverse effect on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse effects would lessen, thereby encouraging the use of Native American cultural resources in the Little Rocky Mountains by the Native populations. Alternative 5 would result in not only continuing and increased impacts to the resource base, but represents an increased period of time for this transition to take place.

4.12.7.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources
No resources would be committed under Alternative 5.

Native American Cultural Resources
Existing impacts would continue and new impacts would be added so that the irreversible and irretrievable impacts to Native American cultural resources would greatly increase. This increase would result from the continuation and expansion of existing activities, the addition of new activities, reclamation, and mine closure. Locations of Native American activities have previously been irreversibly committed (e.g., Gold Bug Butte). This alternative would irreversibly commit additional undisturbed land.

4.12.8 Impacts from Alternative 6

With Alternative 6, the Zortman and Landusky mine expansions would be approved although the waste rock facility would be located on Ruby Flats just east of the Goslin Flats heap leach pad. At Landusky, a drainage notch would be constructed between the August Pit and Montana Gulch to prevent runoff from the pits from flowing into the August tunnel.

Prehistoric and Historic Cultural Resources
Impacts to the Alder Gulch Historic District under this alternative would be similar to those outlined in Alternative 4. Additionally, the added disturbance on Ruby Flats could impact prehistoric sites 24PH2905 and 24PH3203. Site 24PH2905 may also be impacted by use of the land application area.

Native American Cultural Resources
As with the impacts associated with Alternatives 4 and 5, under Alternative 6, the existing high impacts would continue while there would be additional aural, physical, and visual impacts to the Little Rocky Mountains. As a result, the impact level for Native American cultural resources remains high. At the Zortman Mine site, impacts to Shell and Antoine Buttes and the surrounding area would continue and accelerate with increased ore extraction, removal of the waste rock dump in Alder Gulch, and the addition of new facilities. Construction and operation of the conveyer system in Alder Gulch, the waste rock dump at Ruby Flats, and the leach pad in Goslin Flats would add new impacts to Saddle Butte and the surrounding area. At the Landusky Mine, impacts to Gold Bug Butte, Mission Peak, and the surrounding area, would continue and accelerate with new ore extraction activities. Construction and operation of the limestone quarry in the King Creek drainage would add impacts to the Damon Hill area.

4.12.8.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources
Under this alternative, two additional sites would be impacted on Ruby Flats, increasing the overall cumulative impact to prehistoric cultural resources. However impacts would still be low and negative since adverse effects could be mitigated according to 36 CFR 800. Cumulative impacts to historic sites are minor when compared to the current level of disturbance.

Low, negative impacts from this alternative would contribute to the cumulative impact on certain historic sites. Of these, one site (24PH2863) has been determined to be eligible for the National Register.

Mining in the Pony Gulch area would increase the impacts to the Alder Gulch Historic District. Eastward extension of the Goslin Flats leach pad could impact site 24PH2905, a stone circle site. The exploration could also impact previously unrecorded sites. Standard archaeological survey methods would be employed to locate significant sites prior to project development.

Additional impact would result from construction of the 69 kV powerline, identified as a reasonably foreseeable development in Section 2.10.4.1. These impacts would be as described in Section 4.12.6.1.

Native American Cultural Resources

Existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure as with the other alternatives discussed. The magnitude, intensity, incidence, and duration of impacts, however, would greatly increase over current conditions. The cumulative impact is approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains.

All of the reasonably foreseeable activities would increase the magnitude, incidence, and duration of the impacts to Native American cultural resources.

4.12.8.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources

Under 36 CFR 800, adverse project effects can be mitigated. While there will be some loss of individual sites and a change in the setting of the Alder Gulch Historic District, approval of Alternative 6 would not have an adverse effect on prehistoric and historic resources when the mitigation described in Appendix E is implemented.

Native American Cultural Resources

Previous impacts to Native American cultural resources, including high levels of physical disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky), are permanent and unavoidable under any of the alternatives. The physical, visual, and aural disturbance associated with mine operation, reclamation, and closure are unavoidable under all the alternatives. Unavoidable adverse impacts to the Little Rocky Mountains TCP, individual cultural properties, and associated Native American values, however, would greatly increase under this alternative.

4.12.8.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources

The loss of sites is a long-term impact. The loss of setting or feeling in the Alder Gulch Historic District is relatively short-term, lasting the life of the mine.

Native American Cultural Resources

Mining operations and related activities in the Little Rocky Mountains would continue to have an adverse effect on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse effects would lessen, thereby encouraging the use of Native American cultural resources in the Little Rocky Mountains by Native American populations. Alternative 6 would result in not only continuing and increased impacts to the resource base, but represents an increased period of time for this transition to take place.

4.12.8.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources

Loss of archaeological sites is an irreversible and irretrievable commitment. Implementation of this alternative would require a minor additional commitment of resources when compared with the loss of historic sites to date. Loss of the two prehistoric sites would be a greater loss, as the previous loss of prehistoric sites is unknown and these two sites constitute a larger percentage of the database. This is a greater loss than for Alternatives 4, 5, and 7.

Native American Cultural Resources

Existing impacts would continue and new impacts would be added so that the irreversible and irretrievable impacts to Native American cultural resources would greatly increase. This increase would result from the continuation and expansion of existing activities, the addition of new activities, the construction and operation of new facilities, reclamation, and mine closure. Locations of Native American activities have previously been irreversibly committed (e.g., Gold Bug Butte). This alternative would irreversibly commit additional undisturbed land.

4.12.9 Impacts from Alternative 7

Alternative 7 would permit mine expansions with mitigation at both the Zortman and Landusky mines. Alternative 7 was developed as a way to (1) reduce the amount of land disturbance associated with expanded mining activities, (2) reduce the potential for impacts to water resources, and (3) enhance reclamation opportunities on existing facilities. Many of the plans and facility designs for Alternative 7 are similar to or the same as those described for Alternative 4. At the Zortman Mine, the major difference is that the waste rock repository proposed for Alder Gulch in Alternative 4 would be replaced by construction of a waste rock repository on the top of existing facilities at the mine pit complex in Alternative 7. Also, the limestone quarry would be in the LS-2 area. Expansion at the Landusky Mine would be similar to Alternative 6.

Prehistoric and Historic Cultural Resources

The Alder Gulch Historic District, eligible under criteria (a) and (d) of 36 CFR 60.4, would be impacted by construction of the conveyor system. One site in the district (24PH2863, a lime kiln) would be directly impacted. The remainder of the sites that comprise the Alder Gulch Historic District would not be directly impacted by this alternative. However, the setting and feeling of the District would be changed with the construction and operation of the conveyor system. Direct impacts would be low negative, with mitigation measures. Duration would be permanent. Because the conveyor system does not impact the entire District, secondary impacts would also be low negative. Duration would be for life-of-mine, since reclamation includes removal of the conveyor.

One archaeological site (24PH2905, outside the leach pad limits) may be impacted in the land application area.

Native American Cultural Resources

Under this alternative, the existing high impacts would continue while there would be additional aural, physical, and visual impacts to the Little Rocky Mountains TCP. As a result, the impact level for Native American cultural resources remains high. At the Zortman Mine site, impacts to Shell and Antoine Buttes and the surrounding area would continue and accelerate with (a) increased ore extraction, (b) removal of the waste rock dump in Alder Gulch, (c) construction and operation of a new waste rock dump on existing facilities near the Zortman mine pit complex, and (d) the addition of new facilities. Construction and operation of the conveyer system in Alder Gulch and the leach pad in Goslin Flats would add new impacts to Saddle Butte and the surrounding area. At the Landusky Mine site, impacts to Gold Bug Butte, Mission Peak, and the surrounding area, would continue and accelerate with new ore extraction activities.

4.12.9.1 Cumulative Impacts

Prehistoric and Historic Cultural Resources

Implementation of this alternative would result in no additional impacts to prehistoric resources, but the cumulative effect and significance of impacts to prehistoric resources is not known since there was no requirement to record sites during the earlier periods of mining.

Low, negative impacts from this alternative would contribute to the cumulative impact on certain historic sites. Of these, one site (24PH2863) has been determined to be eligible for the National Register.

Mining in the Pony Gulch area would increase the impacts to the Alder Gulch Historic District. Eastward extension of the Goslin Flats leach pad could impact site 24PH2905, a stone circle site. The exploration could also impact previously unrecorded sites. Standard archaeological survey methods would be employed to locate significant sites prior to project development.

Native American Cultural Resources

Under this alternative, existing impacts from past, present, and proposed future actions would continue through the period of mine operation, reclamation, and closure as with the other alternatives discussed. The magnitude, intensity, incidence, and duration of impacts, however, would greatly increase over current conditions. The cumulative impact is approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains.

All of the reasonably foreseeable activities would increase the magnitude, incidence, and duration of the impacts to Native American cultural resources. There would be additional permanent physical impacts to the Little Rocky Mountains TCP.

The 69 kV transmission line from Malta to Goslin Flats is a reasonably foreseeable development which could affect significant historical or prehistorical archaeological sites, or sites significant to Native American culture. The powerline would cross private and federal lands, although the route likely to be proposed by Big Flat

Electric Cooperative would not cross the Fort Belknap Indian Reservation.

It is likely impacts to significant sites could be avoided by modification to the transmission line structure or change in the route. Other mitigation could include data recovery. The line would add visual impacts to the Little Rocky Mountains Historic District that has been determined eligible for the National Register. However, impacts to the eligible district from implementation of Alternative 7 and other expansion alternatives are already considered to be high; the powerline would increase the impact, but not significantly change the magnitude of impact.

If the transmission line is proposed for construction, BLM will review the survey report and consult with the appropriate agencies according to 36 CFR 800 regarding mitigating measures.

4.12.9.2 Unavoidable Adverse Impacts

Prehistoric and Historic Cultural Resources

Cultural resources have already been adversely impacted by mining activities. Under 36 CFR 800, adverse project effects can be mitigated. While there would be some loss of individual sites and a change in the setting of the Alder Gulch Historic District, Alternative 7 would not have an adverse effect on prehistoric and historic resources with the implementation of the mitigation measures described in Appendix E.

Native American Cultural Resources

Previous impacts to Native American cultural resources, including high levels of disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky) are permanent, and unavoidable under any of the alternatives. The physical, visual, and aural disturbance associated with mine operation, reclamation, and closure, are also unavoidable under all the alternatives. Unavoidable adverse impacts to the Little Rocky Mountains TCP District, individual cultural properties, and associated Native American values would increase under Alternative 7 (over the no expansion alternatives).

4.12.9.3 Short-term Use/Long-term Productivity

Prehistoric and Historic Cultural Resources

The loss of sites is a long-term impact. The loss of setting or feeling in the Alder Gulch Historic District is relatively short-term.

Native American Cultural Resources

Mining operations and related activities in the Little Rocky Mountains would continue to have an adverse effect on the use of Native American cultural resources for social, religious, and other cultural purposes. With the cessation of mining, reclamation, and closure activities, these adverse impacts would lessen thereby encouraging the use of Native American cultural resources in the Little Rocky Mountains by the Native populations. Similar to Alternatives 4, 5, and 6 which also include mine expansions, this alternative would significantly increase the amount of time for this transition to take place.

4.12.9.4 Irreversible or Irretrievable Resource Commitments

Prehistoric and Historic Cultural Resources

Loss of archeological sites is irreversible and irretrievable. Implementation of this alternative would require a minor commitment of resources.

Native American Cultural Resources

Under this alternative, existing impacts would continue and new impacts would be added so that the irreversible and irretrievable impacts to Native American cultural resources would also increase. This increase would result from the continuation and expansion of existing activities, the addition of new activities, the construction and operation of new facilities, reclamation, and mine closure. Locations of Native American activities have previously been irreversibly committed (e.g., Gold Bug Butte). This alternative would irreversibly commit additional undisturbed land, but less than Alternatives 4, 5, or 6.

4.12.10 Impacts Summary

All the alternatives represent relatively high and negative impacts to cultural resources. Relative to each other, however, some alternatives would create a greater impact. The following table shows these relative rankings based on impacts to prehistoric, historic, and traditional cultural properties.

Relative Impact Rankings to Cultural Resources

Alternative	Ranking (1 = most favorable)
1	2
2	2
3	1
4	4
5	3
6	4
7	4

Of all the alternatives, Alternative 3 is the most favorable due to no additional mining, and improved reclamation measures. The other two no expansion alternatives are ranked second for their lower intensity reclamation efforts. However, all of the "no expansion" alternatives would have less impact than the mine expansion alternatives.

Of the mine expansion alternatives, Alternative 5 is most favorable due to lower impacts to historic and prehistoric sites. This is due to the fact that no conveyor system will be built through the Alder Gulch Historic District. Additionally, visual impacts to Saddle Butte would be slightly lower for Alternative 5 with no leach pad on Goslin Flats. However, impacts to Native American cultural resources (the Little Rocky Mountains TCP) would be essentially the same for Alternatives 4, 5, 6, or 7. The other three expansion alternatives are all ranked approximately equal due to their anticipated levels of disturbance to prehistoric, historic and traditional cultural properties.

4.13 AREAS OF CRITICAL ENVIRONMENTAL CONCERN (ACEC)

Five areas within or in close proximity of the Little Rocky Mountains have been nominated or designated as ACECs. These areas include Azure Cave and prairie dog towns within the 7km Complex that have been designated ACECs by the BLM. The BLM has received nominations for the following areas: Little Rocky Mountains, Saddle Butte, and Old Scraggy Peak. The following sections summarize potential impacts to each of these existing and nominated ACECs based on the impact analysis in the other resource sections.

4.13.1 Methodology

ACECs are areas with special designation by the BLM based on the relevance and importance of certain resource values. These areas were evaluated based on impacts of each alternative on the specific resources that lead to nomination or designation as an ACEC. Impacts are rated as high or low, positive or negative, based on several factors including:

- Analysis of specific resources presented in previous sections of this Final EIS;
- Consultations with local, state, and federal agencies and resource experts such as Bat Conservation International; and
- Proximity of the ACEC to proposed activity or disturbance.

Factors taken into consideration during the rating process include evaluation of direct and indirect impacts and whether impacts would be of short-term (life of mine) or long-term duration.

4.13.2 Impacts to Azure Cave

Azure Cave was designated as an ACEC based on its significant vertebrate biology, particularly hibernating bats, and geologic values such as the abundance of speleothems.

4.13.2.1 <u>Impacts from Mining-1979 to Present</u>

No direct impacts to Azure Cave have occurred as a result of mining. Indirect impacts to bats that may have occurred include noise from mining operations, summer and foraging habitat disturbance and mortality from drinking cyanide solution. No indirect impacts can be demonstrated with available data. A 1978 survey of Azure Cave found 530 hibernating bats (Chester et al. 1979). A survey of the cave in March 1993 found approximately 250-300 hibernating bats (Butts 1993). This apparent decline in bat numbers could be related to discrepancies in counting methods, the extent of the cave area surveyed, or other factors; however, habitat loss or disturbance may be contributing to the actual decline (Taylor 1994). Similar declines in bat populations have been documented in a number of bat species nationwide. The most common reasons cited are loss of secure roosting sites through cave destruction, unplanned recreational use of caves, abandoned mine closures, loss of late seral stage forest as roosting sites, and loss of foraging habitat (Tuttle and Taylor in press).

No mining-related impacts to geologic values of Azure Cave have occurred to date.

4.13.2.2 <u>Impacts</u>

Impacts to hibernating bats in Azure Cave are detailed in Section 4.5. No alternative would have direct impacts on the cave or hibernating bats. However, several indirect impacts could occur including noise, mortality from consumption of cyanide solutions, and destruction of riparian foraging areas and drinking water sources. Mitigation for loss of drinking water sources and methods to prevent mortality from cyanide solution ponds are discussed in detail in Section 4.5.6.

Mining and reclamation activities under all alternatives would be more than 0.7 miles from Azure Cave and would produce audible noise at the cave between 57 and 66 dBA, or roughly the noise produced by a urban residential area. These levels would be further attenuated by the cave structure, and hibernating bats would not be significantly impacted by noise levels produced under any alternative (Taylor 1994). Noise produced by mining activities would be short-term in duration and would cease after final reclamation.

Evaluation of mine blasting using Particle Velocity versus Square Root Scale Distance equations indicated that blasting associated with Alternatives 4 through 7 would not create noticeable vibration at Azure Cave (W-C 1995).

Under the reasonably foreseeable future actions for Alternatives 4, 6, and 7, blasting could occur at Pony Gulch, approximately 4,000 feet from the cave, and would produce vibration barely perceptible by humans and well within acceptable levels. Vibration from blasting under all alternatives would be too low to cause any damage to cave geologic features and limestone formations. Variables used in calculations included:

- Average number of holes per blast - 500
- Average number of shots per week - 2.5
- Number of holes shot per delay - 20
- Pounds of explosives shot per delay - 5,000 lbs ANFO
- Delay period - 100 msec between delays

Cumulative noise levels from mining activities at Pony Gulch and other actions would be approximately 66 dBA at Azure Cave. This noise level is equivalent to levels of urban residential areas where bats are commonly found and would not create a significant impact to hibernating bats (see Section 4.5). Noise levels from Pony Gulch would be further attenuated by an intervening hill and lodgepole pine forest.

The cumulative effects of noise, vibration, and habitat loss, particularly in riparian and mature Douglas fir along Alder, Carter, and Pony Gulches combined with habitat previously lost due to historic and existing mining could adversely impact summer breeding bats by directly removing breeding and foraging habitat or causing bats to avoid the area. These impacts would not be significant.

4.13.3 Impacts to Prairie Dog 7km Complex

Prairie dog towns within the 7km Complex were designated as an ACEC based on its significant biological resources, primarily the density of prairie dog towns and prairie wildlife species. The endangered black-footed ferret has been recently reintroduced into this complex, elevating the biological significance of this area.

4.13.3.1 Impacts from Mining-1979 to Present

The Prairie Dog 7km complex is more than 8 miles south of the Little Rocky Mountains, and previous mining activities have not impacted the ACEC.

4.13.3.2 Impacts

No impacts would occur to the Prairie Dog 7km Complex under any alternative because the nearest prairie dog town is approximately 8 miles south of proposed mining activity.

4.13.4 Impacts to the Little Rocky Mountains

The entire Little Rocky Mountains have been nominated for consideration as an ACEC because of Native American cultural and historic values.

4.13.4.1 Impacts from Mining-1979 to Present

Impacts from recent mining (1979 to present) to Native American cultural resources have been significant and include physical, visual, and aural impacts (refer to Section 4.12). Previous impacts to ethnographic cultural resources include actual physical removal of parts of sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky).

4.13.4.2 Impacts

Cultural resources evaluated in Section 4.12 describe impacts under all alternatives as relatively high and negative. Relative to each other, however, some alternatives would create a greater impact to cultural resources than others. Relative impacts would be greatest under Alternatives 4, 6, and 7; slightly less under Alternative 5 (primarily due to the lack of the conveyor system and facilities in Goslin Flats); still less under Alternatives 1 and 2; and least under Alternative 3.

Impacts for Alternative 1 through 3 reflect a reduction from existing impact levels due to mine closure and proposed reclamation measures. Alternatives 1, 2, and 3 would allow continued use of ethnographic cultural resources by the Native American population for contemporary and traditional cultural practices and would not affect potential ACEC designation. Therefore, the impact relative to existing conditions is considered negligible.

Impacts to cultural resources common to Alternatives 4-7 would not change the relevance and importance of the Little Rocky Mountains and, hence, its nomination as an ACEC. However, the impacts would affect contemporary practices in some areas of the range for the duration of the mining and reclamation activities, and are therefore ranked as negative low (Alternative 5) to negative moderate (Alternatives 4, 6, and 7), reflecting the relative ranking for cultural resource impacts.

4.13.5 Impacts to Saddle Butte

The entire Saddle Butte area has been nominated for consideration as an ACEC, due to its unique vegetation community.

4.13.5.1 Impacts from Mining-1979 to Present

Saddle Butte is approximately 2 miles from the nearest mining activity and there have been no direct impacts from mining from 1979 to present.

4.13.5.2 Impacts

The nomination of Saddle Butte as an ACEC was based on the presence of a rare savannah community, classified as *Pseudotsuga menziesii/Andropogon scoparius*. Recent surveys conducted in the summer of 1994 by Steve Cooper of the MNHP indicated that this species association was not a community, but rather a seral type that will likely disappear in a short period (Cooper 1994).

The ACEC nomination is approximately 2 miles south of existing and proposed mining activity under Alternatives 1, 2, 3, and 5. Because of this distance, impacts to vegetation, and hence ACEC nomination, would be negligible. Saddle Butte is located directly west of the proposed Goslin Flats heap leach pad and thus would be most impacted by Alternatives 4, 6 and 7, particularly the diversion ditches around the leach pad; however, the *Pseudotsuga menziesii/Andropogon scoparius* community would not be directly or indirectly impacted by disturbance. Therefore, impacts to the unique vegetation community that is the basis for ACEC nomination would be negligible for all alternatives.

4.13.6 Impacts to Old Scraggy Peak

Old Scraggy Peak has been nominated as an ACEC, based on Native American cultural and historic values.

4.13.6.1 Impacts from Mining-1979 to Present

According to Section 4.12 of this Final EIS, impacts from mining 1979 to present on Native American cultural resources, including Old Scraggy Peak, have been significant though limited to visual and aural impacts; no direct disturbance has occurred.

4.13.6.2 Impacts

Impacts would be similar to those described for the Little Rocky Mountains. Impacts would consist of visual and aural impacts of mining at the Zortman Mine and would be greatest under Alternatives 4 through 7 and least for Alternative 1 through 3. Therefore, impact rankings range from negligible for Alternatives 1-3 to negative moderate for Alternatives 4-7, reflecting the relative cultural resource impact rankings. However, no impacts from any alternative would affect potential ACEC designation.

4.14 HAZARDOUS MATERIALS

4.14.1 Introduction and Methodology

Potential environmental impacts associated with the use, storage, and disposal of hazardous materials at the Zortman and Landusky mines are associated with (1) normal or routine uses of hazardous materials and disposal practices and (2) accidental or uncontrolled releases of hazardous materials into the environment.

Key factors in the determination of impact significance include the severity of potential spills or releases in terms of magnitude and toxicity of the material as well as the opportunity for immediate response and effective cleanup. High negative or significant environmental impacts could result from:

- Massive spills or releases that are too large to be readily contained,
- spills of materials that are acutely toxic to people, vegetation, and wildlife in low concentrations,
- spills that occur in locations or situations that prevent immediate response and effective cleanup,
- normal or routine mining activities that involve hazardous materials that cause significant degradation of natural resources, and
- uncertain or ineffective reclamation or cleanup of a facility or material with potentially toxic or hazardous characteristics, unless effective mitigation is available.

All of these situations could be considered to have high negative impacts because of the potential for contamination of natural resources and the potential for harm to human health of on-site workers, local residents, and recreationists. Spills, releases, or routine mining activities would be rated as having low negative impacts if they involve small, easily contained quantities of materials, or where the material in question is not acutely toxic in low concentrations, or where cleanup is immediate and effective.

The following sections describe the potential hazards associated with hazardous material use at the mines, including toxicity characteristics and potential for exposure, known impacts from use of these materials from 1979 to the present, and potential impacts that could arise from each of the project alternatives.

4.14.2 Toxic Hazard Characteristics and Potential Exposure to Hazardous Material Used at the Zortman and Landusky Mines

Important considerations in evaluating the significance of a release, spill, or intended use of a hazardous material include the toxic characteristics, as well as the physical and chemical properties of the material, and potential exposure of receptors (workers, area residents, wildlife). The toxic effects of hazardous materials used in the project area vary considerably by material. Exposure to certain materials could cause severe injury or immediate death in low concentrations, while other materials are considerably less toxic, even in large doses or concentrations. The physical and chemical properties of these materials can also influence how they might behave when spilled or released into the environment. The following is a description of the toxic hazards associated with each hazardous material used at the Zortman and Landusky mines. Most of this information was derived from Material Safety Data Sheets (MSDS) available in project files and the Zortman and Landusky Operating Plans.

Gasoline is used to power light vehicles at the Zortman and Landusky operations. Benzene, one of the components of gasoline, can potentially cause leukemia and is toxic to the blood and blood-forming tissues. Gasoline contains petroleum hydrocarbons, which can irritate the eyes, skin, and lungs with prolonged exposure. Overexposure may cause weakness, headache, nausea, confusion, blurred vision, drowsiness, and other nervous system effects. Greater exposure may cause dizziness, slurred speech, flushed face, unconsciousness, and convulsions. In addition, gasoline is highly flammable and can explode if it reacts with oxidizing agents. Exposure to gasoline would most likely occur to mine workers during fueling or maintenance of mine vehicles. It is also possible that spilled gasoline could contaminate surface or groundwater. This would be unlikely, however, since gasoline is stored on a containment pad and spills of gasoline would be contained and cleaned up promptly by mine staff. Domestic water wells in the towns of Landusky and Zortman are located at considerable distances from the mines and contamination with gasoline is extremely unlikely, even if a discharge to the groundwater occurred at a storage or refueling location.

Diesel fuel is used in large quantities during mining to fuel heavy equipment. Diesel can cause irritation of the skin, eyes, and lungs due to inhalation or direct exposure. Extreme overexposure or aspiration into the lungs may cause lung damage and/or death. Overexposure may cause weakness, headache, nausea, confusion, blurred vision, drowsiness, and other nervous system effects. Greater exposure may cause dizziness, slurred speech, flushed face, unconsciousness, and convulsions. Naphthalene, an ingredient in diesel fuel, can irritate the eyes, skin and lungs. Prolonged exposure can also be toxic to the eyes, liver, kidneys, and blood. Given that diesel is a petroleum hydrocarbon, it is highly flammable and will ignite if exposed to heat or ignition source, and may explode if it reacts with oxidizing agents. Potential exposure to diesel is greatest for mine workers. Other types of exposures that could be experienced are the same as described for gasoline.

Oil and Lubricants would be used by light and heavy mine equipment and to some extent in drilling and other activities. In general, these materials are not acutely toxic, unless exposure is extreme. Exposure to these materials may cause minor skin or eye irritation. Prolonged exposure to waste oil has caused skin cancer in animal tests. Oils and lubricants are insoluble in water and are flammable at high temperatures. Potential exposure to oil and lubricants is most likely for mine workers during vehicle maintenance. Oil and lubricants are stored on a containment pad to minimize potential soil and groundwater contamination.

Antifreeze is also used by mine vehicles and is comprised primarily of ethylene glycol. Routes of exposure can include inhalation, ingestion, absorption, skin contact, and eye contact. Some of the effects of exposure to ethylene glycol by inhalation include headache, nausea, vomiting, dizziness, drowsiness, irritation of the respiratory tract, and loss of consciousness. Ingestion may cause nausea, vomiting, headaches, dizziness, and gastrointestinal irritation. Ingestion may be fatal. Liquid may be irritating to skin and eyes. Skin absorption may be harmful. Chronic effects of overexposure may include damage to kidneys, liver, lungs, blood, or central nervous system. Ethylene glycol is not considered carcinogenic. In terms of its physical properties, ethylene glycol is soluble in water and has a flash point of 232 degrees Fahrenheit in its pure form. It is a slightly viscous liquid with a mild odor. Potential exposure is most likely for mine workers during vehicle maintenance. Ethylene glycol spills can be of concern because of its toxicity, as wildlife and stock or domestic animals may not be able to detect its potential hazard. It is not uncommon for animals to die because of ethylene glycol ingestion. As described for gasoline, diesel, and lubricants, antifreeze is stored on a concrete containment pad to minimize the potential for soil or groundwater contamination.

Ammonium Nitrate is used for blasting when combined with fuel oil (ANFO). Routes of potential exposure include inhalation and ingestion. Dust inhalation may cause tightness and chest pain, coughing, and difficulty in breathing. Contact with skin or eyes may cause irritation. Ingestion may cause headache, nausea, vomiting, gastrointestinal irritation, unconsciousness, and convulsions. If released into the environment due to accidental spill or as a residue from blasting, ammonium nitrate can degrade water quality by raising nitrate levels and stimulating growth or algae and other aquatic plants. Elevated nitrate levels can also cause health effects in human populations and wildlife if contaminated water is consumed and high nitrate levels are present. Domestic water wells are located relatively far from the mining areas and potentially contaminated streams. Human consumption is therefore unlikely.

In addition, ammonium nitrate is highly reactive with various materials as it is a strong oxidizer. Contact with other materials may cause fire or explosion. In terms of its physical properties, ammonium nitrate is slightly soluble in water, is odorless and has the appearance of transparent white crystals or white granules. Fire or explosion of pure ammonium nitrate is the most important hazard associated with this material.

Sodium Cyanide is used for extraction of precious metals from ore and is by far the most toxic material used at the Zortman and Landusky mines. It is extremely poisonous and can cause immediate death if swallowed or inhaled in sufficient quantities. Routes of potential exposure can include inhalation, ingestion, absorption, skin contact, and eye contact. Some of the effects of exposure to sodium cyanide include headache, nausea, vomiting, dizziness, weakness, rapid ineffective breathing, low blood pressure, loss of consciousness, convulsions, or death. Contact with skin or eyes may cause severe irritation or burns. Organs that are affected by exposure to sodium cyanide include the cardiovascular system, the central nervous system, liver, kidneys, and skin. Sodium cyanide is not carcinogenic.

Sodium cyanide is also hazardous because it is highly reactive. Contact with water or acidic conditions liberates poisonous hydrogen cyanide gas. In terms of its physical properties, sodium cyanide is slightly soluble in water. It has the appearance of white granules and is odorless.

Even in low concentrations, spilled or released cyanide could seriously harm wildlife or human populations, should water resources become contaminated and subsequently consumed. Surface water resources are used by area wildlife, while human consumption is limited to groundwater extracted from wells near the towns of Zortman and Landusky. Cyanide is not persistent in the environment. Spilled cyanide solution degrades very quickly if its pH drops below 9 or if exposed to sunlight.

Lime is used primarily for pH control in cyanide solutions. Given its alkalinity, contact with lime can cause skin, eye, nose and throat irritation. Exposure to concentrated lime would be generally limited to mine workers. Release via surface or groundwater could harm vegetation or wildlife, depending on the concentration of the lime in solution.

Hydrochloric Acid is also extremely hazardous. It can cause severe burns and may be fatal if swallowed or inhaled. Hydrochloric acid can cause damage to the respiratory system if vapors are inhaled.

Hydrochloric acid is soluble in water and has the appearance of a clear to slightly yellow, pungent fuming liquid. Hydrochloric acid is also hazardous because it is highly corrosive and reacts with metals and other materials to emit explosive hydrogen gas or hydrogen chloride gas. Hydrochloric acid is used in limited quantities in process circuit lines. Should this material be spilled, it could cause serious harm to mine workers, wildlife, or vegetation if contacted prior to dilution by precipitation or surface water.

Sodium Hydroxide is also extremely hazardous. It can cause severe burns and may be fatal if swallowed or inhaled. Sodium hydroxide can cause severe damage to the respiratory system if vapors or mists are inhaled.

Sodium hydroxide is soluble in water and has the appearance of a clear, odorless liquid. As described for hydrochloric acid, this material could cause serious harm to mine workers, wildlife, or vegetation if exposed to undiluted spilled material. Since it is only used in the refinery and is stored in a double contained tank, the only opportunities for a spill would be during transportation or from a leak in the pipeline from the storage tank to the refinery.

Hydrogen Peroxide is also considered extremely hazardous due its potential for causing severe burns and its oxidizing properties. Effects of exposure to hydrogen peroxide include severe irritation of the skin, severe irritation of the respiratory tract if inhaled, burning of the eyes and blindness if contacted. Ingestion may be irritating to the esophagus and stomach and may cause sudden distension.

Hydrogen peroxide is highly unstable and a strong oxidizer. Contact with various materials, such as combustibles and strong reducing agents may cause fire or explosion. Hydrogen peroxide is soluble in water and has the appearance of a clear, odorless liquid. Since this material is rarely used at all, and is stored in a double walled tank, the likelihood of release and exposure is extremely low. If accidentally released and not cleaned up effectively, hydrogen peroxide could harm vegetation or wildlife if exposed.

Calcium Hypochlorite is considered extremely hazardous due to its potential for causing severe burns and its oxidizing properties. Effects of exposure to calcium hypochlorite include ulcers, discoloration, excema, irritation, and burns when skin or eyes are contacted. Inhalation of dust is irritating and can be severely damaging to respiratory passages and lungs. Ingestion may cause severe burning of mouth and stomach and may be fatal.

In addition, calcium hypochlorite is a strong oxidizer. Contact with various materials, such as water, combustibles and strong reducing agents may cause fire or explosion or generate poisonous hydrogen chloride gas. Calcium hypochlorite is slightly soluble in water. It has the appearance of a white powder with a strong chlorine-like odor. Since this material is rarely used at all, and is stored on containment, the likelihood of release and exposure is very low. If accidentally released and not cleaned up effectively, calcium hypochlorite could harm vegetation or wildlife if exposed.

Powdered Zinc is used in the Merrill-Crowe process for extracting precious metals from process solutions at the Landusky Mine. It is hazardous primarily because of its strong reaction when exposed to air. In terms of health effects of exposure, inhalation of dust may irritate the upper respiratory tract, cause headache, coughing, dizziness or difficulty in breathing. Prolonged exposure may cause dermatitis. Ingestion of zinc powder may cause nausea, vomiting, headaches, dizziness, and gastrointestinal irritation.

Zinc powder dust may become flammable or explosive when mixed with air, especially when damp. It also reacts with water, strong bases, strong acids, oxidizing agents, and alkali metals. It can be an explosion hazard, especially when heated or exposed to an ignition source. Zinc powder is highly insoluble in water and has the appearance of a bluish-gray metal powder with no odor. Since zinc powder is used at only one location and is stored on a lined leach pad, the potential for spill and release into the environment is low. If spilled during transfer or handling, this material would be cleaned up immediately and effectively by mine staff to prevent reaction with air and subsequent fire or explosion.

4.14.3 Impacts From Mining (Pre-1979)

As described in Section 3.14.2, historic mining operations in the project area utilized both mercury and cyanide for gold extraction. Mills were located within the Ruby and Alder Gulch drainages in the Zortman area, and within the King Creek and Montana Gulch drainages in the Landusky area. Other hazardous materials such as gasoline and diesel may have also been used by historic mining operations. Review of water quality records for the various drainages in the project area, as well as newspaper articles, publications describing the history of mining in the Little Rocky Mountains, and other information sources revealed no evidence that significant dumping, accidental spills or releases of hazardous materials occurred prior to 1979. Although spills or releases of hazardous materials may have occurred in the past, no evidence of such occurrences remained in 1979. Water quality data from the 1977-1978 period showed no detections of cyanide or other hazardous materials in any of the project area drainages.

4.14.4 Impacts From Mining - 1979 to Present

Two types of general impacts relating to hazardous materials have occurred at the Zortman and Landusky mines during the period of recent mining activity. First, several cyanide heap leach pads and waste rock dumps have residual hazardous materials and wastes present in them that can not be completely removed, detoxified, or cleaned up. Second, accidental releases or spills of cyanide solution and petroleum hydrocarbons have occurred in the past, as described in Section 3.14.4. In general, these spills were responded to and corrective measures were taken, although not always in a timely enough fashion to prevent environmental degradation. Also, residual contamination may remain over the long-term.

Routine mining operations in recent years have included the use of cyanide solution for heap leaching on several heap leach pads and process circuits at both the Zortman and Landusky mines. Although these cyanide solutions are neutralized and heap leach pads are rinsed at the end of their useful lives, residual cyanide may remain present in the pads over the long term due to blind-offs (zones inaccessible to solution movement due to settling or accumulation of fines) and/or preferential flow patterns that prevent uniform and complete removal of cyanide from the leach pad ore mass. Studies conducted during 1990 indicate the potential for retained cyanide in heaps after rinsing to be minimal (Schafer 1991). Similarly, various chemical reagents used to control the chemistry of cyanide solutions or maintain pumps, pipelines, and spray lines (e.g., anti-scalants) have also been applied to the heap leach pads, which may retain these materials if rinsing is not completely effective. Various wastes disposed of specifically on the Zortman 89 pad, such as laboratory rinses, fume scrubber runoff, reagent residues from dumped reagent containers, and water treatment plant metal hydroxide sludge (2,000 tons per year) may also persist in the leach pad to the extent rinsing does not remove or detoxify them. In the case of metal hydroxide sludge, there is also the potential that acid rock drainage that could form within the leach pad in the future could remobilize these metals.

Blasting of ore and waste rock in the mine pits is accomplished using ANFO, which is a mixture of ammonium nitrate and fuel oil (diesel). After blasting, ore and waste rock are hauled by truck and deposited on the leach pads and waste rock dumps, respectively. Blasting with ANFO can leave residual nitrates on the ore and waste rock. Residual nitrates can degrade water quality if they are dissolved within the waste rock dumps or reclaimed leach pads in leachate and are released into the environment. Nitrates in surface water can stimulate the growth of undesirable algae and other aquatic plants, and at higher concentrations, can cause health problems in human populations and wildlife. As described in Section 3.2 and 4.2, elevated nitrate levels have been observed in drainages in the study area. It is quite possible that these elevated levels are due to runoff of nitrate residues present in waste rock and possibly reclaimed (and perforated) leach pads.

Reclamation of heap leach pads and waste rock dumps at the Zortman and Landusky mines would include reclamation covers that should substantially reduce the amount of infiltration that would occur, thereby reducing the amount of leachate generated. This subject will be discussed further in subsequent sections.

It is possible that residual metals, cyanide compounds, nitrates, and other chemicals could be released from reclaimed leach pads and waste rock dumps into surface and groundwater resources via the perforations or leaks in their liners. However, leachate monitoring, capture, and control measures should prevent release of these materials to surface water bodies and the environment. Residual cyanide compounds may break down within the leach pads on their own, despite less than 100 percent effective rinsing. This breakdown would occur more quickly if the pH of residual solution or leachate is neutral or acidic, since cyanide can only persist in alkaline conditions (pH greater than 9). Given the potential for the formation of acid rock drainage in spent ore within the leach pads, residual cyanide within the pads may be neutralized before draining out of the facility. Of course, acidic conditions could also increase the mobilization of metals in the leachate.

Another waste disposal practice used by the Zortman and Landusky mines is land application disposal (LAD) of neutralized cyanide solution. Solutions disposed in this manner must have cyanide concentrations at or below 0.22 mg/l WAD. In general, solutions are sprayed on the surface, and soil in the LAD area adsorb and attenuate metals and cyanide. Emergency LAD at the Zortman Mine was carried out on Carter Butte to the south of the 84 leach pad between October 1986 and June 1987, in response to unusually high precipitation received at the mine site and the related generation of considerable excess solution in the leach pads. The solution was neutralized with calcium hypochlorite before LAD. Approximately 20 million gallons of neutralized solution were disposed on 17 acres of LAD area. Although LAD is an accepted and permitted practice, and soils are tested for attenuation capacity before LAD is permitted, treated cyanide solution was detected in surface and alluvial groundwater in Alder Gulch because steep slopes and high application rates caused the solution to run off the LAD area into the gulch. During the emergency LAD, total cyanide levels in Alder Gulch peaked at 0.48 mg/l and diminished thereafter. Cyanide levels remained in exceedance of the state aquatic life standard (.0054 mg/l) almost continuously for the five years following emergency LAD. It is possible that the low aquatic species density and diversity in Lower Alder Gulch can be attributed at least in part to cyanide contamination, however, this has not been confirmed and may be due to the low base flow in Lower Alder Gulch which is intermittent at best.

No other routine mining operations or activities have been identified that would result in the release of hazardous materials into the environment. Based on review of available reports and documents and other information provided by ZMI, potentially hazardous materials or wastes have not been disposed on waste rock dumps, in mine pits, or elsewhere at the mine sites or office complex.

The vast majority of hazardous materials used at the Zortman and Landusky mines were completely consumed, with no waste products generated, or eventually degraded with no apparent significant environmental impact. Examples of such consumption include gasoline and diesel fuel, which were combusted in mine vehicles; lime, which is non-hazardous when diluted in process solutions; and cyanide, the overwhelming majority of which is degraded in contained facilities through dilution (rinsing) and other natural processes. A few examples of residual hazardous wastes remain, including waste oil and lubricants, spent citrus-based solvents, and cupels and slag from the assay lab and refinery. These wastes are disposed in accordance with state and federal regulations at approved facilities.

A second source of impact related to hazardous material use has resulted from accidental spills or releases of cyanide solution from heap leaching facilities. As described in Section 3.14, six accidental spills or releases of cyanide solution occurred between 1982 and 1993 (two at the Zortman Mine, four at Landusky). One release from the Zortman Mine into Alder Gulch (on November 1, 1982) contaminated the water supply system for the town of Zortman, which was replaced by another source. Another release from the Zortman Mine (October 1987) entered Ruby Gulch and was neutralized to a large extent with calcium hypochlorite, although concentrations of cyanide remained in Ruby Gulch in the following years (.018-0.44 mg/l) that exceeded the state chronic aquatic life standard (.0054 mg/l). Accidental releases of cyanide solution from the Landusky Mine have similarly impacted Mill and Montana gulches. Both of these gulches suffered cyanide contamination that exceeded aquatic life standards at various times between 1982 and 1994 (up to 0.12 mg/l in Mill Gulch and up to 0.14 mg/l in Montana Gulch). In addition, two releases of cyanide solution at the Landusky Mine (July 1992, September 1993) have contaminated groundwater near the processing plant. At least one of these spills may have exceeded several thousand gallons. Although pumping of this groundwater was initiated, it is unlikely all of the cyanide solution can be recovered. Given the high toxicity of cyanide, and the inability of mine personnel to completely clean up these spills, these incidents were rated as having high negative impacts, though no domestic water supply or surface waters were affected. As mentioned previously, given the instability of cyanide, it is possible that accidentally spilled cyanide solutions may degrade quickly and naturally and that water resources may not be impacted over the long-term or offsite. However, since the timing and extent of this degradation cannot be predicted with certainty, the high negative impact rating remains.

As mentioned in Section 3.14, a release of petroleum hydrocarbons occurred at the Zortman Mine in September 1991. This release was effectively cleaned up to the satisfaction of the Montana Department of Health and Environmental Sciences. This spill was cleaned up with minimal impact to the environment.

No other spills or releases have been reported by ZMI from past mining activities. It is possible that leaks or spills may have occurred that were undetected. No information is available to confirm this possibility. As described in Chapter 3.14, virtually all hazardous materials and wastes are stored on containment facilities or above concrete surfaces, where complete and effective clean up of spills can be achieved. Given that no information on additional spills or accidents has been reported, that virtually all hazardous materials and wastes are stored on containment structures or surfaces, and that mine personnel are trained in spill response and containment and are expected to follow that training, no additional impacts relating to spills or releases of hazardous materials have been identified at the Zortman and Landusky mines.

4.14.5 Impacts From Alternative 1

Alternative 1 would involve no additional mining or new heap leaching as remaining permitted ore at the Landusky Mine is exhausted. Since all permitted ore at the Zortman Mine was exhausted in 1990, no additional mining would occur at the Zortman operation. Continued leaching at Landusky, as well as final reclamation at both mines would require continued use of the various hazardous materials until final reclamation is completed. For the Zortman Mine, use of hazardous materials would continue until about the end of 1997. For the Landusky Mine, use would continue until the end of 2000.

No new leach pads, waste rock dumps or repositories, or other relevant facilities would be constructed. Thus, the locations of hazardous material use, handling, and storage would generally be the same as described for the 1979 to present timeframe (refer to Sections 3.14 and 4.14.4).

In terms of routine mining activities and waste disposal practices, impacts would be similar to those described for recent mining. Cyanide heap leaching would continue for an additional three to four years at the Landusky Mine on the 87 and 91 leach pads, while rinsing and reclamation of the other inactive leach pads would proceed. For the Zortman Mine, final rinsing and reclamation of the 89 leach pad would occur. To date, 20 million tons of ore have been loaded on the leach pads at the Zortman Mine. At Landusky, 107 million tons have been loaded to date.

At the Zortman Mine, no new ore would be loaded onto leach pads and no additional heap leaching would occur, but disposal of lab rinses, fume scrubber runoff, crushed reagent containers, and water treatment plant sludge would continue in the 89 leach pad for an additional two years, until reclamation of that facility around late 1997 or 1998. After that, treatment plant sludge would be deposited in a lined holding pond that would be capped after treatment plant closure. Lab rinses, scrubber runoff and reagent containers would not be generated after mine closure. As described in Section 4.14.4, residual cyanide solution and other compounds may remain in all of the leach pads due to incomplete rinsing. Similarly, residual nitrates from blasting may remain in the leach pads and waste dumps. As for the 89 leach pad, continued disposal of water treatment plant sludge, lab rinses, fume scrubber runoff, and reagent containers would contribute additional opportunity for long-term contamination of the ore mass contained in the leach pad, should final rinsing be ineffective at completely removing, neutralizing, or at least substantially diluting those materials.

The continued active heap leaching at the Landusky Mine on the 87 and 91 leach pads would increase the ore mass that may contain residual cyanide solutions and other hazardous materials/reagents. As described previously, geochemical testing of spent ore has indicated that generation of acid rock drainage is likely within the reclaimed leach pads. Assuming this occurs, it is possible that residual cyanide solution would be neutralized by acidic leachate as these materials drain and mix within the leach pads. Conversely, residual cyanide solution, which is alkaline, could neutralize some of the acid rock drainage as well. In general, as described in Section 4.2.1.3, anticipated water quality from leach pads would include alkaline pHs (with residual cyanide present) in the immediate short-term after reclamation, followed by increased acidity over time as remnant sulfides react, thereby neutralizing residual cyanide in leachate. Sludges from the Landusky water treatment plant would continue to be generated.

The extent that residual hazardous materials within the leach pads and waste rock dumps mobilize and escape into the environment via surface water and groundwater transport would depend on the effectiveness of reclamation capping and water capture and treatment. Effective reclamation capping would minimize infiltration of water that could liberate and/or react with hazardous materials and form contaminated leachate. Effective water capture and treatment would minimize the opportunity for contaminated leachate from impacting water resources downstream of the mine sites. A thorough evaluation of reclamation capping and water capture and treatment measures has been presented in Section 4.2. Based on that evaluation, reclamation covers under Alternative 1 would have minimal effect on reducing infiltration and would not improve water quality above present levels. Water capture and treatment would likely have to continue in the long-term. To the extent leachate from reclaimed facilities contains residual hazardous materials or compounds, the discharge of that leachate is considered to have a negative impact. However, capture and treatment of contaminated leachate would mitigate impacts downstream.

Another routine or normal waste disposal practice under this alternative would be the land application disposal (LAD) of neutralized cyanide solution. LAD would most likely occur at the end of mine life, assuming no emergency LADs would be required. For the Zortman Mine, LAD would occur on Goslin Flats. For the Landusky Mine, LAD would occur on the southeast side of Gold Bug Butte. The Gold Bug Butte location has been permitted for LAD, based on baseline soil data and evaluations of the ability of soil in the LAD area to attenuate cyanide and metals. Assuming LAD is performed properly, neutralized cyanide solution and metals should not impact soil or water resources. If performed improperly, LAD would negatively impact soil and water resources because cyanide and/or metals concentrations would not be effectively attenuated by the soil. Improper LAD can occur if neutralization of cyanide prior to application is ineffective (solution applied to soil has a high cyanide concentration that soil cannot attenuate) and/or application of solution occurs at excessive rates (which could result in runoff of solution into adjacent surface water resources). Under such conditions, vegetation would be lost and/or would fail to reestablish after LAD and wildlife could be lost if exposed to toxic levels of cyanide and/or metals in soil or surface water.

With respect to spills or accidental releases of hazardous materials in the future, the environmental impacts of such a release would depend on which materials are released, the quantity released, and where the release were to occur and the nature and timing of the response. Potential releases could range from a 10 gallon spill of diesel fuel in the fueling area that is immediately and effectively cleaned up, to a catastrophic release of 50,000 gallons of cyanide solution into a surface water drainage. In general, the hazardous materials of greatest concern would be liquid fuels and cyanide. Liquid fuels such as gasoline and diesel are used and stored in large quantities. Cyanide is of concern because it is highly toxic, used in large quantities, has a wide distribution of use at the mine sites (leach pads, ponds, pipelines, process plants), and problems have occurred with spills or accidental releases of cyanide solution in the past.

Diesel fuel and gasoline would continue to be used extensively at the Zortman and Landusky mines as heavy equipment would be used for transportation of ore and waste rock at the Landusky Mine, hauling of reclamation materials, and final capping and grading during reclamation of both mines. As many as 2.6 million gallons of diesel fuel per year would be used at the Landusky Mine alone over the remaining life of this alternative. If spilled or accidentally released, diesel or gasoline could kill vegetation if released in a vegetated area (e.g., truck crashes into forest, overturns and spills fuel), impact surface water quality, and harm aquatic organisms (if spilled into a creek), impact groundwater resources, and/or ignite and cause a fire that either burns mine facilities or causes a forest or grass fire.

Cyanide and cyanide solutions have been and continue to be used in large quantities at both mines, although the Zortman operation is in the process of final rinsing and neutralization of its stock of solution. Not only is cyanide an important concern because of its extreme toxicity, its use is widely distributed at the mine sites in various heap leach pads, solution ponds, and treatment plants, with associated networks of pipelines connecting these facilities. Unlike other hazardous materials, which are stored and used in limited locations, the number and size of facilities containing cyanide solution are extensive, thereby increasing the number of locations where spills or releases could occur. Potential releases in the future could occur as a result of failure of a facility, such as a leak in a leach pad or pond liner, or bursting of a solution pipeline on an unlined surface. In addition, accidental spills or releases could occur as the result of human error, such as the draining of a spray line on an unlined surface. If spilled or accidentally released, cyanide solutions could cause wildlife mortality, impact surface water quality, harm aquatic organisms (if spilled into a creek), or impact groundwater resources. The release of hydrogen cyanide gas would be of greatest concern to mine workers responding to the spill, since the locations where spills could occur are generally removed from populated areas offsite and rapid dilution in air would occur if the spill occurred in an unconfined space.

As described in Section 3.14, gasoline and diesel fuel are stored on-site in aboveground tanks on containment structures. Cyanide and cyanide solutions are generally stored in or on lined heap leach pads or solution ponds to minimize the potential for release into the environment. In addition, mine personnel are trained in emergency response and spill containment practices. For potential future spills of solution that would enter a surface water drainage, ZMI's Cyanide Spill Contingency Plan calls for temporarily damming the affected drainage with earth or impermeable liner, and collection and pumping of the solution back to contained facilities, such as contingency ponds or leach pads. Downstream surface and groundwater monitoring sites would be sampled and analyzed for possible cyanide contamination to confirm that the spill had been contained and impacts minimized. For spills or releases to groundwater, pump back operations would be initiated and recovered solution would be routed to contained facilities. If recovery is incomplete, or migration of contamination is suspected, additional wells would be drilled to facilitate recovery of solution or injection of neutralization solutions, and monitoring of groundwater conditions. The combination of contained storage and emergency preparedness would minimize the chance of an accidental spill or release. Nevertheless, given that spills have occurred in the past at these mines and other cyanide leach gold mines, the probability of such a release in the future is not zero. Depending on the material released, the quantity released, and the location of the release and the response, the magnitude of the associated impacts may vary and could be high and negative. Since the potential impacts associated with accidental spills or releases of hazardous materials vary considerably and cannot be predicted with certainty, no impact rating is assigned.

Other hazardous materials used at the Zortman and Landusky mines such as hydrochloric acid, sodium hydroxide, and calcium hypochlorite are also hazardous. Because of the relatively limited quantities used of these compounds, the limited distribution of use (e.g. refinery only), and substantial containment provided at storage locations the likelihood of a release to the environment is considerably smaller, and these materials are of less concern.

4.14.5.1 Cumulative Impacts

Cumulative impacts associated with past and current use of hazardous materials at the Zortman and Landusky mines under Alternative 1 would be essentially the same as described in Section 4.14.5 and would consist of:

- Potential generation of leachate from spent ore heaps within decommissioned leach pads at both mines. Residual cyanide solution, as well as other process chemicals may remain in the ore heaps due to ineffective rinsing and neutralization over the long-term. Approximately 20 million tons of spent ore would remain within decommissioned leach pads at the Zortman Mine, and 115 million tons would remain in leach pads at the Landusky Mine. Potential infiltration into these heaps could contact and mobilize residual hazardous compounds, which could then be released into the soil and water resources through perforations in leach pad liners. Contamination of water resources with hazardous materials could negatively impact vegetation and wildlife, should contaminated water in creeks or springs be consumed, as well as livestock and human populations should wells or other domestic water supplies be affected. However, capture and treatment of contaminated water would eliminate these impacts.

- Land application disposal (LAD) of cyanide solution in the past contaminated water resources in Alder Gulch. Future LAD under Alternative 1 could also negatively impact soil and water resources in the Goslin Flats area. Impacts could arise from ineffective neutralization of cyanide prior to application and application of solution at excessive rates, which could result in runoff of solution into Goslin Gulch.

- At least six separate spills or accidental releases of cyanide solution have occurred since 1979. As a result, cyanide has been detected in surface and groundwater resources in Ruby and Alder Gulches below the Zortman Mine and in Mill and Montana Gulches below the Landusky Mine. Past cyanide contamination in Alder Gulch has been significant enough to warrant closure and replacement of the town of Zortman's water supply.

4.14.5.2 Unavoidable Adverse Impacts

Past spills or releases of cyanide solutions that have contaminated surface and groundwater resources may prove difficult, if not infeasible to remediate. Although natural processes would degrade spilled cyanide solution over time, it is unclear whether or not this natural degradation would occur before contamination migrates offsite. Efforts to neutralize and/or pump groundwater contaminated with cyanide solution have had limited success to date. Future accidental spills or releases of cyanide solutions could increase this impact, if such releases were similarly difficult to treat, capture, or otherwise neutralize.

Potential future contamination of water resources from leach pads and waste rock dumps draining hazardous leachate would only be avoidable through implementation of long-term monitoring, collection, and treatment of drainage/leachate.

4.14.5.3 Short-term Use/Long-term Productivity

The generation of leachate from reclaimed leach pads that contains residual cyanide, metals, and other reagents could cause long-term negative impacts to surface and ground water resources, vegetation and wildlife downstream of the permit area. Mitigation in the form of monitoring, capture, and treatment of contaminated water would be required.

4.14.5.4 Irreversible or Irretrievable Resource Commitments

The use of hazardous materials or reagents that are made from non-renewable resources, such as gasoline and diesel fuel, would constitute an irreversible and irretrievable loss of those resource commitments.

4.14.6 Impacts From Alternative 2

Alternative 2 would involve no additional mining as described for Alternative 1. The primary difference for Alternative 2 relates to the reclamation measures. Since more intensive reclamation covers would be used, the effectiveness of reclamation as it relates to potential hazardous materials impacts would differ to some extent. In addition, since this alternative would include hauling and placement of clay for reclamation, the use/consumption of diesel fuel, gasoline, oil and lubricants, and antifreeze would increase.

Under Alternative 2, no new leach pads, waste rock dumps or repositories, or other relevant facilities would be constructed. Thus, the locations of hazardous material use, handling, and storage would be the same as described for the 1979 to present timeframe (refer to Sections 3.14 and 4.14.4).

In terms of routine mining activities and waste disposal practices, the potential for residual hazardous materials in reclaimed leach pads and waste rock repositories to react with infiltrating water and leave the facility would be reduced to some extent by more intensive reclamation covers that include a clay layer on facilities identified by ZMI to have acid generating potential. Based on infiltration modeling described in Section 4.2.4, over the short-term, reduced infiltration should reduce the amount of leachate potentially containing hazardous materials, but over the longer term, as the integrity of the clay cap is degraded, infiltration would increase and leachate generation would be similar to that experienced for Alternative 1. Aside from short term reduction of leachate formation, impacts associated with Alternative 2 would the same as described for Alternative 1 and long-term water capture and treatment may be required to mitigate downstream impacts.

LAD would likely occur at the end of mine life. For the Zortman Mine, LAD would probably occur on Goslin Flats. For the Landusky Mine, LAD would occur on the southeast side of Gold Bug Butte. Neutralized cyanide solution and metals would not impact soil or water resources. Improper LAD can occur if neutralization of cyanide prior to application is ineffective (solution applied to soil has high metal concentrations that soil cannot attenuate) and/or application of solution occurs at excessive rates (which could result in runoff of solution into adjacent surface water resources). Under such conditions, vegetation would be lost and/or would fail to reestablish after LAD and wildlife could be lost if exposed to toxic levels of metals in soil or surface water.

With respect to spills or accidental releases of hazardous materials, the environmental impacts of such a release would depend on which materials are released, the quantity released, and where the release would occur. As described for Alternative 1, the hazardous materials of greatest concern would be vehicle fuels and cyanide solution. Since diesel fuel and gasoline would be used in greater quantities under Alternative 2 due to more intensive reclamation capping, the potential for an accidental release is increased to some extent. The potential impacts associated with a spill or release of cyanide solution would be the same as described for Alternative 1, since the quantity and locations of use would be the same.

4.14.6.1 Cumulative Impacts

Cumulative impacts associated with past and current use of hazardous materials at the Zortman and Landusky mines under Alternative 2 would generally be the same as described for Alternative 1 since no new mining would be carried out and the potential sources of contamination (leach pads, LAD, potential for spills before mine closure) would essentially be the same. The primary difference would relate to the use of a clay cap for reclamation of various mine facilities. As described in Section 4.14.6, the proposed clay cap is expected to reduce infiltration and subsequent generation of leachate from leach pads over the short term. However, the cap is expected to degrade over time and lose its effectiveness and, subsequently, the generation of leachate is expected to be similar to that expected for Alternative 1.

4.14.6.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as described for Alternative 1.

4.14.6.3 Short-term Use/Long-term Productivity

Short-term use versus long-term productivity would be the same as described for Alternative 1.

4.14.6.4 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments would be the same as described for Alternative 1 though with increased fuel consumption for transport of reclamation materials.

4.14.7 Impacts From Alternative 3

The primary difference for Alternative 3 relates to the agency mitigated reclamation measures. Since more intensive reclamation covers would be used, relative to Alternatives 1 or 2, the effectiveness of reclamation as it relates to potential hazardous materials impacts would increase to a considerable extent. In addition, since this alternative would include hauling and placement of considerably more clay for reclamation, the use/consumption of diesel fuel, gasoline, oil and lubricants, and antifreeze would increase, relative to Alternatives 1 or 2.

The locations of hazardous material use, handling, and storage would be the same as described for the 1979 to present timeframe (refer to Sections 3.14 and 4.14.4).

In terms of routine mining activities and waste disposal practices, the potential for residual hazardous materials in reclaimed leach pads and waste rock repositories to react with infiltrating water and leave the facility would be reduced to a large extent by more intensive reclamation capping that includes both clay and capillary break layers on virtually all mine facilities. Based on infiltration modeling described in Section 4.2.5, the reclamation covers would be most effective at minimizing infiltration, and therefore, potential generation of leachate contaminated with hazardous materials. In addition, leach pad liners would not be perforated until water quality management objectives have been met for a period of ten years. The combination of more effective reclamation capping, along with extensive leachate monitoring of water quality for leach pads, would greatly reduce the potential for release of contaminated leachate in the future.

LAD would likely occur at the end of mine life. For the Zortman Mine, LAD would probably occur on Goslin Flats. For the Landusky Mine, LAD would occur on the southeast side of Gold Bug Butte. Neutralized cyanide solution and metals would not impact soil or water resources. Improper LAD can occur if neutralization of cyanide prior to application is ineffective (solution applied to soil has a high cyanide concentration that soil cannot attenuate) and/or application of solution occurs at excessive rates (which could result in runoff of solution into adjacent surface water resources). Under such conditions, vegetation would be lost and/or would fail to reestablish after LAD and wildlife could be lost if exposed to toxic levels of metals in soil or surface water.

With respect to spills or accidental releases of hazardous materials, the environmental impacts of such a release would depend on which materials are released, the quantity released, and where the release would occur and the response. As described for Alternatives 1 and 2, the hazardous materials of greatest concern would be vehicle fuels and cyanide solution. Since diesel fuel and gasoline would be used in greater quantities under Alternative 2 due to even more intensive reclamation, the potential for an accidental release is increased to some extent. The potential impacts associated with a spill or release of cyanide solution would be the same as described for Alternative 1, since the quantity and locations of use would be the same.

To minimize the risk of long-term contamination of soil and water resources, the entire Zortman/Landusky mine permit area would be reviewed and inspected prior to mine closure. This mine closure hazardous waste inspection would include a review of surface and groundwater monitoring data and an inspection of all areas where hazardous materials were stored or used to identify evidence of spills or accidental releases that may have contaminated soil and groundwater. Any contaminated soil and/or groundwater would then be remediated to applicable State and Federal standards to prevent migration of contamination offsite and impacts on the environment.

4.14.7.1 Cumulative Impacts

Impacts for both the Zortman and Landusky mines are described above for the life of the project under Alternative 3 and post-closure.

4.14.7.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as described for Alternative 1.

4.14.7.3 Short-term Use/Long-term Productivity

Short-term use versus long-term productivity would be the same as described for Alternative 1.

4.14.7.4 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments would be the same as described for Alternative 1. However, additional fuel resources would be committed to enhanced reclamation covers.

4.14.8 Impacts From Alternative 4

The continued mining at the Zortman and Landusky Mines, along with heap leaching, and reclamation would require continued use of numerous hazardous materials (described in Section 3.14). Final reclamation would be completed around the end of 2007 at Zortman and 2002 at Landusky. Anticipated annual usage of hazardous materials under this alternative is presented in Section 2.8.

At the Zortman Mine, proposed heap leaching of ore would be carried out at the Goslin Flats leach pad. A related feature of this alternative is the relocation of the entire cyanide solution recovery circuit and related hazardous materials use to Goslin Flats adjacent to the leach pad. Aside from cyanide solution, lime, hydrochloric acid, sodium hydroxide, anti scalants, calcium hypochlorite and hydrogen peroxide would all be stored and used at the Goslin Flats leach pad and processing plant complex almost exclusively after final rinsing of the Zortman 89 pad and removal of cyanide solution from the Zortman process ponds are completed (around 1998). Reclamation of the older leach pads and process-related facilities (ponds, pipelines, Merrill-Crowe Plant, etc.) at the Zortman Mine would be carried out over the first few years of this alternative. With a few exceptions (vehicle fuels, ammonium nitrate), this relocation of heap leaching and metal extraction activities shifts the focus of where hazardous materials-related impacts (routine or accidental) may occur to Goslin Flats.

At the Landusky Mine, solution ponds and processing plants would remain at the same locations. Thus, the locations of use, storage, and handling of hazardous materials would not change. Additional mining would merely continue existing hazardous material use, both in terms of location and quantity for about one year.

In terms of routine mining activities and waste disposal practices, new mining and heap leach activities at the Zortman Mine would proceed for approximately seven years after construction of the Goslin Flats leach pad, conveyor, and Carter Gulch waste rock repository were completed. The 89 leach pad would be rinsed and reclaimed, along with the other leach pads at the Zortman Mine. New heap leaching activities at Goslin Flats would involve the treatment of 80 million tons of ore with cyanide solutions. After reclamation of the 89 leach pad is completed, metal hydroxide water treatment plant sludge (2,000 tons per year) would be disposed of on the new leach pad, along with laboratory rinses, and fume scrubber runoff. At Landusky, the addition of approximately 7.6 million tons of new ore on the 87/91 leach pad would prolong the use of cyanide solution until about the end of the year 2000 and would increase the mass of material that could become contaminated with residual cyanide solution and other reagents.

As described for Alternatives 1 through 3, residual cyanide solution, metals, and other reagents may remain in the leach pad ore mass even after rinsing is carried out due to blind-offs or preferential flow patterns that can limit effective rinsing of the ore mass. In general, it is important to note that rinsing is considered to be an adequate means of neutralizing and detoxifying heap leach pads in most cases, and the likelihood of significant retention of cyanide solution and other hazardous materials is low. The potential for presence of residual hazardous materials in the leach pad must be considered after rinsing, however, given that rinsing is not always completely effective and the impacts of the generation and release of hazardous leachate into the environment could be high and negative.

Geochemical testing of spent ore has indicated that generation of acid rock drainage is likely within the reclaimed leach pads. Assuming this occurs, it is likely that residual cyanide solution would be neutralized by acidic leachate as these materials drain and mix within the leach pads. Conversely, residual cyanide solution, which is alkaline, could neutralize some of the acid rock drainage as well. In general, as described in Section 4.2.1.3, anticipated water quality from leach pads would include alkaline pHs (with residual cyanide potentially present) in the short-term after reclamation, followed by increased acidity over time as remnant sulfides react, thereby neutralizing residual cyanide in leachate. Although cyanide would be neutralized by acid rock drainage in the leachate, other hazardous materials, such as acid rinses and metal sludges would remain and could become even more soluble or mobile.

The extent that residual hazardous materials within the leach pads and waste rock repositories mobilize and escape into the environment via surface water and groundwater transport would depend on the effectiveness of reclamation capping and secondary water capture and treatment efforts. Effective reclamation capping would minimize infiltration of water that could liberate and/or react with hazardous materials and form contaminated leachate. A thorough evaluation of reclamation capping and water capture and treatment measures has been presented in Section 4.2. Based on that evaluation, reclamation covers under Alternative 4 would have less than the desired effect at reducing infiltration into the lead pads. As a result, infiltration may over time react with or mobilize residual hazardous materials and generate contaminated leachate. To the extent leachate from the reclaimed leach pads contains residual hazardous materials or compounds, the discharge of that leachate is considered to have a negative impact. Capture and treatment of contaminated leachate would mitigate impacts to receiving waters.

Impacts from generation of contaminated leachate could occur at the older Zortman leach pads, at the Goslin Flats leach pad, and at the waste rock repositories along with any of the leach pads or waste rock repositories at the Landusky Mine. Since Alternative 4 would increase the number of leach pads and waste rock repositories, increase the volume of ore that could become contaminated with cyanide or hazardous material residues, and introduces this impact to a new location (Goslin Flats), the magnitude and distribution of this potential impact would be greater than described for Alternatives 1 through 3.

LAD would occur at the end of mine life. For the Zortman Mine, LAD would occur on Goslin Flats. For the Landusky Mine, LAD would occur on the southeast side of Gold Bug Butte. Evaluations of the ability of soil in the LAD area to attenuate cyanide and metals has been completed. Neutralized cyanide solution and metals should not impact soil, water resources, vegetation, or wildlife. Improper LAD can occur if neutralization of cyanide prior to application is ineffective (solution applied to soil has a high cyanide concentration that soil cannot attenuate) and/or application of solution occurs at excessive rates (which could result in runoff of solution into adjacent surface water resources). Under such conditions, vegetation would be lost and/or would fail to reestablish after LAD and wildlife could be lost if exposed to toxic levels of metals in soil or surface water.

Diesel fuel and gasoline would continue to be used extensively at the Zortman and Landusky mines as heavy equipment would be utilized for transportation of ore and waste rock, hauling of reclamation materials, and final capping and grading during reclamation of both mines. As many as 1.4 and 2.6 million gallons of diesel fuel per year would be used at the Zortman and Landusky mines, respectively. If spilled or accidentally released, diesel or gasoline could kill vegetation if released in a vegetated area (e.g., truck crashes into forest, overturns and spills its fuel), impact surface water quality and harm aquatic organisms (if spilled into a creek), impact groundwater resources if a spill migrates into the ground, and ignite and cause a fire that either burns mine facilities or causes a forest or grass fire. At the Zortman Mine, the vast majority of fuel consumption would be in the pit complex, crusher area, and waste rock repository as opposed to Goslin Flats.

The release of hydrogen cyanide gas would be of greatest concern to mine workers responding to a spill, since the locations where spills could occur are generally removed from populated areas and rapid dilution in air would occur for spills outside of enclosed structures.

As described in Section 3.14, gasoline and diesel fuel are stored on-site in above ground tanks on containment structures. Cyanide and cyanide solutions are generally stored in or on lined heap leach pads or solution ponds to minimize the potential for release into the environment. In addition, mine personnel are trained in emergency response and spill containment practices. For potential future spills of solution that would enter a surface water drainage, ZMI's Cyanide Spill Contingency Plan calls for temporarily damming the affected drainage with earth or impermeable liner, and collection and pumping of the solution back to contained facilities, such as contingency ponds or leach pads. Downstream surface and groundwater monitoring sites would be sampled and analyzed for possible cyanide contamination to confirm that the spill had been contained and impacts minimized. For spills or releases to groundwater, pump back operations would be initiated and recovered solution would be routed to contained facilities. If recovery is incomplete, or migration of contamination is suspected, additional wells would be drilled to facilitate recovery of solution or injection of neutralization solutions, and monitoring of groundwater conditions. The combination of contained storage and emergency preparedness should minimize the chance of an accidental spill or release. Nevertheless, given that spills have occurred in the past, the probability of such a release in the future is not zero. Depending on the material released, the quantity released, and the location of the release and the response, the magnitude of the associated impacts may vary and could be high and negative. Since the potential impacts associated with accidental spills or releases of hazardous materials vary considerably and cannot be predicted with certainty, no impact rating has been assigned.

At the Landusky Mine, cyanide solution would be stored and used in the same locations as has occurred in the past. Therefore, potential spills or releases could impact the same general area as described in Alternatives 1 through 3. The additional mining would extend the use of cyanide solution for about another year, thereby extending the period of risk that an accident or release could occur.

Other hazardous materials used at the Zortman and Landusky mines such as hydrochloric acid, sodium hydroxide, and calcium hypochlorite are also hazardous, yet, because of the relatively limited quantities used, the limited distribution of use (e.g. refinery only), and substantial containment provided at storage locations, these materials are of less concern because the likelihood of a release to the environment is considerably smaller.

4.14.8.1 Cumulative Impacts

Zortman Mine - Cumulative impacts would consist of the combination of impacts from 1979 to the present, the proposed activities under Alternative 4, and impacts from reasonably foreseeable future actions. Impacts from 1979 to present and Alternative 4 were discussed previously. For reasonably foreseeable future actions, the additional mining of 2 million tons of ore in Pony Gulch as an addition to the Zortman Mine would extend active mining for only another four months. The additional 2 million tons of ore would also be leached on the Goslin Flats leach pad, thereby increasing the total mass of ore that could contain residual cyanide solution and other hazardous materials by about 2 percent. Additional heap leaching at the Goslin Flat leach pad would be extended an additional four months, thereby extending the period that an accidental spill or release of cyanide solution or other hazardous material could occur. Active mining in the Pony Gulch area, extraction of limestone from the LS-2 limestone quarry above Zortman or enlargement of the LS-1 limestone quarry, and exploration activities would involve the use heavy equipment and the associated risk of a fuel spill.

Landusky Mine - Reasonably foreseeable mining of an additional 12.2 million tons of ore would extend the life of the Landusky Mine and the period of hazardous material usage (and associated risk of spill or release) for an additional two years. Heap leaching at a new leach pad would add a new facility loaded with spent ore that could contain residues of hazardous materials which could generate contaminated leachate. If an older leach pad were off-loaded and its spent ore backfilled in a pit, the spent ore could be a source of hazardous material residue and contaminated leachate could be generated within the backfilled pit. As described for the leach pads, the potential generation of contaminated leachate could be minimized through effective reclamation capping, and capture and treatment of leachate, if necessary. Continued active mining at Landusky, extraction of limestone from the limestone quarry, and exploration activities would involve the use heavy equipment and the associated risk of a fuel spill.

The use of a water treatment plant at Landusky would result in the generation of metal hydroxide sludge in quantities similar to the Zortman plant. As is the case for the Zortman plant, this sludge would be disposed of in a leach pad and would thereby add material that could react with acidic leachate to mobilize metals. Effective reclamation capping of that leach pad would limit infiltration and potential mobilization of metals, although capture and treatment of leachate may be required.

In summary, the addition of reasonably foreseeable future actions would essentially extend the period of use of hazardous materials and the period that an accidental spill or release could occur. Reasonably foreseeable future actions would increase the volume of spent ore that could contain hazardous material residues and thereby increase the amount and sources of contaminated leachate.

4.14.8.2 Unavoidable Adverse Impacts

Past spills or releases of cyanide solutions that have contaminated surface and groundwater resources may prove difficult, if not infeasible to remediate. Although natural processes would degrade spilled cyanide solution over time, it is unclear whether or not this natural degradation would occur before contamination were to migrate offsite. Efforts to neutralize and/or pump groundwater contaminated with cyanide solution have had limited success to date. Future accidental spills or releases of cyanide solutions could increase this impact, if such releases were similarly difficult to treat, capture, or otherwise neutralize.

Potential future contamination of water resources from leach pads and waste rock repositories draining hazardous leachate would only be avoidable through implementation of long-term monitoring, collection, and treatment of drainage/leachate, should reclamation capping prove ineffective.

4.14.8.3 Short-term Use/Long-term Productivity

The generation of leachate from reclaimed leach pads that contains residual cyanide, metals, and other reagents that could result from mining in the study area over the short-term could cause long-term negative impacts to water resources, vegetation and wildlife downstream of the permit area in numerous drainages without mitigation in the form of monitoring, capture, and treatment of contaminated water.

4.14.8.4 Irreversible or Irretrievable Resource Commitments

The use of hazardous materials or reagents that are made from non-renewable resources, such as gasoline and diesel fuel, would constitute an irreversible and irretrievable loss of those resources.

4.14.9 Impacts From Alternative 5

Use of hazardous materials would continue at both mines until final reclamation were completed around the end of 2007 at the Zortman Mine and the end of 2002 at the Landusky Mine. Anticipated annual usage of hazardous materials would be about the same as Alternative 4 and is described in Section 2.8.

At the Zortman Mine, all heap leaching of new ore would be carried out at the Upper Alder Gulch Leach Pad, with the rest of the cyanide solution circuit remaining in its current place. As a result, the storage, handling and use of hazardous materials related to heap leaching would occur in the same location as before, with exception of the leach pad. At the Landusky Mine, the use, storage, and handling of hazardous materials would be the same as described or Alternative 4.

In terms of routine mining activities and waste disposal practices, new mining and heap leach activities at the Zortman Mine would proceed for approximately seven years after construction of the Upper Alder Gulch leach pad and Carter Gulch waste rock repository were completed. After reclamation of the 89 leach pad, metal hydroxide water treatment plant sludge, laboratory rinses, fume scrubber runoff and crushed reagent containers would be disposed on the new leach pad.

As described for Alternative 4, residual cyanide solution and other hazardous materials may remain in the leach pad ore mass even after rinsing is carried out. Although rinsing is generally considered effective, a low potential exists for residual contaminants to remain present in all of the leach pads at the Zortman and Landusky mines. Depending on whether or not acid rock drainage may form in leachate produced in these leach pads, residual cyanide solution may be neutralized within the heaps before the leachate were to drain out of the facilities. Although the generation of acid rock drainage in the heaps could neutralize residual cyanide, its presence could accelerate the mobilization of metals and other hazardous compounds. Residual nitrates from blasting may also be present in leach pads and waste rock repositories. It is difficult at this time to predict which reactions would occur in the facilities and what contaminants would be present in their leachates.

Under Alternative 5, reclamation of leach pads and waste rock repositories would be more intensive and is likely to be more effective than under Alternative 4 (refer to Section 4.2). As described for Alternative 3, after rinsing, leachate in all of the leach pads would have to meet water quality objectives for 10 years before liner perforation could be performed. The combination of more effective reclamation covers, along with extensive leachate monitoring and water quality objective compliance for leach pads should greatly reduce the potential for release of contaminated leachate in the future, relative to Alternative 4. Conversely, the leach pad site presents a greater risk of seepage and contamination due to the increased hydrostatic head in valley-fill leach pads and the higher quality water resources in Upper Alder Gulch. In addition, the steep valley and complex geology would make seepage capture more difficult compared to the Goslin Flats site.

Land application disposal of neutralized cyanide solution would occur at the end of mine life as described under Alternative 4. Assuming land application disposal is performed properly, there should be no impact on the environment.

With respect to accidental spills or releases of hazardous materials, potential impacts and materials of greatest concern would be the same as described for Alternative 4. For potential spills or releases of cyanide solutions into the environment, the nature, risk, and duration of period that solution would be used would be the same as described for Alternative 4, although the location of use would change for the Zortman Mine. At Zortman, all heap leaching of ore would occur at Upper Alder Gulch, as opposed to Goslin Flats. As a result, if a spill or release were to occur, potential impacts would be experienced in Alder Gulch, Alder Spur, and Ruby Gulch, rather than on Goslin Flats. Additional mining would increase the duration that cyanide solutions would be used and thereby extend the period of risk that a spill or release could occur.

To minimize the risk of long-term contamination of soil and water resources, the entire Zortman/Landusky mine permit area would be reviewed and inspected prior to mine closure. This mine closure hazardous waste inspection would include a review of surface and groundwater monitoring data and an inspection of all areas where hazardous materials were stored or used to identify evidence of spills or accidental releases that may have contaminated soil and groundwater. Any contaminated soil and/or groundwater would be remediated to applicable State and Federal standards to prevent migration of contamination offsite and impacts on the environment.

4.14.9.1 Cumulative Impacts

Cumulative impacts would consist of the combination of impacts from 1979 to the present, the proposed activities under Alternative 5, and impacts from reasonably foreseeable future actions. Impacts from 1979 to present and Alternative 5 were discussed previously. For reasonably foreseeable future actions at the Zortman Mine, extraction of limestone from the ridge above Zortman or enlargement of the Green Mountain limestone quarry, and exploration activities would involve the use heavy equipment and the associated risk of a fuel spill. Reasonably foreseeable future actions and cumulative impacts at the Landusky Mine would be the same as described for Alternative 4.

4.14.9.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as described for Alternative 4.

4.14.9.3 Short-term Use/Long-term Productivity

Short-term use versus long-term productivity would be the same as described for Alternative 4.

4.14.9.4 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments would be the same as described for Alternative 4.

4.14.10 Impacts From Alternative 6

The relocation of the waste rock repository to Ruby Flats instead of Carter Gulch is the primary feature of this alternative. Changing the location of the waste rock repository would shift the location of potential impact from Carter Gulch to Ruby Flats.

Routine mining activities associated with the use and disposal of hazardous materials would generally be the same as described for Alternative 4. For the Zortman Mine, all heap leaching and related solution handling (ponds, processing) would be at the Goslin Flats Leach Pad. Use of vehicle fuels, oil and lubricants, antifreeze, and ammonium nitrate (for blasting) would continue to be at the pit complex primarily. All new waste rock disposal would be at Ruby Flats. As described previously, from a hazardous materials standpoint, the primary concern with waste rock repositories relates to residual nitrates from blasting. Routine mining activities related to hazardous material use and disposal at the Landusky Mine would be the same as described for Alternative 4.

With respect to potential impacts from routine mining activities and waste disposal practices, the potential for residual hazardous materials in reclaimed leach pads and waste rock repositories to react with infiltrating water and leave the facility would be reduced to a large extent by more intensive reclamation covers. Based on infiltration modeling, the reclamation covers for this alternative should be more effective at minimizing long-term infiltration than under Alternative 4. As a result, the potential for generation of contaminated leachate would be reduced. The combination of more effective reclamation covers, along with extensive leachate monitoring for leach pads, should greatly reduce the potential for release of contaminated leachate in the future.

With respect to accidental spills or releases of hazardous materials, potential impacts, locations of impacts and materials of greatest concern would be virtually the same as described for Alternative 4. Since all new heap leaching, cyanide solution storage and processing would take place at Goslin Flats, the risk of future accidental spills or releases of cyanide solution is greatest on Goslin Flats, as opposed to the older Zortman Mine leach pads or process area. Heap leaching activities and related impacts at the Landusky Mine would be the same as described for Alternative 4. Extended mine lives would increase the duration that cyanide solution would be used and thereby extend the period of risk that a spill or release could occur.

To minimize the risk of long-term contamination of soil and water resources, the entire Zortman/Landusky mine permit area would be reviewed and inspected prior to mine closure. This mine closure hazardous waste inspection would include a review of surface and groundwater monitoring data and an inspection of all areas where hazardous materials were stored or used to identify evidence of spills or accidental releases that may have contaminated soil and groundwater. Any contaminated soil and/or groundwater would be remediated to applicable State and Federal standards to prevent migration of contamination offsite and impacts on the environment.

4.14.10.1 Cumulative Impacts

Cumulative impacts would be the same as described for Alternative 4.

4.14.10.2 Unavoidable Adverse Impacts

Unavoidable adverse impacts would be the same as described for Alternative 4.

4.14.10.3 Short-term Use/Long-term Productivity

Short-term use versus long-term productivity would be the same as described for Alternative 4.

4.14.10.4 Irreversible or Irretrievable Resource Commitments

Irreversible or irretrievable resource commitments would be the same as described for Alternative 4.

4.14.11 Impacts From Alternative 7

The relocation of the waste rock repository to the existing mine disturbance area instead of Carter Gulch is one of the primary features of this alternative. Changing the location of the waste repository would shift the location of potential impact from Carter Gulch to the existing mine area.

Routine mining activities associated with the use and disposal of hazardous materials would generally be the same as described for Alternative 4. For the Zortman Mine, heap leaching and related solution handling (ponds, processing) would be at the Goslin Flats leach pad. Use of vehicle fuels, oil and lubricants, antifreeze, and ammonium nitrate (for blasting) would continue to be primarily at the pit complex. Routine mining activities related to hazardous material use and disposal at the Landusky Mine would be the same as described for Alternative 4.

With respect to potential impacts from routine mining activities and waste disposal practices, the potential for residual hazardous materials in reclaimed leach pads and waste rock repositories to react with infiltrating water and leave the facility would be reduced to a large extent by the water balance reclamation covers. The reclamation covers for this alternative should be more effective at long-term minimizing of infiltration than under Alternatives 4, 5 or 6 (refer to Section 4.2.8.6). As a result, the potential for generation of contaminated leachate should be reduced to the largest extent under this alternative. In addition, leach pad liners would not be perforated until water quality management objectives have been met for 10 years. The combination of more effective reclamation capping, along with extensive leachate monitoring for leach pads, should greatly reduce the potential for release of contaminated leachate in the future.

With respect to accidental spills or releases of hazardous materials, potential impacts, locations of impacts and materials of greatest concern would be virtually the same as described for Alternative 4. Since all new heap leaching, cyanide solution storage and processing would take place at Goslin Flats, the risk of future accidental spills or releases of cyanide solution is greatest on Goslin Flats, as opposed to the older Zortman Mine leach pads or process area. Heap leaching activities and related impacts at the Landusky Mine would be the same as described for Alternative 4. Extended mine lives would increase the duration that cyanide solution would be used and thereby extend the period of risk that a spill or release could occur.

To minimize the risk of long-term contamination of soil and water resources, the entire Zortman/Landusky mine permit area would be reviewed and inspected prior to mine closure. This mine closure hazardous waste inspection would include a review of surface and groundwater monitoring data and an inspection of all areas where hazardous materials were stored or used to identify evidence of spills or accidental releases that may have contaminated soil and groundwater. Any contaminated soil and/or groundwater would be remediated to applicable State and Federal standards to prevent migration of contamination offsite and impacts on the environment.

4.14.11.1 Cumulative Impacts

Zortman Mine - Cumulative impacts would consist of the combination of impacts from 1979 to the present, the proposed activities under Alternative 7, and impacts from reasonably foreseeable future actions. Impacts from 1979 to present and Alternative 7 were discussed previously. For reasonably foreseeable future actions, the additional mining of 2 million tons of ore in Pony Gulch as an addition to the Zortman Mine would extend active mining for only another four months. The additional 2 million tons of ore would also be leached on the Goslin Flats leach pad, thereby increasing the total mass of ore that could contain residual cyanide solution and other hazardous materials by about 2 percent. Additional heap leaching at the Goslin Flat leach pad would be extended an additional four months, thereby extending the period that an accidental spill or release of cyanide solution or other hazardous material could occur. Active mining in the Pony Gulch area, extraction of limestone from the LS-2 limestone quarry above Zortman or enlargement of the LS-1 limestone quarry, and exploration activities would involve the use heavy equipment and the associated risk of a fuel spill.

Landusky Mine - Reasonably foreseeable mining of an additional 12.2 million tons of ore would extend the life of the Landusky Mine and the period of hazardous material usage (and associated risk of spill or release) for an additional two years. Heap leaching at a new leach pad would add a new facility loaded with spent ore that could contain residues of hazardous materials which could generate contaminated leachate. If an older leach pad were off-loaded and its spent ore backfilled in a pit, the spent ore could be a source of hazardous material residue and contaminated leachate could be generated within the backfilled pit. As described for the leach pads, the potential generation of contaminated leachate could be minimized through effective reclamation capping, and capture and treatment of leachate, if necessary. Continued active mining at Landusky, extraction of limestone from the limestone quarry, and exploration activities would involve the use heavy equipment and the associated risk of a fuel spill.

The use of a water treatment plant at Landusky would result in the generation of metal hydroxide sludge in quantities similar to the Zortman plant. As is the case for the Zortman plant, this sludge would be disposed of in a leach pad and would thereby add material that could react with acidic leachate to mobilize metals. Effective reclamation capping of that leach pad would limit infiltration and potential mobilization of metals, although capture and treatment of leachate may be required.

In summary, the addition of reasonably foreseeable future actions would essentially extend the period of use of hazardous materials and the period that an accidental spill or release could occur. Reasonably foreseeable future actions would increase the volume of spent ore that could contain hazardous material residues and thereby increase the amount and sources of contaminated leachate.

4.14.11.2 Unavoidable Adverse Impacts

Past spills or releases of cyanide solutions that have contaminated surface and groundwater resources may prove difficult, if not infeasible to remediate. Although natural processes would degrade spilled cyanide solution over time, it is unclear whether or not this natural degradation would occur before contamination were to migrate offsite. Efforts to neutralize and/or pump groundwater contaminated with cyanide solution have had limited success to date. Future accidental spills or releases of cyanide solutions could increase this impact, if such releases were similarly difficult to treat, capture, or otherwise neutralize.

Potential future contamination of water resources from leach pads and waste rock repositories draining hazardous leachate would only be avoidable through implementation of long-term monitoring, collection, and treatment of drainage/leachate, should reclamation capping prove ineffective.

4.14.11.3 Short-term Use/Long-term Productivity

The generation of leachate from reclaimed leach pads that contains residual cyanide, metals, and other reagents that could result from mining in the study area over the short-term could cause long-term negative impacts to water resources, vegetation and wildlife downstream of the permit area in numerous drainages without mitigation in the form of monitoring, capture, and treatment of contaminated water.

4.14.11.4 Irreversible or Irretrievable Resource Commitments

The use of hazardous materials or reagents that are made from non-renewable resources, such as gasoline and diesel fuel, would constitute an irreversible and irretrievable loss of those resources.

CHAPTER 5.0

CONSULTATION AND COORDINATION

5.1 PUBLIC INVOLVEMENT

A Notice of Intent, formally announcing the beginning of the EIS process, was published in the Federal Register in November 1992. The public has been informed of and involved in the EIS process through Federal Register Notices, news releases, direct mailings, and public meetings. In addition, throughout the process, briefings were held with interested publics, Fort Belknap Community Council, Phillips County Commissioners, and Congressional Staffs.

Public scoping meetings were held in the following communities to identify issues and concerns related to the mine life extensions of the Zortman and Landusky mines:

- Dodson, December 15, 1992
  (26 people attended),

- Malta, December 16, 1992
  (39 people attended),

- Hays, December 17, 1992
  (27 people attended), and

- Lodgepole, April 15, 1993
  (30 people attended in the afternoon meeting and 75 people attended the evening meeting).

About 400 copies of the Draft EIS were distributed to the public and other federal and state agencies. A notice of availability of the Draft EIS was published in the Federal Register on August 14, 1995. This was followed by a notice of filing by the Environmental Protection Agency published in the Federal Register on August 18, 1995. The public comment period extended from August 18, 1995 through November 1, 1995 (75 days).

Five open houses/public hearings were held in the following communities to receive oral and written comments on the Draft EIS:

- Lodgepole, September 18, 1995
  (129 people attended with 47 speakers),

- Hays, September 19, 1995
  (153 people attended with 40 speakers),

- Malta, September 20, 1995
  (186 people attended with 22 speakers),

- Landusky, September 21, 1995
  (108 people attended with 14 speakers), and

- Great Falls, September 26, 1995
  (280 people attended with 77 speakers)

The following is a list summarizing the issues and concerns identified by the public which have been addressed in this document:

- Water quality and water supply
- Acid rock drainage
- Wildlife protection and mortalities
- Protection of vegetation and wetlands
- Potential impacts to cultural resources
- Soil characteristics and reclamation issues
- Impacts to geology
- Noise and air quality issues
- Socioeconomic concerns
- Recreational issues and concerns
- Visual and aesthetic impacts and concerns
- Concerns regarding land use and recreation
- Safety hazards from transportation of hazardous materials
- Concerns with effects on human health
- Engineering concerns and potential impacts to human health and environment
- Environmental policy and planning issues
- Possible alternatives to the proposed action

5.2 CONSULTATION

Agencies and organizations contacted and consulted during development of the Draft and Final EIS include:

Advisory Council on Historic Preservation
Agency for Toxic Substances and Disease Registry
Bat Conservation International
Montana Department of Fish, Wildlife and Parks
Montana Department of Transportation
Montana Natural Heritage Program
Montana State Historic Preservation Office
United States Army Corps of Engineers
United States Bureau of Indian Affairs
United States Environmental Protection Agency - Region VIII
United States Fish and Wildlife Service

Consultation under Section 7 of the Endangered Species Act has been completed with the U.S. Fish and Wildlife

Service. Results of this process are included in Appendix C, Biological Assessment.

Consultation under Section 106 of the National Historic Preservation Act has been completed with the State Historic Preservation Office and the Advisory Council on Historic Preservation. This process included six public meetings to develop a Memorandum of Agreement and ultimately a Programmatic Agreement for the treatment and mitigation of historic properties in the Little Rocky Mountains (see Appendix E).

5.3 DISTRIBUTION LIST

The following is a list of organizations, agencies, and individuals to whom this Final EIS or the Final EIS Executive Summary has been distributed.

County Commissioners

Blaine County
Phillips County

State of Montana

Bureau of Mines and Geology
Department of Commerce
Department of Environmental Quality
Department of Fish, Wildlife and Parks
Department of Natural Resources and Conservation
Environmental Quality Council
Governor's Office
Montana State Library
State Historic Preservation Office

Congressional

Honorable Max Baucus
Honorable Conrad Burns
Honorable Pat Williams

Federal

Army Corps of Engineers
Bureau of Indian Affairs
Bureau of Reclamation
Department of Energy
Department of Justice
Environmental Protection Agency
Field Solicitor's Office
Fish and Wildlife Service
Gallatin National Forest
Geological Survey
Mineral Management Service
National Park Service
Office of Environmental Policy and Compliance

Tribal Councils and Committees

Fort Belknap Community Council
Fort Belknap Environmental Protection Department
Fort Belknap Fish and Wildlife
Fort Belknap Planning Department
Fort Belknap Land Committee
Chippewa Cree Tribe
Crow Tribal Council

Libraries

Harlem Public Library
Havre City Library
Lewistown City Library
Montana Tech Library
Phillips County Public Library

Organizations

American Wildlands
Associates of Montana Mining
Beartooth Alliance
Bozeman Historic Preservation Advisory Board
Environmental Education and Policy Network
Glasgow Area Chamber of Commerce
Greater Yellowstone Coalition
Indian Law Clinic
Indian Law Resource Center
Island Mountain Protectors
Land and Water Fund
Landusky School Board
Little Rockies CRM
Malta Area Chamber of Commerce
Mineral Policy Center
Montana Environmental Information Center
Montana Mining Association
Montana River Action Network
Montana Wilderness Association
National Wildlife Federation
Nature Conservancy, The
Northern Plain Resource Council
People for the West
Phillco Economic Growth Council
Red Thunder, Inc.
Sierra Club Legal Defense
Spirit Mountain Cultural Clan
Square Butte Grazing Association
TEAM
Western Environmental Law Center
Wilderness Society, The
Wildlands Studies and Information Center
Zortman Water Users Association

Businesses

Adrian Brown Consultants, Inc.
Battle Mountain Gold
Big Flat Electric Cooperative, Inc.

Billings Gazette
Boulding Soil-Water Consulting
Clausen & Sons, Inc.
Echo Bay Mines
Ezziie's Wholesale, Inc.
Givens, Pursley & Huntley
Great Falls Tribune
Hydrometrics
Independence Mining Co.
KEMC
KMMR Radio
KOJM-KPQX
KPMG
Little Rockies Outfitting
Marble Law Office
Merrill Lynch
OEA Research
Parsons, Behle & Latimer
Pegasus Gold Corporation
Phelps Dodge Corp.
Phillips County News
Riverside Todr. Inc.
Santa Fe Pacific
Schwab Cultural Consulting
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Marian Ereaux
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CHAPTER 6.0

RESPONSE TO PUBLIC AND AGENCY COMMENTS

This Environmental Impact Statement (EIS) was initiated by Montana Department of Environmental Quality (DEQ) and the U.S. Department of the Interior, Bureau of Land Management (BLM) in response to Zortman Mining, Inc.'s permit application to expand mine operations at the Zortman and Landusky mines. As discussed in Section 1.4 of this EIS, this process is required by the Montana and National Environmental Policy Acts (MEPA and NEPA). The BLM and DEQ (referred to as "the agencies") are the lead agencies for preparation of the EIS.

To identify issues and concerns associated with the proposed action, the agencies held public scoping meetings in Dodson (12/15/92), Malta (12/16/92), Hays (12/17/92), and Lodgepole (6/15/93), Montana. Prior announcements of the meetings were made using press releases, mailed notices, and public service announcements. In addition, copies of ZMI's application were available in Harlem, Malta, Lewistown, Billings, and Helena for public review. The public was encouraged to submit comments at the meetings or in writing to the agencies. A number of written comments were received as a result of the public scoping meetings. Details of the public meetings and written comments can be found in the Public Scoping Issues Report issued October 1993 for the Zortman Mine Expansion EIS, and the Report Addendum issued May 1994 for the Landusky Mine.

In August of 1995, a Draft EIS was issued for the Zortman and Landusky mines reclamation plan modifications and mine life extensions. This document presented seven alternatives including the agencies' preferred alternative (Alternative 7) and the company proposed action (Alternative 4). The Draft EIS disclosed the affected environment and the environmental consequences of each alternative.

The Draft EIS was issued with an invitation to the public and interested parties to make oral and written comments. Five open houses/meetings were held to discuss the Draft EIS, at the Medicine Bear Lodge in Lodgepole (9/18/95), John Capture Center in Hays (9/19/95), Guard Armory in Malta (9/20/95), Community Hall in Landusky (9/21/95), and East Middle School in Great Falls (9/26/95). All individuals that requested to speak at the public meetings were given a five minute period to express their comments and concerns. Individuals that exceeded their five minutes were allowed additional time to continue their remarks after all speakers had been given an opportunity to comment. There were 47 speakers at the Lodgepole meeting, 40 at the Hays meeting, 22 at the Malta meeting, 14 at the Landusky meeting, and 77 at the Great Falls meeting. There were seven individuals at the Great Falls meeting that requested to speak but were unable to do so because of the length of the meeting. All participants were encouraged to submit written comments. Written transcripts of the meetings were compiled in order to address and respond to comments in the Final EIS. These meetings were also a forum for the U.S. Department of Army Corps of Engineers to collect public comments on Zortman Mining, Inc.'s 404(b)(1) permit applications for the Zortman and Landusky mine expansions. Table 6.0-1 contains the names of the speakers at the public meetings in the order that they spoke.

The public comment period extended from August 18, 1995, through October 17, 1995. At the request of some commentors, the comment period was subsequently extended to November 1, 1995. A total of 368 written comment letters were received by the agencies. Table 6.0-2 contains a list of the comment letter numbers along with the author and date the letter was received. Federal, state, or local agencies are also identified, as are businesses and special interest organizations.

The transcripts and written comments were compiled and coded according to the various resource subjects, i.e., water resources, cultural resources, wildlife. All comments, written and oral, were reviewed and considered in preparation of the Final EIS. Comments that presented new data, questioned facts or analysis, or raised questions or issues bearing directly upon the alternatives or environmental analysis are responded to in this Final EIS. Comments expressing personal opinions or statements were considered but not responded to directly. Public and agency comments and the response to comments have been detailed in Sections 6.1 through 6.17. The comments within each section are numbered; therefore, comments can be referenced by the section number along with the comment number within the section (i.e., "**6.5:** 3, 7" are comment numbers 3 and 7 in Section 6.5 - Water Resources). Table 6.0-3 lists the various resource subjects and the comment numbers within each section. Tables 6.0-4A and 6.0-4B contain reference charts listing hearing speakers by assigned number, and comment letters and authors along with the response index number(s) that address the issues presented by each speaker or letter.

TABLE 6.0-1
PUBLIC HEARINGS LIST OF SPEAKERS

Order	#	Name	Order	#	Name
LODGEPOLE MEETING			6	LO-27	John Koss
1	LO-33	Don Marble	29	LO-28	Ken Eickerman
2	LO-8	Darryl Crasco	30	LO-29	Kevin Ryan
3	LO-26	John Hawley	34	LO-30	Steve Smith
44	LO-2	Catherine Halver	32	LO-31	Amy Thompson
5	LO-3	Jessie Hawley	33	LO-42	Rod Boland
6	LO-8	J. C. Wise	34	LO-33	Don Marble
4	LO-8	Charles Ereaux	45	LO-34	John Doney
6	LO-8	James Main, Sr.	30	LO-35	Rhonda Snell
6	LO-3	Jill Hala	34	LO-36	Rick Valois
18	LO-8	Ken Helgeson	38	LO-37	Ed Halver
18	LO-9	Doug Ost	34	LO-38	Barbara Burkland
42	LO-18	Tom Thompson	40	LO-39	Paul English
13	LO-18	Rose Main	41	LO-40	Kenneth Main
14	LO-13	Dora Helgeson	42	LO-41	Nona Main
18	LO-18	Will Patric	43	LO-42	Robert Walker
16	LO-13	Ed Bibeau	44	LO-43	Virgil McConnell
18	LO-18	Bob Cochell	45	LO-49	Vicki Freyholtz
18	LO-18	Brenda Rummel	46	LO-50	Arlo Skari
14	LO-17	Joe Azure	47	LO-50	JR Horse Capture
20	LO-20	Poncho Bigby			
21	LO-18	Pat Murray	**HAYS MEETING**		
22	LO-18	Wayne Thompson	4	HA-55	John Hawley
23	LO-21	Joseph Iron Man	2	HA-7	Darryl Crasco
29	LO-22	Clark Kelly	3	HA-56	Tracy Charles King
25	LO-23	Robert Stevenson	4	HA-1	Dean Stiffarm
26	LO-20	Cheryl Carlson	5	HA-2	Darling Garrison
27	LO-25	Roy Cochran	6	HA-3	Wayne Thompson

TABLE 6.0-1
PUBLIC HEARINGS LIST OF SPEAKERS

Order	#	Name	Order	#	Name
7	HA-5	Wendy Stiffarm	34	HA-37	Lucille Kirkaldie
8	HA-6	Robert Stevenson	35	HA-50	Joan Gabelman
9	HA-8	James Main, Sr.	36	HA-51	R. J. Walker
10	HA-9	Linda Kinsey	37	HA-52	Charles Ereaux
11	HA-11	Poncho Bigby	38	HA-53	Rose Main
12	HA-12	Fuzz Carnahan	39	HA-50	Warren Matte
13	HA-13	Morris Belgard	40	HA-49	Shannon Werk
14	HA-14	Jeffrey Havig	NP*	HA-19	Evelyn Werk
15	HA-15	John Doney	*NP - Not available when called.		
16	HA-17	Francis Kolczak	**MALTA MEETING**		
17	HA-18	Rod Boland	1	MA-4	Dan Walter
18	HA-20	Virgil McConnell	2	MA-2	Gilbert Caballero
19	HA-21	Nick Cebulski	3	MA-4	Ron Scott
20	HA-22	Duane Cebulski	4	MA-4	Jeanne Barnard
21	HA-23	Joe Azure	5	MA-5	Jim Carver
22	HA-24	Rhonda Snell	6	MA-6	Jim Sandsness
24	HA-25	Joseph Kirkaldie	7	MA-7	Sam Watens
24	HA-26	Arlene Crasco	8	MA-8	Jeff Youkin
25	HA-27	Steve Smith	9	MA-9	William Parker
26	HA-28	Amy Thompson	10	MA-10	Greg Kielb
27	HA-29	Clark Armstrong	14	MA-11	Paul Kunze
28	HA-30	Kevin Ryan	12	MA-12	Clark Kelly
29	HA-31	Will Patric	13	MA-13	Dwayne Harris
30	HA-32	John Jones	14	MA-14	Kevin Ryan
31	HA-33	Jeremy Walker	15	MA-15	Arlene Crasco
32	HA-34	James Walker	16	MA-16	Ken Eickerman
33	HA-36	Mary Whitecow	17	MA-17	Larry Poulton

TABLE 6.0-1
PUBLIC HEARINGS LIST OF SPEAKERS

Order	#	Name	Order	#	Name
18	MA-18	Bill Hicks	8	GF-9	Greg Peterson
19	MA-19	Frank Green	9	GF-5	Paul Kuuze
20	MA-25	Leonard Leader	10	GF-6	Terry Hertel
21	MA-26	Jill Hala	11	GF-7	Robert Stevenson
22	MA-27	Sandy Bevis	12	GF-8	Jim Hasbrouck
LANDUSKY MEETING			13	GF-9	Angela Boland
1	LA-8	Carol Kienenberger	14	GF-10	Jeffrey Havig
2	LA-26	Francis Jacobs	15	GF-14	Ken Gus Helgeson
3	LA-27	Greg Eklund	16	GF-12	Ken Main
4	LA-8	Skip Deaderick	17	GF-14	Nona Main
5	LA-8	Katie Carlson	18	GF-14	Catherine Halver
6	LA-3	Steven Cole	19	GF-15	Bill Halver
4	LA-3	Brenda Rummel	20	GF-16	Mike Irvin
28	LA-6	Vance Spencer	21	GF-17	Nita Periman
9	LA-5	Lesley Robinson	22	GF-18	Cherye Sullivan
10	LA-7	Dale Veseth	24	GF-19	Chuck Watts
11	LA-9	Lars Rasmussen	24	GF-23	Bruce Parker
12	LA-10	Rod Boland	25	GF-21	Joe Micheletti
13	LA-25	Amy Thompson	26	GF-22	Garth Sandsness
14	LA-12	Kevin Ryan	27	GF-23	Arlo Skari
GREAT FALLS MEETING			28	GF-23	Mert Freyholtz
1	GF-33	John Hawley	29	GF-25	James Main, Sr.
2	GF-33	Delmar Poncho Bigby	30	GF-26	Patrick Chief Stick
3	GF-81	Mr. Keneberg	31	GF-27	Charles Ereaux
4	GF-56	Carol Kienenberger	32	GF-82	Ron Gulver
5	GF-1	James Jensen	33	GF-28	August Peterson
6	GF-2	Donald Marble	34	GF-30	Marian Ereaux
7	GF-3	Mike Hickey	35	GF-31	Carl Seilstad

TABLE 6.0-1
PUBLIC HEARINGS LIST OF SPEAKERS

Order	#	Name	Order	#	Name
36	GF-32	Todd Smith	62	GF-65	Leroy Murphy
47	GF-33	John Hawley	63	GF-61	Gene Koch
38	GF-34	Delmar Poncho Bigby	64	GF-66	Ed Bibeau
39	GF-35	Arlene Crasco	65	GF-69	Tom McKay
40	GF-36	Clark Kelly	66	GF-68	Harvey King
71	GF-39	Joe Azure	67	GF-70	Gerald VanCampen
42	GF-39	Amy Thompson	68	GF-71	Clark Carter
43	GF-40	Melinda Gopher	69	GF-72	Dean Stiffarm
44	GF-41	Ben Carter	70	GF-73	Randy Perez
45	GF-42	Mary Gopher	71	GF-74	Will Patric
46	GF-33	Bob Williams	72	GF-75	Rose Main
47	GF-44	Ron Long	73	GF-76	George Fox
48	GF-45	Ed Stephan	74	GF-77	Warren Matte
49	GF-46	Dennis Shea	75	GF-78	Rowena Gone
50	GF-47	Mark Redfern	76	GF-79	Vicky Freyholtz
51	GF-48	Jessie Hawley	77	GF-80	Skip Deaderick (Dutrick)
52	GF-49	Ruth Burlaigh	NA*	GF-80	John Fitzpatrick
53	GF-50	Jack Severns	NA*	GF-60	Doug Ost
54	GF-51	Mike Porter	NA*	GF-60	Art Lundstrom
55	GF-52	Sam Chapman	NA*	GF-63	Kevin Ryan
56	GF-54	Amberly Stiles	NA*	GF-60	John Jones
57	GF-50	Ken Kempa	NA*	GF-64	Steve Smith
58	GF-56	Carol Kienenberger	NA*	GF-60	Robert Gopher
69	GF-59	Jim Sandsness			
60	GF-57	Wayne Dillon			
61	GF-58	Anne Booth			

*NA: Not called due to hearing length; encouraged to submit written comments.

TABLE 6.0-2
ZORTMAN-LANDUSKY DRAFT EIS WRITTEN COMMENT LOG

Date*	Name	#	Date*	Name	#
8/21	Russell D. Cebulski, Dir. Blackdiggers Enterprises	1	9/25	Gordon Booth	25
8/25	Julia M. Cebulski, Dir. Blackdiggers Enterprises	2	9/25	Marianne Dugan Western Environmental Law Center	26
8/28	Mary Ainne Bachia	3	9/26	William Parker	27
8/28	Donald R. Marble	3	9/25	F. Lee Robinson	8
8/29	Amy Thompson	5	9/27	Terry Olsen	29
8/31	Stanley Wilmoth State Historic Preservation Office	6	9/28	Stuart F. Lewin	30
9/11	Ed Bibeau	7	9/25	Leonard & Linda Nungreau	31
9/12	Ed Bibeau	8	9/25	Kenny Ereaux	32
9/12	Ed Bibeau	8	9/25	Mark Kunze	33
9/18	Greg Kielb, KMMR Radio	10	9/25	Delmar "Poncho" Bigby	31
9/15	Keith Beartusk - USDI, Bureau of Indian Affairs, Billings	11	9/25	Jerome Johnson	45
9/20	Jeff D. Younkin, Vice President Glasgow Area Chamber of Commerce	12	9/25	Ron Tucker	36
9/21	James B. Sandeness, President Malta Area Chamber of Commerce	13	9/25	Daniel E. Ereaux	47
9/22	Nathan G. Wilson	10	9/25	Doyle Grant	38
9/22	Pauline Welch	15	9/25	Rhonda I. Snell	39
9/22	Ron Scott, President First State Bank of Malta	16	9/25	Rhonda I. Snell	44
9/18	Louis Kirkaldie	17	9/25	Virgil F. McConnell	31
9/19	Unknown	18	9/25	Dolphus Doney	42
9/21	Per and Winnifred Storli	10	9/25	Peggy Heath	43
9/21	R. E. Pete Clausen Pete Clausen & Sons Inc.	20	9/25	Ron Tucker	44
9/21	David Clausen Clausen & Sons Inc.	21	9/25	Ron Tucker	45
9/21	Frederick H. Miller	22	9/25	Terry Lodmell	46
9/20	Stan Wilmoth State Historic Preservation Office	23	9/25	John Kinkelaar	47
9/25	B. J. "Swede" Goodheart	24	9/25	Delmar "Poncho" Bigby	48

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Continued)

Date*	Name	#	Date*	Name	#
9/25	Delmar "Poncho" Bigby	49	10/3	Elizabeth W. Main	79
9/25	Beverly J. Evins	50	10/3	Linda S. Chandler	80
9/25	John Doney	54	10/3	Willowa Horn Murdock	81
9/25	Gail Main	52	10/3	John A. Allen	82
9/25	Christine Kinkelaar	53	10/3	Duane L. Stiffarm	93
9/25	Banett Lagerquist	54	10/3	Margaret Doney	84
9/25	Ruth M. Burleigh	55	10/3	Pearl Cochran	85
9/25	Jill Hala	56	10/3	Damon J. Castillo	86
9/25	Clark Kelly, T.E.A.M. President	57	10/3	Edward	97
9/29	James Snow III	58	10/3	Lorilane L. K. Walker	88
9/29	Marjean Carnahan	59	10/3	Vivian Webb	89
9/29	Paul Stephens	60	10/3	William E. Halver	90
9/29	Ron Tucker	61	10/3	Elmer M. Main	91
10/2	T.E.A.M.-Sponsored Petition (44 names)	62	10/3	Mike	82
10/2	Mr. & Mrs. Pat Bibeau	63	10/3	Arirela Crasco	93
10/2	Shelly Bibeau	61	10/3	Reva Sears	94
10/2	Sue & Bob Dickenson	65	10/3	Jeannie J. Farrar	95
10/2	Allan T. Kolczak	66	10/3	Thomas Watts	96
10/2	Allan T. Kolczak	67	10/3	Jeremy P. Limpy	97
10/2	Clark Kelly, President T.E.A.M.	68	10/3	Ray Lynn	98
10/2	T.E.A.M.-Sponsored Petition (406 names)	69	10/3	Jackie Hendrickson-Grant	99
10/3	Violet Yellow	70	10/3	Charles J. Dillon	106
10/3	Julean Horseman	71	10/3	Mathew James Ball	103
10/3	Carol Kindness	72	10/3	John Main	102
10/3	Cecilia Shorman	73	10/3	Tom Cochran	103
10/3	Sherry Bishop	73	10/3	John Grant	103
10/3	Eva Walker	75	10/3	Mitchell Braker	105
10/3	Teresa Brockie	76	10/3	Veronica A. Dillon	106
10/3	Charlene Tipton	77	10/3	Unknown	107
10/3	Delores A. Stump	78	10/3	Anthony Shambo	108

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Continued)

Date*	Name	#	Date*	Name	#
10/3	Gena Wease	109	10/10	T.E.A.M. Petition (19 names)	137
10/3	Dawn Cochran	110	10/10	Glen A. Phillips	139
10/3	Clyde Wing	111	10/10	Lane Schipman	139
10/3	David Doney, Sr.	112	10/10	Carley McCauley	140
10/3	Ed Dayth	113	10/10	Peter T. Barbatsuly	141
10/3	Lois R. Shortman	114	10/11	Clark Kelly, President T.E.A.M.	142
10/3	Donna M. Quincy	115	10/11	Lynda E. Brown	143
10/3	Robin Walsh	116	9/26	Amy Thompson	140
10/3	John Filertel	117	9/26	Joseph W. Azure	145
10/3	Joyce Gone	118	9/26	James Mari, Sr.	146
10/3	Gordon Ball	119	9/26	Dorothy Gopher	147
10/3	Theresa M. Fox	120	9/26	Kenneth Main	148
10/3	Christine Heppner	121	9/26	David Healy	149
10/3	Sylvia Heppner	122	9/26	Mary Gopher	150
10/3	Wesley Bear	123	9/26	Nora M. Main	151
10/3	Carol A. Cochran	124	9/26	Raymond Chandler	152
10/3	Rhea Miner	125	9/26	Stephen L. Gone, Jr.	153
10/3	Don Holzheimer Industrial Electronics	126	9/26	Becky Brisbo	154
10/3	Kathryn Hiestand Neal Miller	127	9/26	Rose Main	155
10/3	Ed Bibeau	128	9/26	Rowena Gone	156
10/4	Pat Bibeau & Family	129	9/26	Harvey King	157
10/4	Louis Bibeau	130	9/26	Brian Robinson	158
10/5	Debbie Kindle	131	9/26	Terry Hertel	158
10/5	Bob and Theresa Frye	132	9/26	George Took the Shield	160
10/5	Clark Kelly, President T.E.A.M.	133	9/26	Chippewa Cree Tribe (GF-81)	161
10/5	Wm. K. & M. L. French	134	9/26	George Took the Shield	162
10/6	Clark T. Carter People for the West	135	9/26	Kevin Ryan	163
10/6	Lars Rasmussen	136	9/26	Wayne Dillon	164

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Continued)

Date*	Name	#	Date*	Name	#
9/26	Sylvia M. Stiffarm	165	10/12	Paul Never Miss a Shot	194
9/26	Dean L. Stiffarm, Sr.	166	10/12	Gordon Booth	192
9/26	Mike Porter	167	10/12	Joan W. Montagne	193
9/26	Mike Porter	168	10/12	Lewis A. McLeord	194
9/26	Lloyd Malmend	169	10/12	Georgia Case	195
9/26	Gene Koch	178	10/12	Bill Swaney	196
9/26	Pat Lundstrom	171	10/12	Pat F. Calf Looking	197
9/26	James Flansburg	172	10/12	Mary B. Price	198
9/26	Terri Flansburg	173	10/16	Dean Pearson	194
9/26	Angela Boland	173	10/16	Kim Guderjohn	200
9/26	Marian Ereaux	175	10/16	Pauline Welch	201
9/26	Ed Stepan	176	10/16	Clare Nomee, Chairman Crow Tribal Council	202
9/26	Clark Kelly	177	9/18	U.S. Environmental Protection Agency Region VIII, Montana Office	203
9/26	Arlene Crasco	178	9/18	Kevin Ryan	204
9/26	Robert Stevenson	179	9/18	Amy Thompson	205
9/26	Paul Kunze	180	9/18	John Doney	206
9/26	Delmar "Poncho" Bigby	181	9/18	Robert Stevenson	207
9/26	Anne M. Boothe Phillco Economic Growth Council	182	9/18	Louis Kirkaldie	208
9/26	Harlan Mount, President Fort Belknap Community Council	183	9/18	Tom Thompson	209
9/26	Harvey King	184	9/18	Jill Hala	210
9/26	John P. Jones	185	9/18	Will Patric Mineral Policy Center	211
9/26	Delmar "Poncho" Bigby	186	9/18	Brenda Rummel Little Rockies Outfitting	212
9/26	Clara Nomee, Chairman Crow Tribal Council	187	9/18	Delmar "Poncho" Bigby	213
9/26	Sam Chapman	168	9/18	Delmar "Poncho" Bigby	214
9/26	Ed Bibeau	189	9/18	Pat Murray	215
9/26	Amberly Stiles	190	9/18	Cheryl Carlson	216

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Continued)

Date*	Name	#	Date*	Name	#
9/19	John P. Jones	217	10/18	Joe Depuydt	243
9/19	Kevin Ryan	218	10/18	Roy Neumiller	244
9/19	Robert Stevenson	219	10/18	Jerrold "Bud" Slade	245
9/19	Steve Smith	220	10/18	Dennis Clausen	246
9/19	Amy Thompson	221	10/19	John M. Porter	237
9/19	Delmar "Poncho" Bigby	222	10/19	Dorothy Salsbery	248
9/20	Jill Hala	223	10/19	Thomas W. Tangen	249
9/20	Jeanne Barnard, Manager Big Flat Electric Cooperative, Inc.	224	10/20	Leonard Seaford	250
9/20	Frank Green	225	10/23	Teresa McKeon	251
9/20	R. E. Pete Clausen Pete Clausen and Sons Inc.	226	10/23	Judy Shafer USDI, National Park Service	252
9/20	Jeff D. Younkin, Vice President Glasgow Chamber of Commerce	227	10/23	Thomas J. Miller	253
9/20	Kevin Ryan	228	10/24	Mr. & Mrs. Pat Bibeau and Family	254
9/20	Gilbert Caballero	229	10/24	Mr. & Mrs. Pat Bibeau and Family	255
9/20	Vance Spences	230	10/24	Shelly Bibeau	256
9/20	Brenda Rummel Little Rockies Outfitting	231	10/24	Katy Matovich	257
9/21	A. J. "Skip" Deaderick	232	10/24	Arlo Skari	258
9/20	Lesley Robinson	233	10/25	Amy Thompson	259
9/20	Phillips County Board of County Commissioners	234	10/26	David J. Ryzak	260
10/17	Marianne Caballero	235	10/26	Mary E. Ryzak	261
10/17	Dale Slade	236	10/26	Sandy Carnahan	262
10/17	Beth Slade	237	10/27	Michael J. Carney	263
10/17	Judy L. Merwin & Family	238	10/27	Jeanne Kolis	263
10/17	Jane Ray	239	10/27	Darrell & Vicki Olson	265
10/18	Lawrence Fickler	240	10/27	Kevin Salsbery	266
10/18	Cody Young	241	10/27	Russell Boulding Boulding Soil-Water Consulting	267
10/18	John Holman	242	10/30	Carol A. Gray	268

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Continued)

Date*	Name	#	Date*	Name	#
10/30	James B. Sandsness	269	10/30	Will Bird	297
10/30	Lesley Robinson, Chairperson Little Rockies CRM	270	10/30	Eleanor Ducharme	298
10/30	Carol Smith	271	10/30	April Borseire	299
10/30	Larry McCaffery Continental Supply, Inc.	272	10/30	Darlene Parisian	300
10/30	Chris L. Grove	273	10/30	Amy H. Messerly	301
10/30	Gary A. Langley, Executive Director Montana Mining Association	274	10/30	Tracy No Big Leggins	302
10/30	Dora Helgeson	275	10/30	Christine Main	303
10/30	Wanda Raining Bird	276	10/30	Lonnie Brown	304
10/30	Daniel E. Healy	277	10/30	Bird Mae Shortman	305
10/30	Mary Bird	278	10/30	Marjorie Walker	306
10/30	Wm. H. Longknife	279	10/30	Andrew Walker	307
10/30	Dorcus Has Eagle	280	10/30	Kimberly Brockie	308
10/30	Wallace Chopwood	281	10/30	Ruby Brockie	309
10/30	Wanda Cliff	282	10/30	Vernie B. Main	310
10/30	Allen Stiffarm	283	10/30	James Main, Sr.	311
10/30	Florence Horn	284	10/30	Patti Jo Doney	312
10/30	John Main	285	10/30	Francine Afong	313
10/30	Ed Moore, Sr.	286	10/30	Bari Painter	314
10/30	Rowena Gone	287	10/30	Mary Kuntz	315
10/30	Alfred Bradley	288	10/30	Cecilia DeCelles	316
10/30	Gerald B. Main, Sr.	289	10/30	William T. Main	317
10/30	Sarah G. Doney	290	10/30	Donovan Archambault	318
10/30	Perry J. Plumage	291	10/30	Misty Arcand	319
10/30	Theodore M. Doney	292	10/31	William Patric Mineral Policy Center	320
10/30	Cora Davis	293	10/31	Darlene Kolczak	321
10/30	Stacey Healy	294	10/31	Don & Eva Robinson	322
10/30	Neal Has Eagle	295	10/31	Darlene Kolczak Landusky School Board	323
10/30	Sophia Healy	296	10/31	Michael V. Main	324

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Continued)

Date*	Name	#	Date*	Name	#
11/1	Claude E. Ereaux, President Ezzie's Wholesale, Inc.	325	11/1	Fort Belknap Community Council by Western Environmental Law Center	343
11/1	Daniel J. Bennett, President Island Range Chapter, MWA	326	11/1	Donald H. Kern, Program Director Montana River Action Network	345
11/1	Mark Cole, President Associates of Montana Mining	327	11/1	Candace Thomas, Planning Division U.S. Army Corps of Engineers	340
11/1	Florence Ore, Chair Northern Plains Resource Council	328	11/1	James Jensen, Montana Environmental Information Center	337
11/1	Sandra McIntyre Northern Rockies Wilderness Society	327	11/1	Edie Adams - USDI, Bureau of Indian Afairs, Fort Belknap	348
11/1	Jay W. Mount	330	11/1	Florence Ore, Chair Northern Plains Resource Council	349
11/1	Genevieve Nez Perce	331	11/1	Rose Main, MPA	350
11/1	Vera Garmann	332	11/1	Indian Law Clinic, U of M for Fort Belknap Environmental Protection Office	351
11/1	Barbara Schmidt	333	11/1	Joseph W. Azure - Fort Belknap Environmental Education and Policy Network	352
11/1	Amy Thompson	339	11/1	Ina L. Nez Perce	353
11/1	Joseph W. Azure Fort Belknap Community Council	335	11/1	Bob	354
11/1	Joseph W. Azure Fort Belknap Community Council	335	11/1	Sharon L. Willows, C.L.A.	355
11/1	William P. Yellowtail U.S. EPA, Region VIII	337	11/2	B. Derek Strahn	359
11/1	Len Broberg	338	11/2	Trista Hoffman	357
11/1	Charles M. Rose	339	11/2	Smucky Mann	358
11/1	Thomas France, Sr. Counsel National Wildlife Federation	340	11/2	Francis Kolczak	359
11/1	David Schwab Schwab Cultural Consulting	341	11/2	Virgil McConnell, Chief Spirit Mountain Cultural Clan	360
11/1	Kevin J. Ryan Pegasus Gold/Zortman Mining, Inc.	332	11/2	Bob Golten, U of Colorado, Indian Law Clinic for Island Mountain Protectors	361
11/1	Jack F. Trope	343	11/3	Susan Daggett and David M. Chambers Sierra Club Legal Defense Fund	362

TABLE 6.0-2 - WRITTEN COMMENT LOG
(Concluded)

Date*	Name	#	Date*	Name	#
11/6	Jim Barrett, Chair The Beartooth Alliance	363			
11/7	Keith Beartusk and Bill Borges USDI, Bureau of Indian Affairs	364			
11/11	Don Bachman	365			
11/14	David Pennington USDI, Bureau of Indian Affairs	366			
11/30	Harlan Mount, President Fort Belknap Community Council	367			
11/29	Fort Belknap Community Council by Western Environmental Law Center	368			

TABLE 6.0-3
RESOURCE SUBJECTS AND COMMENT NUMBERS

Section	Resource Subject	Comment Numbers
6.1	Process	**6.1:** 1 to 79
6.2	Alternatives	**6.2:** 1 to 164
6.3	Geology	**6.3:** 1 to 17
6.4	Geochemistry	**6.4:** 1 to 37
6.5	Water Resources	**6.5:** 1 to 256
6.6	Soil and Reclamation	**6.6:** 1 to 14
6.7	Vegetation	**6.7:** 1 to 13
6.9	Wetlands and Other Waters of the U.S.	**6.8:** 1 to 45
6.9	Wildlife and Aquatics	**6.9:** 1 to 36
6.15	Air Quality	**6.10:** 1 to 27
6.11	Visual Quality	**6.11:** 1 to 3
6.12	Recreation, Land Use, and Transportation	**6.12:** 1 to 6
6.13	Noise	**6.13:** 1 to 2
6.14	Socioeconomics	**6.14:** 1 to 18
6.15	Cultural Resources	**6.15:** 1 to 75
6.16	Hazardous Materials	**6.16:** 1 to 15
6.17	Editorial	**6.17:** 1 to 30

TABLE 6.0-4A
PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER

Hearing Number and Individual		Response Index Number
LO-1	Darryl Crasco	**6.1:** 1
LO-2	Catherine Halver	**6.1:** 49
LO-3	Jessie Hawley	
LO-4	Jill Hala	**6.2:** 34, 43, 45, 95; **6.6:** 13; **6.9:** 1
LO-5	J. C. Wise	
LO-6	Charles Ereaux	
LO-7	James Main, Sr.	**6.1:** 2, 49
LO-8	Ken Helgeson	**6.1:** 78; **6.2:** 45; **6.15:** 53, 54, 64
LO-9	Doug Ost	**6.2:** 45; **6.9:** 1
LO-10	Tom Thompson	**6.9:** 1
LO-11	Will Patric	**6.1:** 1, 2, 6, 74; **6.2:** 135, 155; **6.6:** 1; **6.14:** 3; **6.15:** 37, 65, 66, 75
LO-12	Rose Main	**6.1:** 56; **6.15:** 35, 37, 47, 72
LO-13	Ed Bibeau	**6.2:** 45; **6.5:** 214
LO-14	Dora Helgeson	
LO-15	Bob Cochell	**6.2:** 45; **6.9:** 1
LO-16	Brenda Rummel	**6.9:** 1
LO-17	Joe Azure	**6.1:** 79
LO-18	Pat Murray	
LO-19	Wayne Thompson	
LO-20	Poncho Bigby	**6.15:** 35, 37, 47, 72
LO-21	Joseph Iron Man	**6.15:** 13, 23
LO-22	Clark Kelly	
LO-23	Robert Stevenson	**6.2:** 45
LO-24	Cheryl Carlson	**6.2:** 134
LO-25	Roy Cochran	
LO-26	John Hawley	**6.1:** 15
LO-27	John Koss	**6.2:** 45; **6.9:** 1
LO-28	Ken Eickerman	
LO-29	Kevin Ryan	**6.14:** 2
LO-30	Steve Smith	**6.2:** 43; **6.6:** 13
LO-31	Amy Thompson	

TABLE 6.0-4A - PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER (Continued)

Hearing Number and Individual		Response Index Number
LO-32	Rod Boland	**6.9:** 1
LO-33	Don Marble	**6.1:** 6; **6.5:** 216; **6.15:** 25, 26
LO-34	John Doney	**6.14:** 15
LO-35	Rhonda Snell	
LO-36	Rick Valois	
LO-37	Ed Halver	**6.1:** 15; **6.5:** 94; **6.15:** 13, 23
LO-38	Barbara Burkland	**6.1:** 21, 22, 26, 43; **6.2:** 107, 253; **6.5:** 59, 68, 77
LO-39	Paul English	**6.1:** 48; **6.5:** 7; **6.15:** 51, 52, 59, 61, 62, 69
LO-40	Kenneth Main	
LO-41	Nona Main	**6.5:** 231; **6.5:** 217; **6.15:** 30
LO-42	Robert Walker	
LO-43	Virgil McConnell	**6.15:** 61, 69
LO-49	Vicki Freyholtz	**6.1:** 2, 4; **6.5:** 245; **6.6:** 2; **6.9:** 2; **6.14:** 4
LO-50	Arlo Skari	
LO-51	JR Horse Capture	**6.1:** 77; **6.5:** 215
HA-1	Dean Stiffarm	
HA-2	Darling Garrison	
HA-3	Wayne Thompson	
HA-5	Wendy Stiffarm	
HA-6	Robert Stevenson	**6.15:** 5
HA-7	Darryl Crasco	**6.1:** 1
HA-8	James Main, Sr.	
HA-9	Linda Kinsey	**6.1:** 52; **6.14:** 16
HA-11	Poncho Bigby	
HA-12	Fuzz Carnahan	**6.2:** 45; **6.9:** 1
HA-13	Morris Belgard	
HA-14	Jeffrey Havig	
HA-15	John Doney	
HA-17	Francis Kolczak	**6.9:** 1
HA-18	Rod Boland	**6.2:** 45

TABLE 6.0-4A - PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER (Continued)

Hearing Number and Individual		Response Index Number
HA-20	Virgil McConnell	**6.1:** 5, 66; **6.5:** 233; **6.16:** 5
HA-21	Nick Cebulski	
HA-22	Duane Cebulski	
HA-23	Joe Azure	**6.1:** 11, 50, 52, 66; **6.14:** 18; **6.15:** 3, 19, 24, 33, 37, 53, 54, 64, 68, 74
HA-24	Rhonda Snell	
HA-25	Joseph Kirkaldie	**6.2:** 45
HA-26	Arlene Crasco	**6.2:** 45; **6.9:** 1
HA-27	Steve Smith	**6.2:** 45; **6.9:** 1
HA-28	Amy Thompson	
HA-29	Clark Armstrong	**6.2:** 45
HA-30	Kevin Ryan	**6.5:** 256; **6.8:** 24
HA-31	Will Patric	**6.1:** 1, 2, 4, 6, 74; **6.15:** 35, 36, 37, 47, 72
HA-32	John Jones	**6.1:** 64; **6.2:** 34, 45, 95
HA-33	Jeremy Walker	
HA-34	James Walker	
HA-36	Mary Whitecow	
HA-37	Lucille Kirkaldie	
HA-49	Shannon Werk	
HA-50	Joan Gabelman	
HA-51	R. J. Walker	
HA-52	Charles Ereaux	
HA-53	Rose Main	**6.5:** 94, 187
HA-54	Warren Matte	
HA-55	Tracy Charles King	
HA-56	John Hawley	
MA-1	Dan Walter	
MA-2	Gilbert Caballero	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
MA-3	Ron Scott	
MA-4	Jeanne Barnard	**6.14:** 7
MA-5	Jim Carver	

TABLE 6.0-4A - PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER (Continued)

Hearing Number and Individual		Response Index Number
MA-6	Jim Sandsness	**6.14:** 5
MA-7	Sam Watens	
MA-8	Jeff Youkin	**6.2:** 34, 43, 45, 95; **6.6:** 13; **6.9:** 1
MA-9	William Parker	
MA-10	Greg Kielb	
MA-11	Paul Kunze	
MA-12	Clark Kelly	**6.1:** 33; **6.2:** 45; **6.5:** 213; **6.9:** 1; **6.14:** 6
MA-13	Dwayne Harris	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
MA-14	Kevin Ryan	
MA-15	Arlene Crasco	**6.2:** 45; **6.9:** 1
MA-16	Ken Eickerman	**6.14:** 17
MA-17	Larry Poulton	**6.9:** 1; **6.2:** 45; **6.9:** 1
MA-18	Bill Hicks	**6.9:** 1
MA-19	Frank Green	
MA-25	Leonard Leader	
MA-26	Jill Hala	
MA-27	Sandy Bevis	
LA-1	Skip Deaderick	**6.2:** 45; **6.9:** 1; **6.14:** 6
LA-2	Katie Carlson	
LA-3	Steven Cole	
LA-4	Brenda Rummel	**6.9:** 35; **6.15:** 17, 18, 28
LA-5	Lesley Robinson	**6.9:** 1
LA-6	Vance Spencer	
LA-7	Dale Veseth	**6.9:** 1
LA-8	Carol Kienenberger	**6.9:** 1
LA-9	Lars Rasmussen	**6.16:** 7
LA-10	Rod Boland	
LA-12	Kevin Ryan	
LA-25	Amy Thompson	
LA-26	Francis Jacobs	

TABLE 6.0-4A - PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER (Continued)

Hearing Number and Individual		Response Index Number
LA-27	Greg Eklund	
GF-1	James Jensen	**6.1:** 1; **6.2:** 152
GF-2	Donald Marble	**6.15:** 42
GF-3	Mike Hickey	
GF-4	Greg Peterson	**6.14:** 5
GF-5	Paul Kuuze	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
GF-6	Terry Hertel	**6.1:** 65
GF-7	Robert Stevenson	**6.14:** 4
GF-8	Jim Hasbrouck	**6.2:** 45; **6.9:** 1
GF-9	Angela Boland	**6.14:** 4
GF-10	Jeffrey Havig	**6.9:** 1; **6.14:** 6
GF-11	Ken Gus Helgeson	**6.1:** 1; **6.9:** 3; **6.15:** 33
GF-12	Ken Main	
GF-13	Nona Main	**6.15:** 61, 69
GF-14	Catherine Halver	
GF-15	Bill Halver	**6.1:** 1; **6.5:** 94
GF-16	Mike Irvin	
GF-17	Nita Periman	
GF-18	Cherye Sullivan	
GF-19	Chuck Watts	
GF-20	Bruce Parker	**6.2:** 45
GF-21	Joe Micheletti	
GF-22	Garth Sandsness	**6.5:** 219
GF-23	Arlo Skari	**6.1:** 65; **6.2:** 136
GF-24	Mert Freyholtz	
GF-25	James Main, Sr.	
GF-26	Patrick Chief Stick	
GF-27	Charles Ereaux	
GF-28	August Peterson	
GF-30	Marian Ereaux	**6.1:** 65; **6.9:** 35

TABLE 6.0-4A - PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER (Continued)

Hearing Number and Individual		Response Index Number
GF-31	Carl Seilstad	**6.9:** 1
GF-32	Todd Smith	**6.2:** 45; **6.9:** 1
GF-33	John Hawley	
GF-34	Delmar Poncho Bigby	**6.1:** 2, 3; **6.5:** 221; **6.14:** 7; **6.15:** 35, 37, 47, 72
GF-35	Arlene Crasco	**6.2:** 45; **6.9:** 1
GF-36	Clark Kelly	**6.14:** 6
GF-37	Amy Thompson	**6.14:** 8
GF-39	Joe Azure	**6.1:** 1, 15, 22; **6.9:** 2; **6.5:** 59, 68; **6.15:** 12, 16, 19, 24
GF-40	Melinda Gopher	
GF-41	Ben Carter	
GF-42	Mary Gopher	
GF-43	Bob Williams	
GF-44	Ron Long	
GF-45	Ed Stephan	
GF-46	Dennis Shea	
GF-47	Mark Redfern	
GF-48	Jessie Hawley	
GF-49	Ruth Burlaigh	
GF-50	Jack Severns	**6.1:** 15
GF-51	Mike Porter	
GF-52	Sam Chapman	
GF-54	Amberly Stiles	
GF-55	Ken Kempa	
GF-56	Carol Kienenberger	**6.1:** 64; **6.5:** 220; **6.9:** 1, 35; **6.14:** 4, 5, 9
GF-57	Wayne Dillon	**6.2:** 45
GF-58	Anne Booth	
GF-59	Jim Sandsness	
GF-61	Gene Koch	
GF-65	Leroy Murphy	
GF-66	Ed Bibeau	

TABLE 6.04-A - PUBLIC HEARING COMMENT AND RESPONSE INDEX NUMBER (Concluded)

Hearing Number and Individual		Response Index Number
GF-68	Harvey King	
GF-69	Tom McKay	
GF-70	Gerald VanCampen	
GF-71	Clark Carter	
GF-72	Dean Stiffarm	
GF-73	Randy Perez	**6.9:** 3; **6.15:** 13, 23
GF-74	Will Patric	**6.1:** 2, 15; **6.14:** 3, 37; **6.15:** 65, 66
GF-75	Rose Main	**6.1:** 65
GF-76	George Fox	
GF-77	Warren Matte	
GF-78	Rowena Gone	
GF-79	Vicky Freyholtz	
GF-80	Skip Deaderick (Dutrick)	
GF-81	Mr. Keneberg	
GF-82	Ron Gulver	

TABLE 6.0-4B
WRITTEN COMMENT AND RESPONSE INDEX NUMBER

Letter Number and Organization/Individual		Response Index Number
1	Russell D. Cebulski, Blackdiggers Enterprises	
2	Julia M. Cebulski, Blackdiggers Enterprises	
3	Mary Ainne Bachia	**6.4:** 32; **6.5:** 216; **6.14:** 1-3; **6.15:** 40, 67
4	Donald R. Marble	**6.5:** 94
5	Amy Thompson	**6.15:** 17, 18
6	Stanley Wilmoth, SHPO	
7	Ed Bibeau	**6.14:** 2
8	Ed Bibeau	
9	Ed Bibeau	**6.14:** 2
10	Greg Kielb, KMMR Radio	**6.2:** 34, 43, 45; **6.9:** 1; **6.14:** 4
11	Keith Beartusk-USDI, BIA - Billings	**6.2:** 93, 94; **6.15:** 37, 53, 68, 74; **6.16:** 11
12	Jeff D. Younkin, Glasgow C of C	**6.2:** 45, 95; **6.9:** 1
13	James B. Sandeness, Malta C of C	**6.14:** 5
14	Nathan G. Wilson	
15	Pauline Welch	
16	Ron Scott, First Bank of Malta	
17	Louis Kirkaldie	**6.3:** 5, 6, 8, 9, 14; **6.5:** 51, 176-195; **6.17:** 1, 2, 4, 5
18	Unknown	
19	Per and Winnifred Storli	**6.9:** 1
20	R. E. Pete Clausen, Pete Clausen & Sons, Inc.	**6.2:** 45; **6.9:** 1
21	David Clausen, Clausen & Sons Inc.	**6.9:** 1

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
22	Frederick H. Miller	**6.9:** 1
23	Stan Wilmoth, SHPO	**6.15:** 17, 18
24	B. J. "Swede" Goodheart	
25	Gordon Booth	**6.9:** 1; **6.14:** 1, 6
26	Marianne Dugan, Western Env. Law Ctr.	
27	William Parker	**6.2:** 96; **6.11:** 2
28	F. Lee Robinson	**6.14:** 1
29	Terry Olsen	
30	Stuart F. Lewin	
31	Leonard & Linda Nungreau	**6.14:** 1
32	Kenny Ereaux	
33	Mark Kunze	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
34	Delmar "Poncho" Bigby	**6.2:** 97
35	Jerone Johnson	**62:** 43, 45; **6.6:** 13
36	Ron Tucker	**6.5:** 226
37	Daniel E. Ereaux	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
38	Doyle Grant	
39	Rhonda I. Snell	**6.7:** 6; **6.15:** 61, 69
40	Rhonda I. Snell	
41	Virgil F. McConnell	**6.15:** 51, 52, 59, 61, 62, 69
42	Dolphus Doney	**6.7:** 5

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
43	Peggy Heath	**6.2:** 45; **6.9:** 1
44	Ron Tucker	
45	Ron Tucker	
46	Terry Lodmell	**6.3:** 10
47	John Kikelaar	**6.9:** 1
48	Delmar "Poncho" Bigby	**6.1:** 50, 66; **6.5:** 174, 175; **6.14:** 2, 3, 7
49	Delmar "Poncho" Bigby	
50	Beverly J. Evins	**6.2:** 45; **6.9:** 1
51	John Doney	**6.5:** 212
52	Gail Main	**6.5:** 229
53	Christine Kikelaar	**6.2:** 34, 95; **6.9:** 1
54	Banett Lagerquist	
55	Ruth M. Burleigh	
56	Jill Hala	
57	Clark Kelly, T.E.A.M.	**6.5:** 213
58	James Snow III	**6.3:** 11; **6.10:** 8
59	Marjean Carnahan	**6.2:** 34, 43, 45, 95; **6.6:** 13; **6.9:** 1; **6.14:** 1
60	Paul Stephens	
61	Ron Tucker	
62	T.E.A.M.-Sponsored Petition (44 names)	
63	Mr. & Mrs. Pat Bibeau	**6.14:** 7

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
64	Shelly Bibeau	
65	Sue & Bob Dickenson	
66	Allan T. Kolczak	**6.9:** 1
67	Allan T. Kolczak	
68	Clark Kelly, T.E.A.M.	
69	T.E.A.M.-Sponsored Petition (406 names)	
70	Violet Yellow	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
71	Julean Horseman	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
72	Carol Kindness	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
73	Cecilia Shorman	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
74	Sherry Bishop	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
75	Eva Walker	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
76	Teresa Brockie	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
77	Charlene Tipton	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
78	Delores A. Stump	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
79	Elizabeth W. Main	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
80	Linda S. Chandler	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
81	Willowa Horn Murdock	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
82	John A. Allen	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
83	Duane L. Stiffarm	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
84	Margaret Doney	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
85	Pearl Cochran	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
86	Damon J. Castillo	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
87	Edward	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
88	Lorilane L. K. Walker	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
89	Vivian Webb	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
90	William E. Halver	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
91	Elmer M. Main	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
92	Mike	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
93	Arirela Crasco	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
94	Reva Sears	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
95	Jeannie J. Farrar	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
96	Thomas Watts	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
97	Jeremy P. Limpy	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
98	Ray Lynn	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
99	Jackie Hendrickson-Grant	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
100	Charles J. Dillon	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
101	Matthew James Ball	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
102	John Main	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
103	Tom Cochran	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
104	John Grant	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
105	Mitchell Braker	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
106	Veronica Dillon	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
107	Unknown	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
108	Anthony Shambo	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
109	Gena Wease	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
110	Dawn Cochran	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
111	Clyde Wing	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
112	David Doney, Sr.	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
113	Ed Dayth	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
114	Lois R. Shortman	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
115	Donna M. Quincy	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
116	Robin Walsh	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
117	John Filertel	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
118	Joyce Gone	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
119	Gordon Ball	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
120	Theresa M. Fox	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
121	Christine Heppner	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
122	Sylvia Heppner	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
123	Wesley Bear	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
124	Carol A. Cochran	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
125	Rhea Miner	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
126	Don Holzheimer, Industrial Electronics	

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
127	Kathryn Hiestand and Neal Miller	
128	Ed Bibeau	**6.1:** 42; **6.7:** 2
129	Pat Bibeau & Family	
130	Louis Bibeau	**6.13:** 1
131	Debbie Kindle	**6.2:** 34, 43, 45, 95; **6.6:** 13; **6.9:** 1
132	Bob & Theresa Frye	**6.5:** 59; **6.9:** 1
133	Clark Kelly, T.E.A.M.	
134	Wm. K. & M. L. French	
135	Clark T. Carter, People for the West	**6.9:** 1; **6.14:** 8
136	Lars Rasmussen	**6.5:** 223; **6.9:** 35
137	T.E.A.M. Petition (19 names)	
138	Glen A. Phillips	**6.3:** 15
139	Lane Schipman	
140	Carley McCauley	**6.1:** 1, 22
141	Peter T. Barbatsuly	
142	Clark Kelly, T.E.A.M.	**6.14:** 6
143	Lynda E. Brown	
144	Amy Thompson	**6.14:** 5, 8
145	Joseph W. Azure	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
146	James Mari, Sr.	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
147	Dorothy Gopher	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
148	Kenneth Main	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
149	David Healy	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
150	Mary Gopher	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
151	Nora M. Main	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
152	Raymond Chandler	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
153	Stephen L. Gone, Jr.	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
154	Becky Brisbo	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
155	Rose Main	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
156	Rowena Gone	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
157	Harvey King	**6.1:** 1, 15, 22, 23; **6.5:** 59, 80
158	Brian Robinson	
159	Terry Hertel	
160	George Took the Shield	
161	Chippewa Cree Tribe	
162	George Took the Shield	
163	Kevin Ryan	**6.2:** 98, 99; **6.5:** 224
164	Wayne Dillon	**6.2:** 45; **6.9:** 1
165	Sylvia M. Stiffarm	**6.1:** 15, 22, 23; **6.5:** 59, 80
166	Dean L. Stiffarm, Sr.	**6.1:** 15, 22, 23; **6.5:** 59, 80
167	Mike Porter	**6.2:** 45, 95; **6.9:** 1
168	Mike Porter	**6.2:** 45, 95; **6.9:** 1

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
169	Lloyd Malmend	**6.2:** 43, 45, 95; **6.6:** 13; **6.9:** 1
170	Gene Koch	
171	Pat Lundstrom	**6.2:** 45; **6.9:** 1
172	James Flansburg	**6.9:** 1
173	Terri Flansburg	
174	Angela Boland	**6.14:** 1
175	Marian Ereaux	**6.12:** 3; **6.14:** 1
176	Ed Stepan	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
177	Clark Kelly	**6.14:** 6
178	Arlene Crasco	**6.2:** 45; **6.9:** 1
179	Robert Stevenson	**6.14:** 1
180	Paul Kunze	**6.2:** 41, 43, 45; **6.6:** 13; **6.9:** 1
181	Delmar "Poncho" Bigby	**6.1:** 2, 3, 4, 35, 49, 50, 66, 75; **6.2:** 97, 100, 174, 175; **6.14:** 2, 3, 7; **6.15:** 3, 19, 35, 37, 47, 53, 54, 64, 65, 66, 72, 75
182	Anne M. Boothe, Phillco Economic Growth Council	**6.9:** 1; **6.14:** 9
183	Harlan Mount, Fort Belknap Community Council	**6.1:** 1; **6.15:** 25
184	Harvey King	**6.1:** 50, 66; **6.15:** 20, 36, 49
185	John P. Jones	**6.1:** 64; **6.2:** 90; **6.5:** 172, 173
186	Delmar "Poncho" Bigby	**6.1:** 2, 3, 4, 35, 49, 75; **6.5:** 175, 186; **6.15:** 3, 19
187	Clara Nomee, Crow Tribal Council	
188	Sam Chapman	**6.9:** 1
189	Ed Bibeau	**6.1:** 42; **6.2:** 34; **6.14:** 2, 7; **6.15:** 29, 41

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
190	Amberly Stiles	**6.14:** 4
191	Paul Never Miss a Shot	
192	Gordon Booth	
193	Joan W. Montagne	
194	Lewis A. McLeord	
195	Georgia Case	
196	Bill Swaney	
197	Pat F. Calf Looking	
198	Mary B. Price	
199	Dean Pearson	
200	Kim Guderjohn	
201	Pauline Welch	**6.5:** 225
202	Clara Nomee, Crow Tribal Council	
203	U.S. EPA Region VIII, Montana Office	**6.1:** 21, 22, 26, 43, 48; **6.2:** 90, 91; **6.5:** 77, 202, 204
204	Kevin Ryan	**6.5:** 171; **6.14:** 2
205	Amy Thompson	**6.2:** 45
206	John Doney	**6.5:** 212
207	Robert Stevenson	**6.2:** 45; **6.5:** 215
208	Louis Kirkaldie	
209	Tom Thompson	**6.9:** 1
210	Jill Hala	**6.2:** 34, 45; **6.5:** 170; **6.6:** 13; **6.9:** 1; **6.15:** 29, 41

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER
(Continued)

Letter Number and Organization/Individual		Response Index Number
211	Will Patric, Mineral Policy Center	**6.1:** 1, 2, 26, 43, 48, 54, 67, 74; **6.2:** 92, 135, 136, 155; **6.5:** 100; **6.14:** 10; **6.15:** 35, 37, 47, 53, 68, 72, 74
212	Brenda Rummel, Little Rockies Outfitting	**6.9:** 1
213	Delmar "Poncho" Bigby	**6.1:** 75
214	Delmar "Poncho" Bigby	
215	Pat Murray	
216	Cheryl Carlson	**6.2:** 101
217	John P. Jones	**6.1:** 64; **6.2:** 45, 102; **6.16:** 1
218	Kevin Ryan	**6.14:** 2; **6.15:** 17, 18
219	Robert Stevenson	**6.15:** 5
220	Steve Smith	**6.3:** 12
221	Amy Thompson	
222	Delmar "Poncho" Bigby	
223	Jill Hala	
224	Jeanne Barnard, Big Flat Electric Coop.	**6.14:** 7
225	Frank Green	**6.2:** 95, 162
226	R. E. Pete Clausen, Pete Clause & Sons Inc.	**6.2:** 45; **6.9:** 1
227	Jeff D. Younkin, Glasgow C of C	
228	Kevin Ryan	
229	Gilbert Caballero	**6.2:** 43, 45; **6.6:** 13; **6.9:** 1
230	Vance Spences	
231	Brenda Rummel, Little Rockies Outfitting	**6.15:** 17, 18, 28

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
232	A. J. "Skip" Deaderick	**6.4:** 33, 34, 35; **6.9:** 1; **6.14:** 6
233	Lesley Robinson	**6.9:** 1; **6.12:** 3; **6.15:** 8, 10, 56
234	Phillips County Board of Commissioners	**6.9:** 1
235	Marianne Caballero	**6.2:** 43; **6.6:** 13; **6.9:** 1
236	Dale Slade	**6.2:** 45; **6.9:** 1
237	Beth Slade	**6.2:** 45; **6.9:** 1
238	Judy L. Merwin & Family	**6.2:** 45; **6.9:** 1
239	Jane Ray	
240	Lawrence Fickler	**6.2:** 98, 99
241	Cody Young	**6.2:** 45; **6.9:** 1
242	John Holman	**6.2:** 45; **6.9:** 1
243	Joe Depuydt	**6.2:** 45; **6.9:** 1
244	Roy Neumiller	**6.9:** 1; **6.15:** 47
245	Jerrold "Bud" Slade	**6.9:** 1
246	Dennis Clausen	**6.9:** 1
247	John M. Porter	**6.1:** 55; **6.9:** 1
248	Dorothy Salsbery	**6.2:** 45; **6.9:** 1
249	Thomas W. Tangen	**6.2:** 34, 43, 45; **6.6:** 13; **6.9:** 1
250	Leonard Seaford	
251	Teresa McKeon	
252	Judy Shafer, USDI, NPS	**6.15:** 2

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
253	Thomas J. Miller	**6.5:** 228, 243
254	Mr. & Mrs. Pat Bibeau & Family	**6.2:** 34
255	Mr. & Mrs. Pat Bibeau & Family	
256	Shelly Bibeau	
257	Katy Matovich	
258	Arlo Skari	**6.1:** 3, 5, 6, 11; **6.6:** 1-3, 14
259	Amy Thompson	**6.2:** 99
260	David J. Ryzak	
261	Mary E. Ryzak	
262	Sandy Carnahan	
263	Michael J. Carney	
264	Jeanne Kolis	**6.1:** 15
265	Darrell & Vicki Olson	**6.9:** 1
266	Kevin Salsbery	**6.1:** 33
267	Russell Boulding, Boulding Soil-Water Consulting	**6.1:** 1, 16, 22, 23, 31; **6.5:** 77, 84-100; **6.17:** 6
268	Carol A. Gray	**6.1:** 16, 22, 23, 44
269	James B. Sandsness	
270	Lesley Robinson, Little Rockies CRM	**6.2:** 34, 45; **6.9:** 1; **6.14:** 4
271	Carol Smith	
272	Larry McCaffery, Continental Supply, Inc.	
273	Chris L. Grove	**6.1:** 4, 23, 26, 57, 76; **6.2:** 135, 141, 143, 158; **6.5:** 222; **6.9:** 4, 6; **6.17:** 7

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
274	Gary A. Langely, Montana Mining Assoc.	**6.2:** 43; **6.6:** 13; **6.9:** 1; **6.16:** 15
275	Dora Helgeson	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
276	Wanda Raining Bird	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
277	Daniel E. Healy	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
278	Mary Bird	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
279	Wm. H. Longknife	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
280	Dorcus Has Eagle	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
281	Wallace Chopwood	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
282	Wanda Cliff	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
283	Allen Stiffarm	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
284	Florence Horn	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
285	John Main	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
286	Ed Moore, Sr.	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
287	Rowena Gone	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
288	Alfred Bradley	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
289	Gerald B. Main, Sr.	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
290	Sarah G. Doney	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
291	Perry J. Plumage	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
292	Theodore M. Doney	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
293	Cora Davis	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
294	Stacey Healy	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
295	Neal Has Eagle	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
296	Sophia Healy	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
297	Will Bird	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
298	Eleanor Ducharme	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
299	April Borseire	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
300	Darlene Parisian	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
301	Amy H. Messerly	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
302	Tracy No Big Leggins	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
303	Christine Main	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
304	Lonnie Brown	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
305	Bird Mae Shortman	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
306	Marjorie Walker	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
307	Andrew Walker	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
308	Kimberly Brockie	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
309	Ruby Brockie	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
310	Vernie B. Main	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
311	James Main, Sr.	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
312	Patti Jo Doney	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
313	Francine Afong	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
314	Bari Painter	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
315	Mary Kuntz	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number	and Organization/Individual	Response Index Number
316	Cecilia DeCelles	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
317	William T. Main	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
318	Donovan Archambault	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
319	Misty Arcand	**6.1:** 1, 15, 22, 23; **6.2:** 43, 90; **6.5:** 59, 77, 80
320	William Patric, Mineral Policy Center	**6.1:** 1, 2, 4, 6, 15, 26, 38, 43, 48, 65, 74; **6.2:** 92, 105, 106, 136, 137, 144, 146, 155, 156; **6.3:** 7; **6.5:** 59, 94, 100, 230; **6.6:** 1; **6.9:** 1, 9, 12; **6.14:** 3, 10; **6.15:** 3, 36, 37, 53, 54, 64, 65, 66, 68, 72, 74, 75
321	Darlene Kolczak	
322	Don & Eva Robinson	**6.9:** 1
323	Darlene Kolczak, Landusky School Board	
324	Michael V. Main	**6.1:** 1, 15, 22, 23; **6.5:** 80
325	Claude E. Ereaux, Ezzie's Wholesale, Inc.	**6.1:** 33; **6.2:** 45; **6.9:** 1
326	Daniel J. Bennett, Island Range Chapter, MWA	**6.1:** 1, 23, 26, 43; **6.2:** 103; **6.9:** 15; **6.15:** 26
327	Mark Cole, Associates of Montana Mining	**6.14:** 5
328	Florence Ore, Northern Plains Resource Council	**6.1:** 1, 15, 22, 23, 26; **6.2:** 104; **6.15:** 38
329	Sandra McIntyre, Northern Rockies Wilderness Society	**6.1:** 1, 2, 43; **6.2:** 136
330	Jay W. Mount	**6.1:** 1, 15, 22, 23; **6.5:** 146, 202
331	Genevieve Nez Perce	**6.1:** 1, 15, 22, 23; **6.5:** 146, 202
332	Vera Garmann	**6.1:** 1, 15, 22, 23; **6.5:** 146, 202
333	Barbara Schmidt	**6.1:** 55; **6.2:** 45
334	Amy Thompson	
335	Joseph W. Azure, Fort Belknap Community Council	See letter 352

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
336	Joseph W. Azure, Fort Belknap Community Council	See letter 352
337	William P. Yellowtail, U.S. EPA, Region VIII	**6.1:** 15, 17; **6.2:** 107, 108, 109, 110, 145, 158; **6.5:** 26-50, 253; **6.8:** 35, 37; **6.10:** 9; **6.15:** 33, 51, 52, 59, 62, 69; **6.17:** 8
338	Len Broberg	**6.5:** 77, 94; **6.9:** 21, 22
339	Charles M. Rose	**6.1:** 44; **6.2:** 34, 45; **6.9:** 1
340	Thomas France, National Wildlife Federation	**6.1:** 1, 2, 14, 30, 34, 67; **6.2:** 111, 112, 135, 146, 148, 152; **6.3:** 13; **6.4:** 22; **6.5:** 59, 74-82, 256; **6.6:** 4; **6.8:** 7, 8, 24, 26, 27, 31, 38, 39; **6.9:** 13, 16, 23, 24, 25, 31, 32; **6.10:** 10-14; **6.11:** 1; **6.14:** 4; **6.15:** 3, 8, 9, 10, 13, 15, 26, 46, 50, 51, 52, 53, 54, 56, 57, 59, 62, 64, 69, 70, 74
341	David Schwab, Schwab Cultural Consulting	**6.1:** 43; **6.2:** 136; **6.14:** 3; **6.15:** 3, 8, 10, 11, 55, 56, 65, 66, 73, 75
342	Kevin J. Ryan, Pegasus Gold/ZMI	**6.1:** 15, 27, 32, 37, 40; **6.2:** 1-44; 46-60, 163; **6.3:** 16, 17; **6.4:** 13, 15, 17-20, 101-145, 238, 246-248, 256; **6.6:** 7, 9, 10, 11; **6.7:** 8, 10, 12; **6.8:** 1-4, 24, 28-30; **6.10:** 15-24; **6.11:** 3; **6.12:** 2, 5; **6.13:** 2; **6.14:** 4, 11, 12; **6.15:** 4, 6, 17, 18, 29, 39, 41; **6.16:** 2-4, 8-10, 13; **6.17:** 10-30
343	Jack F. Trope	**6.1:** 4, 5, 22; **6.2:** 149; **6.4:** 36; **6.5:** 230; **6.15:** 13, 23, 50
344	Fort Belknap Community Council by Western Environmental Law Center	**6.1:** 1, 4, 6, 7, 13, 20, 22, 34, 38, 44, 45, 51; **6.2:** 111-118, 146-148, 152, 153; **6.3:** 13; **6.5:** 80, 81, 146-169, 230, 232, 236, 239-242, 254, 256; **6.6:** 2, 4, 6, 8; **6.7:** 9; **6.8:** 7, 25, 31, 32, 40; **6.9:** 13, 14, 16-19, 32, 34; **6.15:** 3, 12, 16, 25, 26, 35, 37, 50, 51, 52, 53, 54, 57, 59, 61, 62, 64, 68, 69, 71, 72, 74
345	Donald H. Kern, Montana River Action Network	**6.1:** 2, 5, 19, 58, 65, 74; **6.2:** 135, 152; **6.5:** 13, 71-73; **6.8:** 10
346	Candace Thomas, U.S. Army, COE	**6.1:** 6, 11, 23, 52, 53, 60, 63, 64, 65, 68, 69, 70, 73; **6.2:** 61-89, 138-140, 155, 157-161, 164; **6.3:** 1-4; **6.4:** 9-11, 14, 16, 17, 37; **6.5:** 1-12, 15-25, 235, 249-252, 256; **6.6:** 5; **6.7:** 1, 4, 11, 13; **6.8:** 9, 11-24, 26, 30, 33, 41-45; **6.9:** 8, 10, 11, 27-30, 36; **6.12:** 4, 6; **6.15:** 13, 37, 53, 68, 74; **6.16:** 6; **6.17:** 3
347	James Jensen, Montana Environmental Information Center	**6.1:** 4, 11, 30, 49; **6.2:** 112, 152, 155; **6.4:** 1-8, 12; **6.5:** 51, 52, 54-68, 70; **6.6:** 3

TABLE 6.0-4B - WRITTEN COMMENT AND RESPONSE INDEX NUMBER (Continued)

Letter Number and Organization/Individual		Response Index Number
348	Edie Adams, USDI, BIA - Fort Belknap	**6.1:** 3, 18, 22, 28, 50, 52, 66, 75; **6.2:** 119-125; **6.5:** 14, 234, 237, 244, 253; **6.8:** 38; **6.9:** 1, 3, 20; **6.10:** 25; **6.14:** 18; **6.15:** 19, 31, 34, 43-45, 48; **6.16:** 14
349	Florence Ore, Northern Plains Resource Council	See letter #328
350	Rose Main, MPA	**6.1:** 11, 36, 50, 66, 67; **6.2:** 126, 150; **6.14:** 13, 14; **6.15:** 32, 39
351	Indian Law Clinic, U of M for Fort Belknap Environmental Protection Office	**6.1:** 2, 9, 14, 15, 29, 45; **6.2:** 127, 128, 136, 151, 152, 154; **6.5:** 75, 198, 199; **6.8:** 6, 8, 26, 27, 34, 38, 39; **6.9:** 23, 24, 31, 33; **6.14:** 4, 15; **6.15:** 1, 9, 13, 15, 19, 22, 35, 37, 50-54, 57, 59, 62, 68, 69, 74
352	Joseph W. Azure, Fort Belknap Environmental Education and Policy Network	**6.1:** 1, 4, 8, 10, 23, 25, 46, 59, 61, 62, 65, 72; **6.2:** 129-133; **6.5:** 200, 201, 253, 255; **6.6:** 12, 13; **6.7:** 3, 4; **6.9:** 26; **6.10:** 27; **6.15:** 7, 12, 16, 19, 21, 47, 51, 52, 59, 60, 69; **6.16:** 12, 15; **6.17:** 9
353	Ina L. Nez Perce	**6.1:** 1, 4, 11, 15, 22, 23, 24, 67; **6.2:** 136, 149; **6.5:** 174, 196, 197, 230; **6.8:** 32; **6.9:** 5, 23, 24; **6.15:** 13, 19, 22, 23, 50, 54, 57
354	Bob	**6.1:** 1, 15, 22, 23
355	Sharon L. Willows, C.L.A.	**6.1:** 3
356	B. Derek Strahn	**6.2:** 142; **6.15:** 14, 51, 52, 58, 59, 62, 63, 69
357	Trista Hoffman	**6.1:** 2, 5; **6.2:** 158; **6.15:** 62
358	Smucky Mann	**6.2:** 45; **6.9:** 1
359	Francis Kolczak	
360	Virgil McConnell, Spirit Mountain Cultural Clan	**6.1:** 50, 66; **6.5:** 203; **6.10:** 26; **6.15:** 25
361	Bob Golten, U of CO, Indian Law Clinic for Island Mountain Protectors	**6.1:** 11, 12, 23, 50, 63, 66, 70, 71, 75; **6.2:** 155; **6.5:** 51-70, 205-211; **6.8:** 38; **6.9:** 7, 21; **6.15:** 27, 38, 46
362	Susan Daggett and David M. Chambers, Sierra Club Legal Defense Fund	**6.2:** 155; **6.4:** 23-31; **6.8:** 5, 36
363	Jim Barrett, The Beartooth Alliance	**6.1:** 15, 23, 67; **6.5:** 227; **6.8:** 26; **6.15:** 38

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Letter Number and Organization/Individual		Response Index Number
364	Keith Beartusk (forwarding #267) and Bill Borges, USDI, BIA	**6.1:** 36, 39, 41, 47; **6.2:** 126, 150, 151; **6.12:** 1; **6.14:** 14; **6.15:** 32, 39
365	Don Bachman	
366	David Pennington, USDI, BIA	
367	Harlan Mount, Fort Belknap Community Council	**6.1:** 2, 3, 4, 35; **6.4:** 21, 22; **6.15:** 3, 19
368	Fort Belknap Community Council by Western Environmental Law Center	**6.10:** 1-7

6.1 PROCESS

1. COMMENT: The Draft EIS is premature given the litigation underway against Pegasus Gold and Zortman Mining, Inc., by the State of Montana, U.S. Environmental Protection Agency, and the Fort Belknap Gros Ventre and Assiniboine Tribes for violation of the Federal Clean Water Act (CWA) and the Montana Water Quality Act. The agencies should withdraw the Draft EIS and await completion of the settlement negotiations and publication of the compliance plan.

The Draft EIS admits that the State of Montana has "determined that adequate hydrologic and water quality baseline data did not exist prior to the current mining activities. This information is necessary to develop water quality-based effluent limits in the discharge permit. Therefore, the Water Quality Improvement Plan has been expanded to include additional data collection" (Draft EIS at page 1-18).

How can the agencies purport to disclose in the EIS what the impacts of mine expansion will be when the impacts of the existing mine are still being studied? It does not seem prudent to proceed with an EIS designed to sanction expansion when the full extent of the company's non-compliance with the Clean Water Act is not yet known. The same is true of an EIS designed to establish parameters for reclamation when the extent of what must be reclaimed is unknown.

The analysis of water quality impacts contained in the existing Draft EIS does not include monitoring data of water flowing north toward the Fort Belknap Indian Reservation. Although the Draft EIS admits the data on hydrology and water quality are incomplete, it fails to address NEPA's requirement that the BLM obtain data to remedy this inadequacy unless the cost of gathering the data are "exorbitant" (40 CFR 1502.22).

To satisfy this requirement, BLM must wait for the ongoing studies required by the Consent Decree to be complete. The BLM cannot claim the costs of developing information needed to evaluate how the facility will achieve compliance with water pollution laws are exorbitant, because that information is forthcoming. Thus, the Draft EIS is premature.

In addition, Pegasus/ZMI has also prepared a groundwater report. Although this report is currently confidential because of the ongoing settlement negotiation, the report will become public upon conclusion of the litigation, and will be critical to evaluating the impacts of mine expansion. (70 through 125, 140, 145 through 157, 183, 211, 267, 275 through 320, 324, 326, 328, 329 through 332, 340, 344, 352, 353, 354, LO-1 LO-11, HA-7, HA-31, GF-1, GF-11, GF-15, GF-39)

RESPONSE: The EIS addresses the impacts of the existing and expanded mining operations. There is adequate information available to characterize the groundwater flow and quality so as to describe existing conditions, assess impacts, and evaluate alternatives or develop mitigation. Section 3.2.5 of the Draft EIS summarizes and interprets existing water quality data for both mine sites, including those drainages flowing toward the Fort Belknap Indian Reservation. Section 4.2 assesses potential water resource impacts associated with each of the seven alternatives.

Compliance with the water quality laws must be achieved under any of the alternatives. The EIS conclusion regarding future compliance with water quality laws is that by implementing the mitigation measures specified (e.g., selective waste handling, enhanced reclamation covers, segregation of storm versus mine drainage, capture sumps, trenches and wells, water treatment at both mines, etc.), compliance would be achieved. This assessment depends on effective reclamation-capture-treatment technology, rather than on what the final permit effluent limits will be. Should water management and surface reclamation alone fail to achieve full compliance with future discharge standards, the BLM and DEQ have required and bonded for water treatment necessary to achieve compliance.

For these reasons, the BLM and DEQ have determined that all data necessary to prepare the EIS and to make a reasoned choice among alternatives are currently available. Although additional data are necessary to establish final discharge limits, those data are not necessary to assess impacts and, therefore, are not necessary for preparation of the EIS. Exact effluent limits do not need to be established in order to predict whether the approach that would be used at the mines is likely to achieve compliance with the water quality standards.

Section 1.5.3.1 of the Draft EIS summarizes the lawsuit and alleged violations, and has been updated for the Final EIS. Appendix A of both the Draft and Final EIS contains a description of the water quality improvement measures proposed by ZMI as part of the settlement agreement. In addition, measures that would be used under the various alternatives to achieve compliance are included in Appendix A.

2. COMMENT: How can the BLM and DEQ even consider the environmental impact statement process, much less consider approval of ZMI/Pegasus application with full knowledge of the current and historical violations of the Clean Water Act and other environmental laws associated with this mining activity? The preparation of this Draft EIS is clearly contrary to the intent of the "bad actor" provision of the 1971 Montana Metal Mine Reclamation Act (MMRA), the purpose of which is to keep mining companies from opening new mines or expanding operations while not in compliance with the law. (MCA 82-4-351(a)) Considering the existing reclamation plans are not adequate and the mine is in violation of the state and federal clean water acts, if the agency granted a permit for the proposed expansion, they would be acting in a manner contrary to what the law allows. (181, 186, 211, 320, 329, 340, 345, 351, 357, 367, LO-7, LO-11, LO-49, HA-31, GF-34, GF-74)

RESPONSE: The MMRA (82-4-337(1), MCA) requires DEQ to process mining applications upon their receipt. NEPA and MEPA require the preparation of an EIS when the proposal may have a significant environmental impact. The provision cited by the commentor authorizes denial of a permit if the operation and reclamation plans would result in violation of air or water quality laws. The "bad actor" provisions are summarized in the response to the following comment. None of these provisions prohibit the agencies from preparing an EIS. The purpose of this EIS is to disclose and evaluate the environmental effects of the proposed project and alternatives designed to minimize those effects, not evaluate ZMI's corporate compliance history. The proposal before the agencies consists of a revised reclamation plan to correct existing deficiencies, as well as an operating plan to mine and process additional ore.

3. COMMENT: The past record of ZMI must be taken into account when the final decision is made and their record indicates that the expansion permit must be disapproved based on past violations of state and federal water quality laws. (181, 186, 258, 348, 355, 367, GF-34)

RESPONSE: The Montana Metal Mine Reclamation Act contains a number of provisions that allow or require an amendment to be denied if the applicant has violated the Act. The Operating Permit may not be granted if the applicant has forfeited a bond and not reimbursed the state, has not paid a penalty for which DEQ has obtained a judgement, is in violation of an abatement order, or is in violation within Montana of any air quality, water quality, or reclamation statute, rule, or regulation of the state or the United States. Furthermore, the DEQ may refuse to grant an application if the applicant has had an operating permit revoked. Together with other information (e.g., potential environmental effects disclosed in the EIS) the past compliance record of ZMI will be taken into account at the time a permit decision is made.

4. COMMENT: The Draft EIS does not contain any record of violation and enforcement activity. The failure to disclose this information leaves the public and the decision maker with no way to anticipate or predict the efficacy of enforcement. The most important corollary here is that without this information there is no way to predict and disclose environmental effects -- the primary purpose of NEPA. The EIS seems to assume that all environmental laws will be followed. As we all know, this has not been the case in the past and may not be the case even now. Further, the Draft EIS presents no rationale that would lead a person to believe this would occur in the future. At a minimum you must disclose: the nature of past and/or present violations; the date and duration of the violations; the date at which enforcement action was initiated, and the date at which compliance was attained. (181, 186, 273, 320, 343, 344, 347, 352, 353, 367, LO-49, HA-31)

RESPONSE: The chronology of events leading up to the current enforcement action is contained in Section 1.1.3 of the Draft EIS. Section 1.5.3.1 of the Draft EIS relates the history of the civil suit filed against ZMI for alleged violations of the Montana Water Quality Act. The EIS does indeed assume that in the future environmental law will be complied with and that mitigation contained in the EIS will be implemented in a manner consistent with its intent. The EIS evaluates the project and not the operator. Past and present water quality impacts are disclosed in Chapters 3.0 and 4.0. The date at which compliance with the Clean Water Act will be attained is dependent on the outcome of the civil suit currently pending as of this writing. Technical measures needed to achieve compliance are part of all alternatives.

5. COMMENT: Given the atrocious environmental record of the developers, it cannot be assumed that the mine expansion will occur in the manner described in the Draft EIS. It is simply premature and a dishonest analysis of the impacts of the proposed expansion to assume compliance with project specifications in view of the developer's track record. (258, 343, 345, 357)

RESPONSE: The EIS presumes the operator would implement the project as described in Chapter 2.0. Consistent implementation is necessary in order to compare impacts across alternatives. The EIS evaluates the environmental effects of the project and is not specific to a certain operator. The monitoring and construction quality control programs specified in the agency modified alternatives are intended to monitor implementation of mitigation measures (project specifications) and allow the agencies to verify compliance.

6. COMMENT: At no point in the EIS is it mentioned that Pegasus is presently being sued by the State of Montana, the EPA and the Fort Belknap Gros Ventre and Assiniboine Tribes for on going violations of the Clean Water Act. The EIS should include a discussion and listing of the recent Administrative Order, Consent Decree, and lawsuit actions. Sufficient information should be provided in the Final EIS to enable the reader to understand the relationship of these actions to the issues and alternatives being addressed in the EIS. (258, 320, 344, 346, LO-11, LO-33, HA-31)

RESPONSE: Section 1.5.3.1 of the Draft EIS contains a chronology of events concerning the civil suit. This chronology has been updated in the Final EIS. As of this writing, parties to the suit are engaging in settlement negotiations. Section 2.4 of the Final EIS, which identifies the agencies' preferred alternative, discusses the various ways a selected alternative may be implemented. Appendix A also discusses the relationship between the legal actions and the water quality improvement measures by alternative. However, the focus of the EIS is on the technical mitigations used to reduce impacts to water resources. A legal analysis on the merits of the various violations, orders, lawsuits, and possible settlement conditions is outside the scope of the EIS.

7. COMMENT: EPA has sued the mine because, in EPA's opinion, Pegasus/ZMI is currently in violation of the CWA. The Draft EIS does not even state whether BLM agrees or disagrees with this opinion. Presumably , the BLM agrees with EPA that the mine is in violation of the CWA, since both agencies are part of a "unitary executive." (344)

RESPONSE: The EPA is responsible for determining compliance with the CWA. The BLM has issued Notices of Noncompliance for violation of the CWA based on EPA's and DEQ's determination. The BLM has also stated that the existing reclamation and operating plans are not adequate for managing potentially acid generating rock. The BLM has determined that a major modification to the Plan of Operations must be made to address these issues. This administrative action is one of the primary purposes of the EIS.

8. COMMENT: Page 2-104, mentions water treatment in accordance with 1994 administrative order, but fails to say what is in the order or show the order. (352)

RESPONSE: The DEQ issued an Administrative Order on September 28, 1994, authorizing construction and discharge from the Ruby Gulch water treatment plant. Interim effluent limits and monitoring requirements are contained in this order. A complete copy of the Administrative Order is on file and available at the Montana Department of Environmental Quality.

9. COMMENT: A review of their reclamation history shows that Pegasus has not complied with this law (MMRA). Many areas are not reclaimed and the areas that have allegedly been reclaimed have consisted of capping the mounds of waste with an oxidized ore and soil mixture. They then spray these capped mounds with a seeded spray to produce a vegetative cover. According to area residents, these reclamation efforts have not been successful, since the reclamation efforts have washed away during rainstorms, making erosion and AMD a problem once again. (351)

RESPONSE: Chapter 2.0 of the EIS describes ZMI's revised reclamation plan (see Sections 2.6 and 2.8), as well as the agencies' modifications to it (see Sections 2.7, 2.9, 2.10, and 2.11). Section 4.3 evaluates and presents the agencies' assessment of the adequacy of the existing reclamation covers, while Section 4.4 assesses the effectiveness of ZMI's revegetation efforts to date. The EIS discloses that existing reclamation plans and procedures are inadequate (Section 2.1).

10. COMMENT: On pages 1-11, the Draft EIS says under MMRA Laws, the lands and waters must be returned to beneficial use; it fails to say what type of use and by whom, certainly not traditional and cultural practitioners. (352)

RESPONSE: The MMRA addresses the type of use in §82-4-336(7): "The reclamation plan must provide for the reclamation of all disturbed land to comparable utility and stability <u>as that of adjacent areas</u>." The law also makes a distinction between reclamation and complete restoration in §82-4-301 "the very character of many types of mining operations precludes complete restoration of the land to its original condition."

11. COMMENT: No further mining disturbance should be allowed in the Little Rocky Mountains until pending lawsuits by the State of Montana, EPA, and the Tribes against Pegasus Gold. Alleged violations of the Federal Clean Water Act should be disclosed in the EIS. A listing of all such administrative orders, consent decrees, and legal action should be presented and discussed in the EIS. (258, 346, 347, 350, 353, 361, HA-23)

RESPONSE: The agencies are processing the permit application by ZMI for additional mining at the Zortman and Landusky mines. Other legal, administrative, and enforcement issues cannot be resolved through the EIS process. However, the NEPA and MEPA process can proceed without all of these other processes reaching full resolution. Section 1.5.3.1 of the Draft EIS summarized the lawsuit and alleged violations (this section has been updated for the Final EIS).

12. COMMENT: The Draft EIS discussion of "issues and concerns" as it relates to the seriousness of ARD is inadequate. It should, for example, at least mention the IBLA appeals regarding the construction of the Sullivan leach pad. These appeals are important because they show that the appellants raised the problem of ARD at least five years ago. Both the BLM and the state Division of Lands, as well as the mining companies, had long rejected those ARD claims. Indeed, the agencies did not inform the public that ARD and/or precursors of ARD were indicated by water testing as early as 1986. (361)

RESPONSE: Potential ARD was documented in a field report prepared by BLM in 1987 with regard to Ruby Gulch. ARD was considered and evaluated in the 1990 EA for the Landusky Mine and not judged to be a significant issue. It was not until data compilation began in 1992 for evaluation of the Zortman expansion project that ARD was recognized as a wide-spread issue at both mines. Section 3.2 of the Draft EIS discusses in detail the existing water quality conditions in and around the mine site and presents data which indicate the seriousness of water quality impacts associated with ARD. Development of acidic conditions in Mill Gulch as a result of construction of the 1987 Mill Gulch leach pad and/or waste rock dump were disclosed to the public in the 1990 Environmental Assessment for Landusky Permit Amendment 10 regarding the Sullivan Park leach pad (EA, pg. 60). The purpose of the "issues and concerns" discussion in the Draft EIS is to identify the range of issues related to the proposed action raised during public scoping. The seriousness of the ARD problem is disclosed in Chapters 3.0 and 4.0 of the EIS. The IBLA appeals are an historical regulatory issue which has been resolved.

13. COMMENT: The only "measure" that would bring Pegasus/ZMI into compliance with the CWA, and therefore prevent unnecessary or undue degradation, is development of the compliance plan and the issuance of appropriate CWA permits. Until Pegasus/ZMI receives a permit authorizing discharge, the current mine operations are in violation of the Clean Water Act and the Montana water quality laws. The BLM must "take any action necessary" -- including delaying expansion -- to prevent the undue degradation caused by continuing violations of water quality laws. According to the Government Accounting Office, "BLM and the Forest Service have the authority to prevent cyanide operations that do not comply with federal laws and regulations from starting, and to seek court ordered closure of, operations" that violate the law. Nowhere does the Draft EIS discuss the fact that approval of an expansion would violate the plain language of FLPMA's implementing regulations. This omission compounds the FLPMA violation by failing to provide the "full and fair discussion" NEPA requires. 40 C.F.R. § 1502.1. The BLM must also identify and analyze in the Draft EIS mitigation measures that will <u>ensure</u> that the mine will come into compliance with the Clean Water Act and other laws. (344)

RESPONSE: Compliance with the CWA is required to prevent unnecessary or undue degradation. This is an element of <u>all</u> alternatives in the EIS. In response to decisions issued by the Montana BLM State Director requiring modification of the mine plans to address acid rock drainage, ZMI has proposed modified reclamation and water management plans to correct existing water quality degradation. These plans are one subject of this EIS. In addition, ZMI has proposed plans for expanded mining. Taken together, viable sets of alternatives have been developed that would provide for compliance with the CWA under two general scenarios; for existing facilities only (Alternatives 1-3), or with expanded mining (Alternatives 4-7). Compliance with the CWA may be achieved under either scenario, thus unnecessary or undue degradation would be corrected/prevented under either expansion or non-expansion alternatives. The identification of unnecessary or undue degradation does not automatically require mining operations to be suspended provided remedial measures to abate the degradation are available. This is explained in detail in a recent decision regarding the Zortman-Landusky Mine by the Interior Board of Land Appeals. See <u>Red Thunder, Inc.</u>, 129 IBLA at 237 (1994). A decision that approved the expansion under the preferred alternative would <u>not</u> violate FLPMA's implementing regulations since it would require remediation to correct existing unnecessary or undue degradation and require mitigation to prevent its future occurrence. Mitigation measures needed for the mine to achieve compliance with the Clean Water Act, and other laws, are included in the EIS.

14. COMMENT: ZMI has violated its current permit by mining into sulfide ores and acid mine drainage has occurred. This violation could be grounds for a suspension of ZMI's current operating permit under MCA §82-4-362(1). (340, 351)

RESPONSE: There is no restriction in existing permits against mining sulfide bearing material. Past environmental documents have presumed that the mined material did not represent a significant acid generating impact.

15. COMMENT: The Final EIS should analyze the option of: "Requiring ZMI to bring its current operations into compliance with environmental laws prior to approval of the mine expansion operation." The BLM and DEQ should require compliance with the Federal Clean Water Act and Montana Water Quality Act prior to any consideration of expansion. (70 through 125, 145 through 157, 165, 166, 264, 275 through 319, 320, 324, 328, 330, 331, 332, 337, 341, 351, 353, 354, 363, LO-26, LO-37, GF-39, GF-50, GF-74)

RESPONSE: The agencies are required to consider and evaluate the potential environmental effects of submitted mining proposals. Requiring compliance prior to expansion is an implementation option. Any of the alternatives could be implemented in that manner. The EIS describes and evaluates Alternative 3, Mine Expansions Not Approved and Agency Mitigated Reclamation, to disclose the effects of achieving compliance with the water quality and reclamation laws will not allow mine expansion. Expansion could then be allowed at some point in the future.

16. COMMENT: It would seem prudent, and logical to defer any decisions involving approval of activities that would extend the life of the Z/L mines until Zortman Mining, Inc (ZMI) is able to demonstrate that further contribution to the widespread surface and ground-water contamination that has occurred since 1979 is stopped and plans developed and implemented to prevent further movement of contaminated groundwater. At a minimum this would require resolution of litigation underway by the State of Montana, U.S. Environmental Protection Agency and the Fort Belknap Gros Ventre and Assiniboine Tribes concerning violations of the federal Clean Water Act and a determination of whether the Water Quality Improvement Plan described in Appendix A of the Draft EIS, is successful in controlling further surface and groundwater contamination. (267, 268)

RESPONSE: Based on the analysis, the ultimate conclusion regarding future compliance is that by using selective waste handling, enhanced reclamation cover, segregation of storm water vs. mine drainage, capture and pumpback facilities, and water treatment plants at both mines, compliance with state and federal water quality laws would be achieved. The status of ZMI's compliance with the water quality laws will be considered when the decision on the application is made.

17. COMMENT: Given the history of water quality degradation at these mine sites as documented in the Draft EIS, we [EPA] believe a demonstration of good faith by ZMI to restore and protect water quality should be considered. In our view, a good faith demonstration by ZMI includes timely settlement of existing water quality enforcement litigation and actual compliance with Best Available Demonstrated Treatment limits that will be required until Montana DEQ issues an MPDES permit. This recommendation is supported by Section 82-4-335(9), Montana Code Annotated. (337)

RESPONSE: It is the agencies conclusion that by using selective waste handling, enhanced reclamation cover, segregation of storm water vs. mine drainage, capture and pumpback facilities, and water treatment plants at both mines, compliance with state and therefore federal water quality laws would be achieved. Therefore, the agencies have little justification to withhold a decision on mine expansion activities.

18. COMMENT: "To the Bureau of Land Management Permitting Official, if the permit is granted, please justify to my (BIA's) attention as to why the Permittee would be in compliance with (2); failure to take into consideration the effects of operations on other resources and land uses (primarily Fort Belknap Indian and tribal lands and its resources)." (348)

RESPONSE: Should the Operating Permit/Plan of Operations be approved using the preferred alternative it would contain numerous mitigating measures which have been designed to avoid or reduce environmental impacts. These measures would mitigate the impacts to water resources, vegetation, wildlife, wetlands and cultural resources both within and adjacent to the area of operations. Thus, appropriate consideration would be afforded to other resources and land uses, including those resources and uses outside the area of operations as required by BLM regulations at 43 CFR 3809.0-5(k).

19. COMMENT: The agencies have determined that existing operation and reclamation plans are not adequate to prevent unacceptable impacts from ARD. Modified reclamation plans are required (Draft EIS, 1-11). It is difficult to understand how the agencies can adequately address the environmental protection needs associated with the proposed expansion of the mine when the mine as currently it exists does not have adequate environmental safeguards. (345)

RESPONSE: One of the primary purposes of the EIS process is to develop adequate environmental safeguards for existing as well as expanded mining activities. These requirements allow determination of reclamation effectiveness and provide contingencies in event of unusual or unpredicted occurrences.

20. COMMENT: The Draft EIS fails to assess whether and when the facility will be in compliance with water quality laws. (344)

RESPONSE: Based on the analysis, the ultimate conclusion regarding future compliance is that by using selective waste handling, enhanced reclamation cover, segregation of storm water vs. mine drainage, capture and pumpback facilities, and water treatment plants at both mines, compliance with state and federal water quality laws would be achieved. Appendix A presents the Water Quality Improvement Plan which has been derived from water quality improvement measures proposed by ZMI, and after consultation between EPA, BLM, and DEQ. This appendix outlines the technical approaches of a plan to improve water quality and is mitigation that would be required by the DEQ and BLM and is common to all alternatives of the EIS.

21. COMMENT: The BLM should state, in the EIS, what options it has to require compliance with the Clean Water Act (CWA) and Montana Water Quality Act (WQA) prior to or as a condition of expansion. (203, LO-38)

RESPONSE: The BLM must review the operator's proposed Plan of Operations to determine whether it would result in unnecessary or undue degradation of the Federal lands. Measures needed to prevent unnecessary or undue degradation are required as conditions of approval. Unnecessary or undue degradation briefly means, among other things, failure to comply with applicable environmental statues and regulations. Compliance with the CWA and WQA is required to prevent unnecessary or undue degradation. Measure necessary to compliance with the CWA/MWQA are part of all alternatives.

22. COMMENT: The calculated costs of reclamation and bond amounts being used by the company and the Bureau of Land Management (BLM) will not be enough to cover water management after the mine closes. The method used to calculate the costs has proved to be inadequate in other cases. Sufficient bond should be posted to sustain future reclamation activities and to ensure compliance with all applicable Federal regulations. The Draft EIS should discuss how permanent protection of surface and groundwater would be assured. The company proposed action includes draining the Landusky pit complex through the existing August Adit. The agency modification (see Alternatives 3, 5, 6, and 7) involves backfilling the pit to a free-draining condition. This would eliminate the need to ensure perpetual function of the engineered drain. (70 through 125, 140, 145 through 157, 165, 166, 203, 267, 268, 275 through 319, 324, 328, 330, 331, 332, 343, 344, 348, 353, 354, LO-38, GF-39)

RESPONSE: No cost calculations have yet been completed. The $25 million figure on page 1-13 of the Draft EIS refers to the current reclamation bond. This will be recalculated once a preferred alternative is selected in the Record of Decision. Section 82-4-338 of Montana Metal Mine Reclamation Act requires the applicant to post a bond sufficient to insure funding is available to meet reclamation plan objectives including long-term water management. These costs are calculated based on projected flows, as well as construction, operation and maintenance costs. The agencies are precluded from arbitrarily setting bond amounts. A primary function of the EIS is to evaluate and modify the applicant's proposed reclamation plan to ensure compliance with applicable state and federal regulations (see Table 1-3 of the Draft EIS for listing of applicable statutes). Chapter 2.0 and Appendix A discuss water quality protection measures. These would all be bonded for before the decision could be implemented.

23. COMMENT: The Draft EIS provides no information on reclamation costs, bond amounts, or calculations that would allow evaluation of whether these are adequate to provide ZMI with an incentive to carry out reclamation requirements. How would permanent protection of surface and groundwater be assured? The Draft EIS provides no information on how long monitoring and treatment of contaminated surface and groundwater is likely to be required after mining ceases, how much it would cost and who would pay for it. (70 through 125, 145 through 157, 165, 166, 267, 268, 273, 275 through 319, 324, 326, 328, 330, 331, 332, 346, 352, 353, 354, 361, 363)

RESPONSE: Of primary concern with regard to the reclamation plans is how well they mitigate potential environmental impacts, not how much they cost to implement. The EIS evaluates the effectiveness of the reclamation measures for each alternative. Once a decision is made and a preferred alternative is selected, the reclamation bond is merely an enforcement tool which is used by the agencies to insure implementation of the reclamation plan. It is a key part of the compliance program. By law, the amount of the bond must be high enough to insure compliance. Therefore, the compliance program is not the subject of the EIS analysis.

The $25 million figure cited on page 1-13 of the Draft EIS text refers to the reclamation bond currently held by the agencies for the existing operation. Once an alternative is selected, a new reclamation bond would be calculated and held for 100 percent of the anticipated reclamation costs. The reclamation costs and bond amount would be calculated using standard engineering and construction estimating techniques on what it would cost the agencies to implement the reclamation plan. This includes costs for water management and long-term treatment using annuities or trust funds. Reclamation bonding information is available to the public in agency files.

24. COMMENT: The Draft EIS says the State can require a trust fund for extended water treatment or facility maintenance, but it fails to say if that is the case or not, and if so what amount. (353)

RESPONSE: As specified in Appendix A of the Draft EIS, water treatment would be conducted at both Zortman and Landusky. A bond amount and mechanism will be calculated and put in place prior to implementation of the selected alternative that provides for water treatment costs.

25. COMMENT: The Draft EIS states that a separate bond for the shale or clay to be mined is required, but fails to state how much and when. (352)

RESPONSE: A bond for 100 percent of the anticipated reclamation costs of the clay pits will be held prior to implementation of the selected alternative.

26. COMMENT: The adequacy of the reclamation bond must be discussed in terms of long range environmental protection. (203, 211, 273, 320, 326, 328, LO-38)

RESPONSE: The function of the EIS is to evaluate the adequacy of the reclamation measures not the reclamation bond. The adequacy of the reclamation plans were evaluated in terms of their ability to meet statutory requirements. A bond will be calculated and held for the amount necessary to fully implement the plans and statutory requirements.

27. COMMENT: It is unclear if bonding would be required to reverse perforations in the leach pad. What is the agencies intent regarding bonding for this requirement? (342)

RESPONSE: The agencies' liner perforation criteria are presented in Section 2.7.2.4. Because the need to reverse liner perforation is not foreseeable, no bond would be held. However, as a contingency, liner perforation would be conducted in a manner that would allow reversal of the procedure.

28. COMMENT: Any areas lacking baseline data should be documented as soon as possible by the permitting agencies, i.e., Bureau of Land Management and Montana Department of Environmental Quality to determine realistic bonding requirements. (348)

RESPONSE: The baseline data are adequate to understand the effects of the alternatives.

29. COMMENT: In reviewing corporate information which Pegasus made available in 1988 for potential investors, it appears that Pegasus has never intended to protect the area against environmental degradation or to fully reclaim the mine as required by Montana law. In this document, Pegasus admits to having no intention of spending more than the bond amount for any environmental expenses. They also state that they had no expenditures for environmental protection from 1985-88. 590 PLI/Corp. 617, <u>Gold-Linked Debt Securities</u>, Wolfram, Steven L. and Rossell, Marc. (1988). (351)

RESPONSE: The current reclamation bond is $25 million for both mines ($10 million for Zortman, $15 million for Landusky) none of which has been released. The operator is financially liable for all costs to perform reclamation -- even if such cost exceeds the actual bond amount. Should the expansion application be approved, a new bond would be calculated to cover the revised reclamation plans contained in the selected alternative.

30. COMMENT: From review of historic documents, it is apparent that Pegasus Gold intended to spend no more than the reclamation bond in effect in 1988 for any environmental expenses. Higher compliance standards, including monitoring and bonding levels, are suggested. (340, 347)

RESPONSE: The bond amount has been and will be further updated to address environmental protection requirements *and contingencies for future cleanup* for whatever alternative is selected. Real-time monitoring and agency review of future conditions would be provided. Bond amounts are based upon engineering estimates of actual agency costs, with contingencies. See Section 1.5.1.

31. COMMENT: Water quality monitoring data for the Gold Bug Adit indicate that levels of contamination of groundwater flowing from the Landusky Mine area have been steadily increasing since mining began in 1979 (Figure 3.2-18). Inadequate mine design, and careless operations that have caused multiple spills of toxic cyanide, solution have created a legacy of ground-water contamination that could continue for hundreds of years. The Draft EIS needs to address financial and regulatory mechanisms that are required to ensure that Pegasus Gold and ZMI don't simply walk away from the Zortman and Landusky mines after the last ounce of profitable gold has been extracted. (267)

RESPONSE: See Section 1.5.1 for more information on reclamation bonds.

32. COMMENT: Alternative 7 apparently proposes removal of tailing and restoration of Ruby Gulch as the mitigation for existing disturbance to waters of the U.S. Have the agencies completed a NEPA analysis on this mitigation? (342)

RESPONSE: All actions as part of or resulting from implementation of Alternative 7 have been evaluated for environmental impacts. This EIS constitutes the NEPA analysis. Please see Section 4.2 of the EIS which analyzes impacts of Ruby Gulch tailing removal.

33. COMMENT: I would encourage you to remove the Zortman mine tailing reclamation from this permit consideration until further evaluations can be made on its need and whether it is even a desirable option. Zortman Mining should not be held responsible for the removal of all the mine tailing from Ruby Gulch. (266, 325, MA-12)

RESPONSE: Removal and restoration of the Ruby Gulch drainage has been identified as one approach to achieve mitigation for past disturbances to waters of the U.S. BLM and Council on Environmental Quality (CEQ) regulations (43 CFR 3809.0-5(k) and 40 CFR 1508.20(e)) do not restrict mitigation to only those areas within the immediate area of operation. The agencies can require off-site mitigation to compensate for other impacts that ZMI is responsible for creating. See Appendix F of the EIS for mitigation measures required pursuant to Section 404 of the Clean Water Act.

Analysis performed on the tailing has shown that once removed they are suitable material that could be used in the reclamation covers either as a subsoil or a drain layer (see Sections 2.7.2.1 and 2.11.2.1 in the EIS) (Womack 1995 and Ryan 1996).

34. COMMENT: The Draft EIS fails to reveal the recent discovery that the volume of old tailing at Ruby Gulch was greatly underestimated. It has recently been discovered that Pegasus/ZMI underestimated by a factor of ten the volume of tailing it will have to dispose of in moving the old tailing from Ruby Gulch. The Draft EIS assumes there will be enough room for all the <u>new</u> tailing that will be created. Draft EIS at 2-232. This assumption is no longer valid, given the significant new information about the extent of existing tailing that must be moved. (340, 344)

RESPONSE: The volume of tailing in upper Ruby Gulch is estimated to be 0.6 million cubic yards including that portion already stockpiled from construction of catchment ponds (Womack 1995, Ryan 1996). Chemical and material analysis on the tailing has shown that the tailing could be used as reclamation material. In the EIS under Alternative 7, the tailing would be used as part of the reclamation cover. This option was included in the Draft EIS (Section 2.11.2).

35. COMMENT: The responsibility of ZMI/Pegasus is not only limited to reclamation of those activities resulting from POST-1979 but also include PRE-1979 activities dating back to the late 1870-early 1880 time frames up to and including the present. (181, 186, 367)

RESPONSE: The function of the EIS format is not to determine liability, but rather to analyze the impacts of the action on the environment. BLM and CEQ regulations (43 CFR 3809.0-5(k) and 40 CFR 1508.20(e)) do not restrict mitigation to only those areas within the immediate area of operation. The agencies can require off-site mitigation to compensate for impacts that ZMI is responsible for creating. Removal of the Ruby Gulch tailing and reconstruction of the drainage, OK, Upper Alder Gulch, and Montana Gulch Waste rock dump removal, and construction of ponds closer to Azure Cave are a few examples of mitigation measures that are being proposed to offset the impacts that ZMI is or would be responsible for creating.

36. COMMENT: There should be a sensitivities summary for each resource topic (i.e., those conditions that can affect or be affected by the proposed action). By summarizing such sensitivities, the overall technical assessment can be further focused on significant adverse changes. (350, 364)

RESPONSE: Chapter 4.0 of the EIS provides a comprehensive assessment of the environmental effects of the alternatives. With the exception of Geology, Recreation, ACECs, and Hazardous Materials, the individual sections in Chapter 4.0 provide summary tables identifying those conditions for each resource that would be most effected by the proposed action and alternatives. In addition, overall summary tables are provided in the EIS, Table 2.3-1 and, in the stand-alone Executive Summary, Table ES-2. One of the purposes of the Executive Summary for the Draft EIS was to highlight the environmental consequences, with emphasis on the most significant impacts, especially impacts associated with the four primary issues of concern; water quality, reclamation and its associated impacts, cultural resources, and socioeconomics.

37. COMMENT: For purposes of describing the affected environment, and quantifying the impacts associated with the alternatives, the Draft EIS generally presents the environmental conditions that existed in the Little Rocky Mountains before modern mining began in 1979 [See e.g., page 3-50 (Baseline Surface Water Quality - Pre-1979); page 3-80 (Baseline Groundwater Quality); page 4-27 (Impacts from Mining - 1979 to Present)]. ZMI agrees that the description of the pre-1979 environment is useful and the analysis of impacts from 1979 to the present is responsive to scoping comments. However, in measuring the impacts of the proposed alternatives, and comparing among alternatives, ZMI believes that NEPA requires a comparison with conditions at the time of the proposed action, not pre-mining baseline. This distinction may become important, for example, in comparing the potential impacts of water quality, for as the Draft EIS correctly indicates, water quality has improved and will continue to improve as a result of construction of capture and treatment systems (page 3-110) and implementation of the water quality improvement plan under any of the alternatives (page 4-27). (342)

RESPONSE: The rules for implementing MEPA and the regulations for implementing NEPA require an analysis of cumulative impacts which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions (MCA 26.2.642 (7) and 40 CFR § 1508.7). In measuring the impacts of the proposed alternatives the regulations are clear that the analysis must address cumulative impacts which includes past actions. The baseline discussion in the Affected Environment, focuses on conditions prior to the era of large-scale, modern mining and disturbance, which began in 1979. Each environmental resource discussion in the Environmental Consequences addresses impacts from activities in the past (1979-present), and then goes on to discuss the potential impacts of each alternative.

38. COMMENT: Throughout the Draft EIS, the BLM improperly defers disclosure of impacts to the future, when the compliance plan, water discharge permit, and other important documents will be completed. The Draft EIS may not avoid a discussion of the impacts to groundwater or how impacts will be mitigated by deferring to a plan that is not available to the public. This deferral of analysis violates NEPA and makes it impossible for the public and decision makers to comment meaningfully on the adequacy of the analysis. (320, 344)

RESPONSE: The impacts to water resources based on the alternatives, including the Water Quality Improvement Plan, are described in Section 4.2 for each alternative and Table 4.2-10 summarizes impacts for water resources. Agency mitigated reclamation is included under Alternatives 3, 5, 6, and 7. Appendix A presents the Water Quality Improvement Plan which has been derived from water quality improvement measures proposed by ZMI, and after consultation between EPA, BLM, and DEQ. Appendix A outlines the technical approaches of a plan to improve water quality and is mitigation that would be required by the DEQ and BLM, common to all alternatives in the EIS. One part of the plan is the monitoring requirements that would be implemented to improve and maintain water quality on and adjacent to the mine sites. No impacts analysis has been deferred.

39. COMMENT: "Chapter 4.0, Environmental Consequences--It would have been preferable to use actuarial factors of risk to characterize the significance of impacts--i.e., exposure (resources and population at risk), frequency (temporal factors off impact occurrence), and severity (degree of harm)--instead of magnitude, incidence (a temporal consideration), and duration (another temporal consideration). By describing impact significance without consideration of exposure, the impact assessment lacks a sharp focus on the particular resources and populations that may be affected by the proposed action." (364)

RESPONSE: Impacts are assessed for each environmental and human resource with regard to direct effects, indirect effects, cumulative impacts, and impact significance. This includes impacts, or exposure, to the following resources: geology, water, soil, vegetation, wetlands, wildlife, air, recreation, visual, socioeconomic, and cultural. The terms magnitude, incidence, and duration are defined in the introduction of Chapter 4.0 of the EIS. Magnitude refers to the extent (or degree) of the impact. Incidence is the frequency of impact occurrence and may be continuous or periodic. Duration refers to the time within which the impact will occur (short-term or long-term). As defined in the EIS, incidence and duration are not necessarily limited by time.

40. COMMENT: The entire Little Rocky Mountain range has been designated as a study area for environmental impacts. It should be noted that the potential environmental impacts are confined to a much smaller area. (342)

RESPONSE: The study area for this project varies for each environmental resource, but it is generally the area encompassed by the Little Rocky Mountains. For instance, effects to air quality generally have a much wider distribution than just near the mine permit area or haul roads, although the level of impact is usually much dispersed on the large scale. Socioeconomic and cultural impacts are wide-reaching, as are transportation, recreation, and visual effects. Even geologic resources are affected on a regional scale; consider the mining of the Seaford and Williams clay pits to provide reclamation materials. Conversely, impacts to resources such as soil are confined to the immediate project area.

41. COMMENT: "The following categories of impacts are discussed separately for each resource topic within each alternative: • Cumulative Impacts, • Unavoidable Adverse Impacts, • Short-Term Use vs. Long-Term Productivity, • Irreversible or Irretrievable Resource Commitments. These impact categories provide the basis for a critically important policy analysis that is at the heart of the NEPA process. However, when these impact topics are discussed in a disjointed format, such as that used in this Draft EIS, the focus remains on relatively small, topical concerns. In contrast, when all of the single-issue, topical concerns are assembled together, policy analyses can be used to identify issues that cut across resource topicality to define the larger environmental, social, economic and political issues facing the decision-makers. It almost goes without saying that these issues are greater than the sum of their parts. In this EIS, if the topical parts are not assembled together and their policy implications not adequately analyzed for the Final EIS, the decision makers will be deprived of the big-picture information they need to make reasonable decisions that will minimize harm while maximizing benefit to the environment and all of the stakeholders. Therefore, it is strongly recommended that the topical discussions of the four categories of impacts listed above be consolidated into single sections for each alternative. Then, for each category of impact, complete a policy-level analysis that defines the critically important adverse environmental, social, economic and political issues associated with each alternative. This approach will help put the bigger issues on the table. (364)

RESPONSE: Table 2.3-1 is provided as an impact summary matrix, inclusive of all the critical components mentioned in this comment. It contains both quantitative information and/or relative impact rankings for each resource area and for primary issues of concern under the resource areas. A more detailed discussion of these impacts is contained in Chapter 4 where the impacts are broken down into cumulative, unavoidable adverse, short-term use vs. long-term use productivity, and irreversible or irretrievable resource commitments. The purpose of the EIS is to present an analysis of the technical issues and associated environmental impacts. The EIS is not intended to constitute a "policy analysis" nor discuss "political issues" or "policy implications." A limited discussion of such factors may be appropriate in the Record of Decision when the technical issues/consequences identified in the EIS can be considered in conjunction with these non-technical factors.

42. COMMENT: Allow Zortman Mining to modify their plans as new technology becomes available to increase effectiveness and lower costs. (128, 189)

RESPONSE: As stated in the Draft EIS, "Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule" (page 2-235). This allows for some modifications based on new technology (e.g., improved goesynthetic clay liner or filter fabric) but does not allow for changes in performance criteria or facility location and/or size. Reclamation would have to meet the construction and performance criteria contained in a Record of Decision (i.e., minimum depths for topsoil, subsoil and capillary break; criteria for non-acid generating material. Modifications outside the scope of the approved plan would require the operator to submit specific proposals for agency review and additional environmental analysis.

43. COMMENT: With such extreme negative impacts to hydrology, soils, wildlife, and human health posed by the acid rock drainage from initial mining activity, how can the BLM and Montana Department of Environmental Quality ensure public health and safety and environmental quality while allowing expansion of the problem with the exposure of sizable quantities of new acid generating rock? How will permitting agencies assure that compliance will be met at the mine if it is allowed to expand? (203, 211, 320, 326, 329, 341, LO-38)

RESPONSE: Under the 1971 Montana Metal Mine Reclamation Act, the DEQ has the authority to inspect facilities and operations for compliance with applicable laws, and to confirm the company's self-monitoring. BLM has similar authority on federal lands. Monitoring is discussed for each alternative under the section "Monitoring Programs and Research Studies." Under Alternative 7, the preferred alternative, the agencies would require that ZMI implement a program to monitor discharges from mine facilities, as well as long-term viability of surface reclamation. The program must evaluate the continued performance of such features as reclamation covers, revegetation success and permanence, erosion control measures, and water treatment effectiveness. Bonding is held to ensure these measures are implemented as described in the approved plan.

44. COMMENT: The Draft EIS fails to provide a system for the long-term monitoring of either surface or groundwater or for a system which will ensure compliance with water quality standards in the future. Because the mining activity is likely to cause violations of groundwater quality standards, ZMI should, at a minimum, be required to submit monitoring information pursuant to the Montana Water Quality Act. MCA § 75-5-602 (4), (5). (268, 339, 344)

RESPONSE: ZMI is required to submit monthly, quarterly, and yearly water quality monitoring reports to DEQ and BLM. Monitoring programs are described in Chapter 2.0 and Appendix A.

45. COMMENT: The Draft EIS calls for the company to monitor the site, including its mining activities as well as their compliance and reclamation efforts. This is a major concern. There is at least a conflict of interest here since it is in the company's best interest to cut down on any unnecessary costs and make the operation as profitable as possible. Random, periodic inspections and monitoring by the state would resolve some of the controversial issues of this proposal. (344, 351)

RESPONSE: Under the 1971 Montana Metal Mine Reclamation Act the DEQ has the authority to inspect facilities and operations for compliance with their permit and applicable laws, and check the company's self-monitoring. BLM has similar authority on the public lands. The DEQ and BLM routinely conduct inspections and supplemental monitoring of mine facilities.

46. COMMENT: The Draft EIS says the agencies are restricting the use of certain waste rock types in reclamation, but doesn't say who will be responsible to enforce this action or other agency added mitigation. (352)

RESPONSE: Monitoring programs are discussed under each alternative in the Draft EIS. ZMI would be responsible for self-monitoring, including characterization of waste rock, based on the selected alternative to be presented in a Record of Decision. The BLM is required by law to prevent unnecessary or undue degradation and ensure compliance with the permit conditions. Under the 1971 Montana Metal Mine Reclamation Act the DEQ has the authority to inspect facilities and operations for compliance with their permit and applicable laws, and check the company's self-monitoring. The DEQ and BLM routinely conduct inspections and supplements monitoring of existing facilities.

47. COMMENT: In the Draft EIS, the alternatives' features are simple statements that certain activities will occur. However, for decision-makers and the public to feel confident that specific avoidance and mitigation measures will be completed, the measures must be described as performance standards addressing the basic questions of who, what, when, where, and how. Added to this should be the basic question of: How will the measure be mandated and monitored by the lead and cooperating agencies? (364)

RESPONSE: The impact assessment is based on the full implementation of the alternatives described in Chapter 2.0. Wherever possible, performance standards or objectives are used when describing mitigating measures. Permit requirements will be mandated in the Record of Decision and monitored by the lead agencies, or by the agency issuing a specific associated permit (e.g., 404 permit monitoring by COE).

Procedures for enforcement of permit conditions are described in the respective agency regulations should compliance by the operator not occur. In addition, many of the mitigating measures are related to reclamation procedures which are covered by the reclamation bond. Should the operator be unwilling or unable to implement the reclamation requirements, the agencies would collect the bond amount needed to have the reclamation performed.

48. COMMENT: Long-term reclamation is a requirement under all alternatives of the Draft EIS. What is meant by "reclamation"? Can it be achieved? How will permanent protection of surface and groundwater be assured? (203, 211, 320, LO-39)

RESPONSE: "Reclamation means taking such reasonable measures as will prevent unnecessary or undue degradation of the Federal lands, including reshaping land disturbed by operations to an appropriate contour and, where necessary, revegetating disturbed areas so as to provide a diverse vegetation cover. Reclamation may not be required where the retention of a stable highwall or other mine workings is needed to preserve evidence of mineralization" (43 CFR § 3809.1-4(j)). Under state law, reclamation means achieving comparable stability and utility with adjacent, undisturbed lands. Reclamation bonds are held to ensure that the reclamation plans are implemented. This includes measures to protect surface water and groundwater. Reclamation effectiveness for each alternative is addressed in the "Soil and Reclamation Effectiveness" section of the Environmental Consequences, Chapter 4.0.

49. COMMENT: It appears that approval of the mine expansion is a foregone conclusion and you are using this process to justify your decision. (181, 186, 347, LO-2, LO-7)

RESPONSE: Identification of a preferred alternative is required in a Draft EIS to allow the public to review the agencies preference. A number of changes have been made to the Preferred Alternative between the Draft EIS and Final EIS, largely in response to public comments. Major changes include: removal of the Peregrine Falcon reintroduction study for the pit highwalls, relocation of the limestone quarries to avoid impacts to northern drainages, routing of all post-reclamation pit runoff to the south, updating of the Water Quality Improvement Plan presented in Appendix A, completion of the Programmatic Agreement for mitigation of impacts to cultural resources presented in Appendix E, and the inclusion of new Appendix F which presents the aquatic ecosystem mitigation plans. Alternative 3 has also been changed to evaluate the agencies' preferred reclamation cover in combination with a non-mining alternative. The alternative selected for implementation, along with the rationale for the selection, will be provided in the Record of Decision. However, it should be noted that the decision before BLM is not <u>if</u> mining can be conducted on these lands but <u>how</u> mining should be conducted to prevent unnecessary or undue degradation. The public lands are open to mining and proposed mine plans presented to BLM must be reviewed, conditioned with whatever measures are needed to prevent unnecessary or undue degradation, and then approved.

50. COMMENT: The Purpose and Need statements in the Draft EIS do not adequately support and explain the Native American viewpoint and objections to mining in the Little Rocky Mountains. As one example, the Turtle Mountain tracts on the southwest side of the Little Rocky Mountains were purposely eliminated from the environmental impact research. Also, the use of mercury in early gold processing is not addressed to the satisfaction of Native Americans in the EIS, such as it may have affected current water contamination. (48, 181, 184, 348, 350, 360, 361, HA-20, HA-23)

RESPONSE: The two-fold Purpose and Need for the project is properly stated in the EIS as currently written. BLM and DEQ have seriously considered other viewpoints as the Draft EIS and Final EIS were prepared. Unfortunately, all points of view cannot be accommodated within the existing statutory framework. A range of alternatives, including alternatives that would not approve expansion plans, have received much thought and attention as the EIS was prepared. The Turtle Mountain tracts were not eliminated from EIS study and are addressed in various sections of the Final EIS. Lands held in trust for members of the Fort Belknap Tribes would be subject to little or no impact from any of the alternatives. Water quality testing has not identified mercury as a contaminant of concern in the mining areas. It will continue to be included in the monitoring programs.

51. COMMENT: The Draft EIS violates NEPA's readability requirement by burying discussion of impacts in inappropriate sections. NEPA requires that an EIS be "readable." <u>Oregon Environmental Council v. Kunzman</u>, 817 F.2d 484, 493-94 (9th Cir. 1987); <u>see</u> 40 C.F.R. §§ 1500.4(e), 1502.8, 1502.10. To this end, an EIS must be "clearly present[ed]" in a "clear format," and must be "organized and written so as to be readily understandable by governmental decision makers and by interested non-professional laypersons likely to be affected by actions taken under the EIS." <u>Kunzman</u>, 817 F.2d at 494; 40 C.F.R. §§ 1500.4(e), 1502.10. These requirements are not met in this Draft EIS. Discussion of critical impacts is left out of the appropriate sections and buried in sections where one would not expect to find it. For example, to discover the full impacts of this project on sensitive bat species, one must look not only section on impacts to Wildlife from Alternative 7, but also to the sections on Alternatives 1 and 4, the sections on "Areas of Critical Environmental Concern," "Noise," "Vegetation," and "Water," and the Appendix containing the Biological Assessment. Draft EIS at 4-124 to 4-127; 4-133-35; 4-282 to 4-283; Appendix B at 17. Compounding this scattering of discussion is the fact that the Wildlife section purports to disclose impacts to bat species. See Draft EIS at 4-121. It is only after perusing the entire Draft EIS that one discovers that the proposed expansion is likely to have devastating impacts on bat species; it is only in the "Wildlife" discussion of Alternative 4 (not the preferred alternative) that the Draft EIS mentions that these sensitive species may actually leave the area because of the disruption caused by the project. Draft EIS at 4-135. Furthermore, these significant impacts are not discussed in the Executive Summary. Similarly, the discussion of impacts to cultural properties is spread out between the "Cultural Resources" section, the "Vegetation" section, the "Socioeconomic" section, and Appendix E. See Draft EIS at 4-96, 4-228-29, 4-268, EI. This scattering of discussion of significant impacts violates NEPA's "readability" requirements. (344)

RESPONSE: The format used for the EIS is consistent with the format recommended by the regulations for implementing NEPA (40 CFR § 1502.10). The format of the Environmental Consequences, Chapter 4.0, was organized by resource subject (i.e., vegetation and wetlands, wildlife and aquatics, etc.) to facilitate a review by the decision maker and the public. In the resource sections of Chapter 4.0, references are made to other alternatives where impacts are the same. This is to reduce the volume of the EIS consistent with the regulations for implementing NEPA (40 CFR § 1502.2(a)). The agencies recognize the complexity of the EIS given the existing mine facilities and problems with acid rock drainage. This was the reason an Executive Summary, a separate document, was prepared containing a description of the proposed action and other alternatives, the agencies preferred alternative, a summary of existing environmental conditions in the study area, and a disclosure of the major impacts and issues associated with the various alternatives. This summary was 39 pages and was also included in Volume 1 of the Draft EIS.

The section on ACECs is based on the analysis of specific resources presented in other sections of the Draft EIS; Wildlife and Aquatics, Noise, etc. With respect to the bats in Azure Cave, the ACEC section of the Draft EIS states "Impacts to hibernating bats in Azure Cave are detailed in Section 4.5," Wildlife and Aquatics. No new information is provided in the ACEC section concerning the bats. The biological assessment, Appendix C, is entirely based on the EIS and does not provide new information.

In the Executive Summary, while overall impacts to wildlife resources are considered low and negative under Alternative 7, reference is made that impacts to ACECs are similar to those for Alternatives 4 and 6. Alternative 4 provides a discussion of the moderate impacts to the hibernating bats. The summary table, Table ES-2, disclosures a moderate level of impact for Azure Cave and associated bat habitat.

52. COMMENT: The Draft EIS is too complicated for the general public to read and understand, and this is in violation of the National Environmental Policy Act and the EIS guidelines. (346, 348, HA-9, HA-23)

RESPONSE: The agencies recognize the complexity of the EIS given the existing mine facilities and problems with acid rock drainage. This was the reason an Executive Summary, a separate document, was prepared containing a description of the proposed action and other alternatives, the agencies preferred alternative, a summary of existing environmental conditions in the study area, and a disclosure of the major impacts and issues associated with the various alternatives. This summary was 39 pages and was also included in Volume 1 of the Draft EIS.

The regulations for implementing NEPA require that an EIS be written so the decision-makers and the public can understand the document (40 CFR § 1502.8). The regulations also provide guidance for the length of EISs: normally less than 150 pages and for proposals of unusual scope or complexity normally less than 300 pages (40 CFR § 1502.7). While the regulations provide guidance on the length of an EIS they do not require that an EIS be limited to 150 or 300 pages. Given the complexity of two existing mines and the issues of acid rock drainage and water quality, the Draft EIS is written commensurate with the importance of the impacts being addressed.

53. COMMENT: A major concern is that significant additional information relevant to environmental concerns and bearing on the proposed action and its impacts seems to be needed. Several specific areas of concern are: how requirements dealing with violations (both resolved and unresolved) will change the descriptions of the proposed action and the alternatives; the economic screening of alternatives; clarification regarding long-term collection and treatment of mine waters; the functions and values of the streams that were affected; storm event sediment loading in streams; and cumulative impact analysis. In light of these concerns, we suggest consideration of the preparation of a supplement to the Draft EIS. (346)

RESPONSE: Public and other agency comments can be adequately addressed in the Final EIS through revisions to the Draft. The changes to the proposed action and alternatives are not substantial, and the revisions and new information is not a significant change from the Draft EIS.

54. COMMENT: It has not been made clear how a proposed expansion of the Landusky operation became part of this analysis. Mineral Policy Center thought that, in this review, only an expansion of the Zortman mine was being contemplated. (211)

RESPONSE: In March 1994, the BLM and DSL issued a Decision Record on corrective measures to address acid rock drainage at the Landusky Mine. This decision withheld approval of final long-term reclamation and closure designs until an EIS was completed. In April 1994, a "Dear Reader" letter notified the public of the inclusion of the Landusky Mine expansion and modified reclamation plans within the scope of the Zortman Mine EIS along with tentative alternatives to be evaluated in the EIS. In addition, a notice was issued in the Federal Register including the Landusky Mine within the scope of the Zortman Mine EIS (59 CFR 16656, April 7, 1994).

55. COMMENT: Since there has been so many delays after ZMI filed a permit amendment application for the Mine Extension Project in May of 1992, there will be 120 employees laid off by January 1996. This could have been avoided. (247, 333)

RESPONSE: Several delays occurred since the Zortman Mine Life Extension application was filed in May of 1992. One of the major factors in these delays was the need to address remediation measures to control acid rock drainage (ARD). In the summer of 1992, it was noted that ZMI's approved operating and reclamation plans were not adequate to address ARD. Subsequently this required remediation plans for the Landusky Mine and revised Zortman expansion plans to include remediation of existing facilities. To address this problem, ZMI revised its mine expansion application for the Zortman Mine and submitted revised reclamation plans and requested approval for a relatively small increase in mining activities at the Landusky Mine. The BLM and DEQ are proceeding with the EIS preparation as expeditiously as possible while making certain that the project issues are thoroughly addressed.

56. COMMENT: I believe that Fort Belknap should be given the right - should have been given the right to be a · cooperating agency in the process of this Environmental Impact Statement. I believe we have that right under NEPA. (LO-12)

RESPONSE: There are two lead agencies preparing the EIS. The BLM is the lead federal agency and the DEQ is the lead state agency. The cooperating agencies are the EPA and the Corps of Engineers. The lead and cooperating agencies are either making a permit decision based on the analysis presented in the EIS, or have oversight authority on permits to be issued by another agency (e.g., EPA oversight on MPDES permits). Responsibilities of a cooperating agency include development of information for the EIS, preparation of portions of the analysis, commitment of staff time to the lead agencies' interdisciplinary team, and expenditure of its' own funds to support the EIS effort. No permit decision is required from either the Fort Belknap Community Council or the Bureau of Indian Affairs (BIA) for the proposed action or alternatives. Both parties were provided the opportunity to become a cooperating agency on the EIS and neither requested designation as a cooperating agency.

This does not mean the BIA and the Council were excluded from the EIS process. Both the BIA and the Council have participated in the public meetings held on the Fort Belknap Indian Reservation. Briefings have been presented to the Council on several occasions regarding the existing and proposed mining activities. The lead agencies intend to maintain this level of contact and involvement beyond completion of the EIS. Participation in the EIS process does not require designation as a cooperating agency.

57. COMMENT: The BLM is required to ensure the professional and scientific integrity of its analysis. The method used to do this is not disclosed. Given the susceptibility of the BLM to political manipulations, even at its lowest levels, it would seem prudent to incorporate some type of impartial, outside peer review. Why was this not done? (273)

RESPONSE: The EIS identifies the methodologies used and makes references to the scientific and other sources relied upon for conclusions. In particular, the methodologies used for the impact analysis are discussed under each resource section in the Environmental Consequences, Chapter 4 of the Draft EIS. The references are listed in Chapter 6 of the Draft EIS. After preparing the Draft EIS the agencies requested comments from the public through a 75-day public comment period. This ensures "that environmental information is available to public officials and citizens before decisions are made and before actions are taken" (40 CFR § 1500.1(b)).

58. COMMENT: The DEQ and BLM have determined that an EIS is required in order to make a permitting decision regarding ZMI's application, but at the same time, they have failed to meet the intent of the law (MEPA and NEPA) by ignoring the fact that existing conditions at the mine already significantly affect the quality of the human environment in an adverse manner. (345)

RESPONSE: The EIS acknowledges that past impacts are significant. One purpose of this EIS is the need to correct inadequacies in the existing operating and reclamation plans that have caused these significant impacts. In early 1993, the agencies informed ZMI that the reclamation plans had to be modified to mitigate existing acid rock drainage and to ensure successful surface reclamation. The EIS is for the expansion of the Zortman and Landusky mines and modified reclamation measures at both mines to address existing as well as potential future impacts.

59. COMMENT: On page 2-241 of the Draft EIS, the expansion proposal at the Zortman Mine also allows for 14.6 million tons of earth disturbance at the Landusky Mine without thorough environmental impact analysis. (352)

RESPONSE: The Draft EIS discloses the environmental consequences associated with expansion of the Zortman and Landusky mines and modified reclamation plans at both mines. The expansion of the Landusky Mine, 7.6 million tons of ore and 7 million tons of waste rock, is thoroughly evaluated in the Draft EIS under Alternatives 4 through 7. Discussions in Chapter 2.0 are limited to a description of the activity under the respective alternatives. Chapter 4.0 contains the environmental impact analysis of the activities described in Chapter 2.0.

60. COMMENT: Section 1.1, page 1-1, states that the baseline for this analysis is circa 1979 which marks the beginning of modern, large-scale mining in the Little Rocky Mountains. For Zortman Mining, Inc., the baseline should include pre-1979 activities that were authorized and occurred via Small Miner Exclusion Statements through the State of Montana. (346)

RESPONSE: Little relative surface disturbance, other than exploration roads, was present in the current mine areas prior to 1979 (see Figures 1-2, 1-3, and 1-4 in Chapter 1.0). The area around the Ruby pit, mill, and along Ruby Gulch is the notable exception. Therefore, the baseline discussion in the Affected Environment focuses on conditions prior to the era of large-scale, modern mining and disturbance, which began in 1979. However, the cumulative impacts in the Environmental Consequences section include historic mining disturbances in Montana Gulch, Beaver Creek, Pony Gulch, and the Hawkeye Mine; plus mill tailing in King Creek, Alder Gulch, and Ruby Gulch.

61. COMMENT: On page 1-1 the Draft EIS mentions the original EIS was done for Zortman Mining Company (Gulf Resources) and Landusky Mining Company (Wharf Resources), but it fails to explain how the EIS relates to and covers the present day ZMI of Pegasus Gold Corporation's mining activities. (352)

RESPONSE: The permitting history for each mine is discussed on page 1-6 of the Draft EIS and summarized in Table 1-1 for the Zortman Mine and Table 1-2 for the Landusky Mine. The tables summarize the purpose for the Operating Permits (00096 and 00095) and Plan of Operations (MTM-77778 and MTM-77779) along with each subsequent amendment. Revisions to the operating and/or reclamation plans were analyzed pursuant to MEPA and NEPA. Permits can be transferred between operators subject only to posting of the necessary reclamation bond.

62. COMMENT: On pages 2-248 and 2-249, concerning reasonably foreseeable future actions, the Draft EIS states there is anticipated further exploration involving 200,000 feet of road and 600 more drill sites, the Zortman Mine it is expected to mine 2 million more tons of ore in the Pony Gulch area, and the Landusky Mine is expected to mine 12.2 million more tones of ore and construction of a new leach pad for this ore. The Draft EIS doesn't mention what would happen to the reclamation areas that are scheduled to be reclaimed for the present expansion, should the mines decide to use existing areas and leach pads for future actions. There is no time frame or specifics on the reclamation plans which could be suspended indefinitely to accommodate future mining at both mines. (352)

RESPONSE: Under Alternative 7, the preferred alternative, reclamation of all facilities at the Zortman Mine would occur within 3 years after the Goslin Flats heap leach pad has been detoxified. Final reclamation of the Landusky Mine is anticipated within 3 years of detoxification of the 87/91 leach pad. Reclamation timing of individual facilities is contingent upon operational factors, and scheduling variations within the overall timeframe could occur. Reclamation schedules are presented in Chapter 2.0 of the Draft and Final EIS.

Reclamation activities are submitted to the DEQ on an annual basis, reporting the previous year's reclamation and the activities anticipated for the following year. Should the reasonably foreseeable additional mining actually be proposed, an amendment to the Plan of Operations and Operating Permit would be required along with environmental analysis. Reclamation of existing and/or proposed facilities could be delayed or modified based on the environmental review of any proposed permit amendment in the future.

63. COMMENT: The economic viability of the project, given the current world market for gold and silver, should be addressed in the EIS. (346, 361)

RESPONSE: The regulations for implementing NEPA at 40 CFR 1502.23 note that a cost-benefit analysis can be prepared for a project, but that a monetary analysis should not be prepared if there are important qualitative considerations, as there are with this project.

64. COMMENT: We are not here to decide whether ZMI has the right to mine or not, ZMI has the statutory right to mine by law. This mine, for the acres it encompasses, is located on over 90 percent private land. A statement that notates our statutory right to mine on private and public lands should be inserted in the cover letter and the Purpose and Need section of the Final EIS. The underlying public purpose from a public interest perspective is to supply the public with needed gold and silver by mining in an environmentally sound manner. (185, 217, 346, HA-32, GF-56)

RESPONSE: As stated in the "Purpose and Need for Action" section of the Draft EIS, "the lands in the project area are either private lands or public lands open to mineral development and the operator has properly filed for approval of mineral development activity under relevant state and federal laws and regulations." The agencies consideration of the permit modifications proposed by ZMI constitute state and federal actions which may significantly affect the quality of the human environment under MEPA and NEPA, necessitating the preparation of an EIS. The DEQ and BLM will consider the analysis in the EIS to make final decisions regarding issuance of the Operating Permits and Plan of Operations for the Zortman and Landusky mines. For clarification, the mine does not encompass "over 90% private land." Approximately 30% of the Zortman Mine and 60% of the Landusky Mine disturbances have occurred on public land. Overall, of the total 1,200 acres of existing disturbance at both mines, approximately one-half (i.e., 600 acres) has occurred on public lands.

65. COMMENT: The Purpose and Need section should include a discussion of the need for gold and silver. What will the gold and silver be used for? (320, 345, 346, 352, GF-6, GF-23, GF-30, GF-75)

RESPONSE: A discussion of the demand for gold, including uses, is in the section "Purpose and Need for Action" of Chapter 1.0 of the EIS (page 1-10 of the Draft EIS). As stated, "Jewelry is the largest single use, involving an estimated 70 percent of the gold supply. Gold held for investment was the second largest use (gold jewelry often doubles as an investment). Other uses, such as electronics, dental, coinage and other miscellaneous industrial uses, comprised about 15 percent of total demand." While silver is also produced at the Zortman and Landusky mines the primary target metal is gold.

66. COMMENT: The Purpose and Need statements in the Draft EIS do not adequately support and explain the Native American viewpoint and objections to mining in the Little Rocky Mountains. As one example, the Turtle Mountain tracts on the southwest side of the Little Rocky Mountains were purposely eliminated from the environmental impact research. Also, the use of mercury in early gold processing is not addressed to the satisfaction of Native Americans in the EIS, such as it may have affected current water contamination. (48, 181, 184, 348, 350, 360, 361, HA-20, HA-23)

RESPONSE: The two-fold Purpose and Need for the project is properly stated in the EIS as currently written. BLM and DEQ have seriously considered other viewpoints as the Draft EIS and Final EIS were prepared. Unfortunately, all points of view cannot be accommodated within the existing statutory framework. A range of alternatives, including alternatives that would not approve expansion plans, have received much thought and attention as the EIS was prepared. The Turtle Mountain tracts were not eliminated from EIS study and are addressed in various sections of the Final EIS. Lands held in trust for members of the Fort Belknap Tribes would be subject to little or no impact from any of the alternatives. Water quality testing has not identified mercury as a major contaminant of concern in the mining areas. It will continue to be included in the monitoring programs.

67. COMMENT: The need to develop precious metals at the Zortman and Landusky mines does not justify an alternative (Alternative 7) that suggests reclamation can only be achieved by allowing mine expansion. Alternative 1, No Action, should address reclamation without mine expansion. (211, 340, 350, 353, 363)

RESPONSE: The agencies have evaluated a full range of seven alternatives in response to NEPA and MEPA requirements, and developed Alternative 7 to meet both mine expansion and environmental protection needs. Alternative 3 has been specifically developed to address the need for adequate reclamation *without* mine expansion. By definition, No Action, Alternative 1, must assume that the current situation continues into the future under existing permit requirements.

68. COMMENT: Purpose and need should be addressed separately, and should include silver. (346)

RESPONSE: The regulations for implementing NEPA at 1502.13 and the BLM and DEQ EIS guidance all suggest these issues be addressed together, specifying both a) proponent and b) agency purpose and need for preparation of the EIS. The 1995 amount of silver produced at the Zortman and Landusky mines has been added to Chapter 1.0 in the Final EIS.

69. COMMENT: Pages ES-1 and 1-10 "These pages need to discuss the purpose and need from the applicant's perspective and from a public interest perspective in order to meet Corps of Engineers 404 EIS requirements. Request the following be added to the discussion of purpose and need on these pages:

In the 404 permit applications, it is stated that the purpose of the Zortman Mining Inc. proposed activities is to recover gold and silver from the existing Zortman and Landusky mines. Therefore, the basic project purpose is to mine gold and silver. In accordance with the Clean Water Act, the Corps of Engineers is required to consider and express in it's NEPA document the activity's underlying purpose and need from a public interest perspective. Thus, the underlying project purpose from a public interest perspective is to supply the public with needed gold and silver by mining in an environmentally sound manner." (346)

RESPONSE: The purpose and need for the proposed mining action is presented in the executive summary and Section 1.3 of the Final EIS. As stated, the purpose and need for this action addresses two basic issues: (1) mineral development needs (applicants perspective), and (2) environmental protection needs (public interest perspective). The Corps' requested language has been added to Chapter 1.0 under Agency Responsibilities.

70. COMMENT: The Corps of Engineers 401 and 404 authorities should be more fully explained in Section 1.5 of the Draft EIS. (346, 361)

RESPONSE: Section 1.5 of the Final EIS has been revised to include language provided by the Corps of Engineers to more fully address their authority and responsibilities.

71. COMMENT: No vested rights may be acquired until the discovery of a "valuable mineral deposit." 30 U.S.C. 22; Davis v. Nelson, 329 F.2d 840 (9th Cir. 1964). Prior to discovery, a mining company is a mere licensee or tenant at will. Cole v. Ralph, 252 U.S. 286 (1920).

The Draft EIS has not shown that ZMI has made a discovery of a "valuable mineral deposit." To have a "valuable mineral deposit," there must be a showing that the mineral can be extracted, removed, and marketed at a profit. United States v. Coleman, 390 U.S. 599 (1968). The determination of "marketability" must take into account environmental protection costs. United States v. Kosanke Sand Corp., 12 IBLA 282, 298-299 (1973). Therefore, before ZMI is entitled to approval for an expanded mine, it must set forth sufficient information to show that it can make a profit after internalizing all of the reasonable environmental costs required in preventing against undue and unnecessary degradation. (361)

RESPONSE: Under the United States mining laws, claimants and operators have been authorized to develop locatable mineral resources on public lands that are open to operation of the Mining Law. BLM-administered land in the project area is open to the operation of the Mining Law in conformance with the Judith-Valley-Phillips Resource Management Plan. ZMI filed an application with the BLM, and DEQ, to expand its mining operations and amend Plan of Operations MTM-77778 and MTM-77779. The operations are located on private and public land. The regulations for mining activities on public land detail the requirements for approving a Plan of Operations, or a modification to an already approved Plan of Operations, which is the case for the Zortman and Landusky mines. The BLM must review the operator's proposed Plan of Operations to determine whether it would result in unnecessary or undue degradation of the Federal lands. Measures needed to prevent unnecessary or undue degradation are required as conditions of approval. A sufficient showing of a mineral to constitute a "discovery," is not required to approve a Plan of Operations. This is because when the area is open to operation of the Mining Law, a mining claim is not necessary to conduct mining operations.

72. COMMENT: Does the 1872 Mining Law really apply to foreign mining corporations? (352)

RESPONSE: The General Mining Law of 1872 applies to minerals owned by the United States. Under the Mining Law mineral deposits are open to exploration, development, and purchase by citizens of the United States. This includes a corporation organized under the laws of the United States.

73. COMMENT: A discussion on the 1872 Mining Law is recommended for Section 1.5.2 (page 1-13). This section discusses unnecessary and undue degradation. A discussion is needed which explains what caused the unnecessary and undue degradation from past Zortman Mining, Inc. mining, what lessons were learned, and how those lessons are being applied to the proposed expansion. The public needs to understand how such a situation will be prevented from occurring in the future. (346)

RESPONSE: The General Mining Law of 1872 declared "all valuable mineral deposits in lands belonging to the United States...to be free and open to exploration and purchase." The Mining Law gives individuals and companies the right to mine on lands open to mineral entry. This is conditioned only by the requirement that it can be conducted without causing unnecessary or undue degradation.

A discussion of acid rock drainage and modifications to required existing plans to prevent unnecessary or undue degradation is included in the section "Other Documentation and the Acid Rock Drainage Issue" in Chapter 1 of the EIS.

74. COMMENT: The permitting agencies should facilitate a public tour of the Zortman-Landusky Mine so concerned citizens can better understand conditions at the mine and comment effectively on this Draft EIS. The public would like to see reclamation that has been adequate and effective. (211, 320, 345, LO-11, HA-31)

RESPONSE: The BLM and DEQ do not have the authority to provide access onto the mine sites for non-regulatory personnel. This request should be addressed to ZMI. If ZMI then decides to facilitate a public tour, BLM and DEQ personnel would be available to join the tour to answer any questions or concerns.

75. COMMENT: The comment period was an inadequate amount of time to review the document in view of the vastness of the project, the seriousness of existing violations, the missing data, and the complexity of the Draft EIS. The comment period should be extended 30, 60, or 90 days. (181, 186, 213, 348, 361)

RESPONSE: The agencies actively sought public comments on the Draft EIS and made diligent efforts to involve the public through the environmental review process consistent with the regulations for implementing NEPA. These efforts included, but were not limited to, public open houses/hearings in Hays, Lodgepole, Malta, Landusky, and Great Falls, and extending the opportunity for briefings, mailing the Draft EIS to the public prior to the comment period beginning on August 18, and extending the comment period to November 1, 1995. While we understand and appreciate your concerns about the complexity and length of the Draft EIS, the 75-day comment period was appropriate for this EIS.

76. COMMENT: The BLM erroneously limited public participation in its initial scoping letter and in the Draft EIS comment period by using a deadline date. Although early comments are more effective, the agency has no authority under NEPA to limit public participation in this way. Comments arriving late in the process may, out of practicality, receive less consideration. The Draft EIS failed to assess and disclose the impact of this error. The Final EIS must contain this disclosure. (273)

RESPONSE: Scoping occurs during development of the EIS as stated in the initial scoping brochure distributed at the public meetings, "Scoping comments are accepted at any time but are especially helpful in the early stages of the EIS process." The agencies also consider all comments received throughout the EIS process but cannot always address late comments in a Final EIS and still meet deadlines for getting an EIS completed and printed on time. As stated in the Dear Reader letter of the Draft EIS, "For consideration, your written comments should be received by close of business on October 17, 1995." The comment period was subsequently extended to November 1, 1995, allowing more time than the 45-day minimum required by the regulations for implementing NEPA.

77. COMMENT: "I think we should look at all these various pictures and on why the EPA wasn't asked to sit here." (LO-51)

RESPONSE: As a cooperating agency for preparing the EIS, EPA was given the opportunity to participate at the public meetings for the Draft EIS. The EPA's regional office in Denver, Colorado, has the lead on the EIS. The BLM encouraged the EPA's Team Leader for the EIS and anyone else on the EPA's EIS Team to attend the public meetings. The EPA declined, due to travel budget concerns. The lead agencies, BLM and DEQ, were not aware a representative from the EPA office in

Helena, Montana, would attend the public meetings in Lodgepole and Hays. EPA's representative was given the opportunity to participate in the open house at the public meeting in Hays.

78. COMMENT: "Why are you having a meeting in Great Falls?" (LO-8)

RESPONSE: The public meeting in Great Falls provided an opportunity for public involvement from a regional level. Expansion of the Zortman and Landusky mines along with modification of the reclamation plans has considerable regional interest.

79. COMMENT: I'm concerned about the public comments offered here tonight. Will they be accepted again tomorrow night, and the next night, and the next night as four separate comments? (LO-17)

RESPONSE: All substantive comments, written and oral, are considered. Similar comments are combined and summarized for a response. It is necessary to submit a comment only once to have it considered.

6.2 ALTERNATIVES

1. **COMMENT:** The Water Quality Improvement Plan is not mentioned in Section 2.5.1.6 (page 2-42 of the Draft EIS) until the last paragraph. The reference to the Water Quality Improvement Plan is generally contained in the first paragraph of other alternatives. While this is the "No Action" alternative, and discussion of existing water capture and treatment structures is important, the requirements in the final Water Quality Improvement Plan or Compliance Plan and MPDES permit will supersede the existing structures. So, it might be more appropriate to mention the plan up front. Section 2.5.1.6 (page 2-47 of the Draft EIS) does not make it clear that the Water Quality Improvement Plan will be required under this alternative. (342)

RESPONSE: Reference to the Water Quality Improvement Plan has been added to this section to make clear that the plan would be required under this alternative.

2. **COMMENT:** Under "Surface Reclamation" for Alternative 1, it should be noted that no leach pad liners have been penetrated at the site. (342)

RESPONSE: This has been noted in Section 2.5.2.4, Leach Pad Reclamation.

3. **COMMENT:** Currently, the statement regarding the Gold Bug Adit, "no other treatment is required at this site", is correct (Section 2.5.3.6, page 2-68 of the Draft EIS). However, this may change with the Compliance Plan and the appropriate levels of treatment for Gold Bug Adit water will be determined by the Water Quality Division. (342)

RESPONSE: The text has been changed to reflect treatment requirements under the Water Quality Improvement Plan.

4. **COMMENT:** In Section 2.5.4.7 (page 2-77, paragraph 1), there is a reference to Section 2.5.2.5 as describing various water control and leachate capture systems in effect at the Zortman Mine. Section 2.5.2.5 describes "Waste Rock Dump Reclamation." The listed features are described in Section 2.5.1.6. But wouldn't it be more appropriate to refer to the various water control and leachate capture systems for the Landusky Mine described in Section 2.5.3.6? It might also be more appropriate to include the discussion contained in Section 2.5.4.7 in Section 2.5.3.6. As for Zortman, state that under this alternative ZMI would capture and treat seepage in accordance to the Water Quality Improvement Plan. (342)

RESPONSE: Sections concerning collection, control, and discharge of surface water and seepage water have been revised and consolidated in all alternatives in one section "Water Management." For example, see Section 2.5.1.6 in the Final EIS.

5. **COMMENT:** The first paragraph on page 2-95 of the Draft EIS is a little confusing. The first sentence indicates that geochemical testing would be required on all disturbance areas. The second to the last sentence indicates that geochemical testing would not be required on the Gold Bug repository and Mill Gulch dump. Thus, only the Montana Gulch dump would be tested. (342)

RESPONSE: The text in Section 2.6.2 has been clarified to eliminate the confusion. Facilities not removed for pit backfill would be tested for sulfur content. Those areas with greater than 0.5 percent sulfur would be capped with Reclamation Cover A. All mine disturbance areas would be tested (except the Mill Gulch waste rock dump, 91 leach pad dike, and Gold Bug waste rock repository).

6. **COMMENT:** In Section 2.6.4.6, page 2-95, of the Draft EIS, haul road testing and capping requirements should be included. Commentor suggests revising text to, "Haul roads would be tested on a 100-ft center to determine acid generation potential. Portions of haul roads with greater than 0.5% sulfur would be capped with Reclamation Cover A prior to coversoil application." (342)

RESPONSE: The text has been modified to clarify that haul roads would be tested, and covered with topsoil if not potentially acid producing, or covered with clay and topsoil if potentially acid producing.

7. **COMMENT:** The requirement in Section 2.7.2.8 of a test fill for compacted clay from the Seaford clay pit is not appropriate (page 2-104 of the Draft EIS). ZMI has successfully constructed compacted clay fill in past construction activities and has demonstrated the effectiveness of the clay. This procedure is costly, time

consuming and unnecessary for work that has been done in the past. Additionally, because the clays are obtained from an outcrop, they are reasonably uniform and will meet the 10^{-7} cm/sec permeability when placed correctly. (342)

RESPONSE: The tests outlined in this section would provide assurance that the clay is suitable material, uniform, and would meet the permeability requirements. Please note that Alternative 3 no longer uses clay in reclamation covers. However, the comment and response still apply to Alternatives 5 and 6.

8. COMMENT: The Seaford clay will not meet the specifications in Section 2.7.2.8, page 2-104, of the Draft EIS. Seaford pit materials are high plasticity clays derived from Cretaceous shales. These clays usually classify as CH in the Unified System. Klohn Leonoff (1984) reports liquid limits (LL) of 45 to 62, with PI of 18 to 37. Three of four samples tested by Klohn Leonoff were CH, and one was a CL. Cretaceous clays observed from the Zortman area have normally appeared to be CH.

The requirement that the "clay" should have a maximum of 20% passing the #200 sieve appears to be a misprint. This requirement is inconsistent with the classification, and it should say a "minimum of 20% passing #200." The clays from the Seaford pit are likely to have fines (passing #200) contents above 90%. These clays may also exceed a PI of 35, and most will classify as a CH rather than CL or SC. The requirement for maximum particle size is not needed as the clods will break down upon wetting and compaction.

In Section 2.7.2.8, page 2-105, placement testing at a rate of one in 2,000 yd^3 is excessive for the Seaford clay because the borrow area is uniform. Indicator tests (fines, gradation, Atterberg limits) only need to be done occasionally at the discretion of the third party engineer. (342)

RESPONSE: There was a typographic error in the referenced statement in Section 2.7.2.8. The clay should have a <u>minimum</u> of 20% passing the 200 sieve. The plasticity index (PI) should be at least 10, but no upper limit is needed for this application. Test frequency for Fines, Particle Size, Plasticity Index, and Water Content can be 1 per 5,000. The density sand cone and nuclear tests could also be conducted daily. These changes have been added to the Final EIS. Please note that Alternative 3 no longer uses clay in reclamation covers. However, the comment and response still apply to Alternatives 5 and 6.

9. COMMENT: Alternatives 3 and 6 state that the pits will be backfilled to an elevation of 4,900 ft, while Alternatives 5 and 7 state that the pits will be backfilled to an elevation of 4,850 ft. Is this correct? (342)

RESPONSE: The difference in backfill amounts for the Landusky pits is due to the pit drainage requirements. In the Draft EIS, Alternatives 3 and 6 would drain surface water to Montana Gulch, while Alternatives 5 and 7 would drain water to King Creek. Please note that backfill elevations and drainage requirements have changed in the Final EIS. Alternative 7 has been revised to drain water to Montana Gulch. Less backfill is required to create free draining conditions to Montana Gulch. In the Final EIS, the Landusky pits would be backfilled to an elevation of 4,740 feet under Alternatives 3, 6, and 7. Under Alternative 5, the pits would be backfilled to an elevation of 4,850 feet.

10. COMMENT: In the Draft EIS Section 2.7.4.2, page 2-108, the sixth paragraph states that no testing of leach pad surfaces or waste rock dumps would be conducted because it is assumed that they have the potential to generate acidic conditions. ZMI objects to this conclusion and has provided data on some of these facilities which suggests that they are not likely to acidify. This data was collected during the summer of 1993 as part of a surface grid sampling program for Zortman and Landusky leach pads. Samples were tested for total sulfur. (342)

RESPONSE: The reason for the assumption that all surfaces would be acid generating is to provide a conservative requirement to ensure reclamation success. Degradation to water quality has occurred from the existing waste rock facilities and ore heaps. There is also the potential for these facilities to become acid generating in the future. The BLM and DEQ recognize that the surfaces of some facilities may have low potential to generate acid.

11. COMMENT: The values in the first paragraph of Section 2.8.1 (page 2-113 of the Draft EIS), 405 acres and 877, include the Seaford clay pit and therefore are not consistent with the values cited in the Zortman permit application. (342)

RESPONSE: While disturbance at the Seaford clay pit (or Williams clay pit, for the Landusky Mine) is not within the mine permit boundary, it nevertheless represents a disturbance connected to the proposed mine expansion. The total disturbance estimates are appropriate.

12. COMMENT: The schedules in the paragraph following Table 2.8-2 of the Draft EIS need to be revised. A suggested revision is "The material handling, crushing, overland conveyor, and heap stacking systems are designed to operate 24 hours per day, 7 days per week, 50 weeks per year. The solution carbon adsorption and carbon stripping system are designed to operate 24 hours per day, 7 days per week, 52 weeks per year. The metals refinery is designed to operate 8 hours per day, 5 days per week, 52 weeks per year." (342)

RESPONSE: These changes have been incorporated into the Final EIS.

13. COMMENT: In the Draft EIS Section 2.8.1.6, page 2-135, note that we [ZMI] did not state in the permit application that we would use DHES requirements found in Circular WQB-2. The Company Proposed Action would use EPA standards listed in the permit application. (342)

RESPONSE: The text has been revised.

14. COMMENT: Draft EIS Section 2.8.1.7, page 2-135, <u>Water Capture and Treatment</u>, paragraph 1, line 15. This sentence is incorrect. Commentor suggests revising as follows: "The Alder Spur capture system would be re-sized to collect seepage from the 6-inch, 24-hour event." (342)

RESPONSE: The text has been revised.

15. COMMENT: Draft EIS Section 2.8.2, page 2-141, column 2, paragraph 1 - Non Acid-Forming Material. ZMI is generally referring to non-acid forming material as "blue waste." (342)

RESPONSE: The text has been revised.

16. COMMENT: The second reference in Section 2.8.2.4 of the Draft EIS to Alder Gulch under the "Waste Rock Facilities" Heading should be changed to "Carter Gulch." (342)

RESPONSE: The text has been revised.

17. COMMENT: The reference in Section 2.8.2.4 of the Draft EIS to grading to "3H:1V where topography allows" was deleted from ZMI's permit application. (342)

RESPONSE: The text has been revised.

18. COMMENT: The reference in Section 2.8.2.4 of the Draft EIS to reducing slopes to 3H:1V was deleted from ZMI's permit application. (342)

RESPONSE: The text has been revised.

19. COMMENT: ZMI's permit application lists bench widths as 20 ft, not 25 ft as stated in Sections 2.8.1.5 and 2.8.2.5 of the Draft EIS. (342)

RESPONSE: The text has been revised.

20. COMMENT: Section 2.8.2.9, page 2-157, paragraph 4 or paragraph 2 of Seeding Methods. This paragraph lists "Broadcast, hydroseeding and drill seeding methods." While all these methods will probably be used, hydroseeding is considered a broadcast method and is listed in ZMI's permit application as such. (342)

RESPONSE: The text has been revised.

21. COMMENT: In the Draft EIS, page 2-157, the first paragraph under "Planting Methods" should read as follows: "As clumped plantings on leach pads (with the exception of Goslin Flats)," (342)

RESPONSE: The text has been revised.

22. COMMENT: In the Draft EIS, page 2-157, the second paragraph under "Planting Methods" should read as follows: "Heap leach pads (with the exception of Goslin Flats) and waste repository." (342)

RESPONSE: The text has been revised.

23. COMMENT: Section 2.8.3.1, page 2-159, Table 2.8-10. The Landusky Addendum lists the Currently Permitted Total Waste Rock as 60,000,000 tons and the Proposed Total as 67,000,000 tons. (342)

RESPONSE: The appropriate table (2.8-4) has been revised.

24. COMMENT: Section 2.8.3.4, page 2-162, paragraph 2 - Repository Construction, line 8. The Landusky Addendum states that waste rock from the expansion would increase the Gold Bug repository load to approximately 21 million tons. Commentor suggests changing "23 million tons" to "21 million tons." (342)

RESPONSE: The text has been revised.

25. COMMENT: Section 2.8.4.1, page 2-168, column 1, paragraph 1 of Williams Clay Pit, line 4. The Williams clay pit is located 6 road miles from the town of

Landusky. Commentor suggests change "2 miles" to "2 direct miles or 6 road miles." (342)

RESPONSE: The text has been revised.

26. COMMENT: In Alternative 4, page 2-169 of the Draft EIS, the language was revised in the Landusky Addendum to exclude the 3H:1V slope reduction. Commentor suggests revising this sentence as follows: "Leach pad slope reduction would not result in off-loaded pad materials being moved into natural or constructed drainages." (342)

RESPONSE: The text has been revised.

27. COMMENT: Section 2.8.4.4, page 2-169, column 2, paragraphs 1 and 2, last sentence of both. These statements need clarification. One says, "if necessary", the other "will be." The Company Proposed Action is to test first and cover if necessary. Commentor suggests replacing "will be" with "if necessary." (342)

RESPONSE: Appropriate clarification has been made to this text.

28. COMMENT: The discussion on page 2-174 of the Draft EIS for Reclamation Quality Control lists depths for Reclamation Cover B only. Commentor suggests revising as per Section 2.8.2.8, Reclamation Quality Control (for Zortman). (342)

RESPONSE: The text has been revised.

29. COMMENT: In Section 2.8.6.2 of the Draft EIS (page 2-178), there is no discussion of the reasonably foreseeable landfarm for Landusky described on page 54 (June 16, 1995) of the Landusky Addendum. (342)

RESPONSE: A discussion concerning a reasonably foreseeable landfarm for Landusky has been added to the Alternative 4 description in the Final EIS.

30. COMMENT: Section 2.10.1.7, page 2-215, paragraph 1, line 1. This sentence is incorrect. The Company Proposed Action uses the 6-inch, 24-event as the design storm. (342)

RESPONSE: Alternative 6 would require ZMI to use the 6.33-inch, 24-hour event as the design storm.

31. COMMENT: In the Draft EIS, page 2-215, the third sentence is inconsistent with the Water Quality Improvement Plan. Commentor suggests revising the text to indicate that the Alder Spur capture system would be re-sized for the 6-inch, 24-hour event. (342)

RESPONSE: Under Alternative 6, the Alder Spur capture system would be sized for the 6.33- inch, 24-hour event.

32. COMMENT: In the Draft EIS, page 2-226, under Section 2.10.4.7, it states that "the channel would be sized to handle a 7-inch, 24-hour storm event within the pit drainage basin." Is this correct? (342)

RESPONSE: No, the design event should be the 6.33-inch, 24-hour storm. The text has been revised.

33. COMMENT: ZMI is proposing to construct an alternative water source for bats, large game and other wildlife upstream of the Goslin Flats leach pad in Goslin Gulch as part of the mitigation plan for the Section 404 permit for the Zortman Extension Project. (342)

RESPONSE: This mitigation has been incorporated into the description of the Company Proposed Action (Alternative 4), Section 2.8, and thereby incorporated into Alternatives 6 and 7.

34. COMMENT: Under Alternative 7, Section 2.11.1.1, the requirement that oxide and non-oxide ore be mined in equal portions and that non-oxide waste rock be placed immediately in completed pits is not possible. If oxide and non-oxide ores are to be mined in equal increments, several pits will be required to be operating at the same time to obtain those ores. That precludes mining of one phase and backfilling from another phase. The proposed mining method in this alternative appears to be suitable for strip mining of a flat bedded coal deposit, but is not feasible for a disseminated gold deposit.

Non-oxide waste rock will be generated before pits are available for backfill, so the immediate backfill requirement is not feasible. Additionally, according the description in this section, "yellow" and "green" waste are considered non-oxide in nature. As shown in Table 2.8-4, the total non-oxide waste rock quantity estimated to be mined is 49.1 million tons, while approximately 20 million tons is the total backfill quantity in Figure 2.11-2. To consider rehandle of nearly 30 million additional tons would equate to a "no-action" alternative.

Furthermore, these requirements remove all flexibility necessary to adapt to changing costs and gold prices by ZMI. As currently proposed in Alternative 7, pit sequencing and waste handling is unworkable and unrealistic. Using waste handling as the only guideline for pit planning and sequencing may not allow mining to proceed.

ZMI strongly urges waste handling techniques from Alternative 4 be incorporated into Alternative 7. Those techniques, in addition to the proposed reclamation cover, will provide protection against acid generation within the waste rock facilities. ZMI will attempt to backfill during operations to the maximum extent possible with non-oxide waste rock. (10, 53, 59, 131, 189, 210, 249, 254, 270, 339, 342, LO-4, HA-32, MA-8)

RESPONSE: This mitigation was not intended to require that non-oxide waste rock be backfilled into active mine pits as it is generated. Rather, the backfill requirement in the Final EIS preferred alternative is that only waste rock with less than 0.5 percent total sulfur be backfilled in the Zortman pit below the water table and that only waste rock meeting the non-acid generating criteria be backfilled in the zone of water table fluctuation.

35. COMMENT: Under Alternative 7, Section 2.11.1.1, removal of the entire Zortman 85/86 leach pad ore and dike would require excavation of approximately 8.4 million tons of material. As the material has already been leached, it is unlikely the material in the leach pad would be economic to process on the Goslin Flats leach pad. In order to use the material as pit backfill, the material would have to be excavated during operations to provide space for waste rock mined from the pit. Essentially, it would require removal of the 85/86 leach pad and dike as backfill and placement of waste rock from the pit in its place that could have been placed as backfill. Operationally, this would be difficult to accomplish and be cost prohibitive. A portion of the 85/86 leach pad will be removed in order to develop the open pit, and that is the extent removal should be required.

The proposed entire rehandle of the 85/86 leach pad and dike is not necessary as the area will be capped with an enhanced reclamation cover for long term protection of water resources. The waste rock cap over the 85/86 leach pad will be constructed so as to provide drainage around the facility. The Zortman water treatment plant will provide short term treatment of impacted waters until the enhanced reclamation cap is in place and functioning.

If drainage can be routed around the 85/86 leach pad, what is the rationale for removing the facility? (342)

RESPONSE: While it is possible that a new reclamation cover would eliminate some or most infiltration into the facility from surface water, it is possible that problems may still exist as a result of seepage from below or along the facility margins. A review of water quality data and the history of mine pit operations has concluded that the majority of water quality degradation in upper Ruby Gulch is derived from water infiltrating through the mine pit floor and not from the leach pad. Therefore, because removal of the entire 85/86 leach pad could create operational difficulties, removal of the facility would not be required unless water quality management objectives could not be met.

36. COMMENT: In the Draft EIS, page 2-231, Waste Rock Handling, the way the third sentence is written could indicate the pit bottom would have a layer of non-acid generating, acid-buffering material prior to backfill, although that is not what is stated in Section 2.11.2.3. If that is how the sentence is to interpreted, ZMI does not believe this is necessary as the enhanced reclamation cover will provide adequate protection against potential acid generation. (342)

RESPONSE: This alternative does require that the bottom of the pit be "lined" with a layer of non-acid generating, acid buffering material prior to backfill. Waste backfilled into the Zortman and Landusky pits which would be within the zone of fluctuating water table (i.e., the zone from low water table to high water table) could only be non-acid generating. Waste placed into the pits below the zone of fluctuating water table (i.e, the perennially saturated zone) must have a total sulfur content less than 0.5 percent.

37. COMMENT: The agencies' quality control procedures are not described in Section 2.10.1.4. Are the quality control procedures the same as described in Section 2.7.2.8? (342)

RESPONSE: Please note that the reference to reclamation quality control has been revised to Section 2.7.2.7 in the Final EIS (Section 2.7.2.8 in the Draft EIS).

38. COMMENT: Section 2.11.1.7, page 2-234, first paragraph, first line. This sentence is inconsistent with the Company Proposed Action. The Company Proposed Action uses the 6-inch, 24-hour event as the design storm. (342)

RESPONSE: Alternative 7 would require ZMI to use the 6.33 inch, 24-hour event as the design storm.

39. COMMENT: Section 2.11.1.7, page 2-234, first paragraph, first line. This sentence is inconsistent with the "other agency-mitigated alternatives" and the Water Quality Improvement Plan. Commentor suggests revising the sentence to indicated that all seepage water capture systems would be re-sized to handle seepage from the 6-inch, 24-hour event. (342)

RESPONSE: The text has been revised to clarify that "seepage" would be captured. However, the design event is the 6.33-inch, 24-hour storm.

40. COMMENT: In the Draft EIS Section 2.11.1.7, page 2-234, construction of the waste rock repository may not necessarily render seepage capture systems unusable or ineffective, especially in Ruby Gulch. These seepage capture facilities would be replaced on an as-needed, site specific basis. The facilities design for Goslin Gulch will include a contingency seepage capture system for the underdrain network. A suggested revision is "Interceptor wells may be necessary downstream of the new mine facilities in Alder Spur and Ruby Gulch if new facility construction hampers operation. The decision for upgraded capture facilities will be based on water quality results. A seepage collection system will be included in the Goslin Gulch facility design and built downgradient of the leach pad for contingency water management." (342)

RESPONSE: According to the engineering plans for such a facility, provided by ZMI to the BLM and DEQ, new capture systems would have to be developed in Ruby Gulch and Alder Spur. It is understood that the Goslin Flats leach pad would have a seepage collection system constructed for water management.

41. COMMENT: Section 2.11.2, page 2-234, paragraph 5 (4th bullet). Most facilities would be covered by the waste rock cap, with the exception of the 82 leach pad and portions of the 79/80/81. Off-loading of material should not be required as ZMI has demonstrated reclamation success on slopes of 2H:1V to 2.5H:1V. Additionally, those facilities were built to the slope agencies approved when originally permitted, and to require off-loading now is excessive and cost prohibitive. Additionally, if clay capping is not to be used, the only requirements for slope reduction are geotechnical stability and reclamation success. Why are the agencies proposing 3H:1V overall, which would increase surface area for infiltration? Commentor suggests that the Final EIS and/or Record of Decision do not require off-loading of facilities or sloping to 3H:1V.

The reclamation requirement of 3:1 slopes in the agencies' alternatives is unnecessary and expensive. The 3:1 reclamation slope should only be required in areas where it makes sense from now on (i.e., new facilities). A less restrictive contour specification would still be stable, secure, and present a more pleasing and realistic appearance (than 3:1 slopes). (180, 342)

RESPONSE: The potential for reclamation to be successful is greatly enhanced with slopes of 3:1 or less. Reclamation is generally easier on gentler slopes since there is less erosion and vegetation is established faster. The 3:1 slopes would result in reclaimed facilities that have less visual intrusion on the surrounding, undisturbed landscape. It is important to note that the facilities mentioned in this comment have not been reclaimed; therefore, they are not evidence of successful reclamation nor would the mitigation entail "re-reclamation." This mitigation is a sound and justified method to prevent future degradation of environmental resources. The slope reduction would cost more than leaving facilities in their existing configuration. However, there is no information that this mitigation is "cost-prohibitive." The 3:1 slopes are more stable than the referenced slopes of 2:1 or 2.5:1. Some site specific flexibility exists, particularly in those areas where construction of 3:1 slopes would result in impacts to sensitive areas (e.g., drainage bottoms).

42. COMMENT: Section 2.11.2, page 2-234, paragraph 2 (1st bullet). This sentence is not consistent with detailed descriptions of reclamation procedures. Testing is described for existing waste rock dumps, process plant site, soil stockpiles and haul roads and a cover to be used if the facility is potentially acid generating. ZMI would agree with the detailed reclamation descriptions, but not with use of water balance covers on every facility, regardless of acid generating potential. The agencies did not present evidence to support the contention that reclamation of closed facilities has resulted in demonstrable impacts. (342)

RESPONSE: Note that testing criteria for facilities cited in the comment pertain to footprints of facilities that have been removed, not the actual facilities themselves. Except for the Mill Gulch and Gold Bug waste rock repositories, ore and waste rock facilities, regardless of their existing reclamation status, are assumed to be potentially acid generating and therefore would require the enhanced reclamation covers specified by Alternative 7. At Zortman, those facilities not covered by the new waste rock repository would require reclamation with the appropriate water balance or water barrier cover. For those facilities at Zortman which would be removed and not covered by the new waste rock repository (e.g., Alder Gulch waste rock dump), the surface testing criteria would be applied to their facility footprints to determine reclamation cover requirements. At Landusky, leaching and waste rock facilities not already sporting an enhanced cover would require water balance or water barrier covers. Surface testing to determine cover requirements would apply only to disturbed areas (e.g., haul roads) whose acid generating potential is questionable.

With regard to the contention that evidence of demonstrable impacts is lacking to support requiring reclamation regardless of acid generating potential, Section 3.2 presents ample evidence that water chemistry has been affected in all drainages where mine facilities are sited. Therefore, consistent with the objectives of preventing unnecessary or undue degradation, and achieving successful reclamation, reclamation of existing leach pads and waste rock facilities with enhanced reclamation covers as specified is required.

43. COMMENT: In the Draft EIS, page 2-234, Section 2.11.2, the 3:1V slope requirement, with benches at 50 foot vertical spacing is not appropriate, or well supported by research as necessary. These requirements are expensive, cumbersome, and result in a substantial increase in unwarranted land disturbance. There is a multitude of evidence illustrating successful reclamation on slopes steeper than 3:1V. The 50 foot vertical bench spacing was no doubt taken from a manual developed for smaller scale construction activities, not large scale surface mining. Other bench configurations have been proven effective for storm water control. Bench drains can easily be sized to accommodate runoff from interbench slopes with 100 foot vertical spacing between benches. ZMI and several other mine sites have demonstrated that dozer gouges are an effective method of erosion control on inter-bench slopes with bench spacing up to 200 foot vertical.

It is unnecessary to require the mine company to install drainage benches on reclaimed facilities at a 50-foot interval. Erosion control benches placed at intervals of 100-feet would be sufficient. (10, 33, 35, 37, 59, 131, 169, 176, 180, 229, 235, 249, 274, 310, 342, LO-4, LO-30, MA-2, MA-8, MA-13, GF-5)

RESPONSE: This mitigation has been revised. Benches are now specified at 100-foot vertical spacing. The potential for reclamation to be successful is greatly enhanced with slopes of 3:1 or less. Where environmentally feasible, the 3:1 slope mitigation is necessary to prevent future degradation of environmental resources. While there may be evidence at some mines that 2:1 slopes can be successfully reclaimed, there is much more evidence that 3:1 slopes are more stable and more likely to have successful reclamation than steeper slopes. While this requirement would result in more land disturbance, all of the disturbance for existing facilities should occur within the permit boundaries, in areas which have already been disturbed to some extent.

44. COMMENT: In the Draft EIS Section 2.11.2, page 2-235, ZMI has begun testing the tails for quantity and quality. If the tailing are suitable for use as a subsoil for the water balance cover or use as a construction material, it may be feasible to remove the tailing in a cost effective manner. Should the quality of the tailing be such that they are unusable (e.g. slimes, acid generating, etc.), the material should not be disturbed. Additionally, should the tailing be removed, some tailing may be need to remain in order to properly restore the stream channel.

ZMI is proposing post reclamation drainage as mitigation to waters of the United States in the 404 permit application. Ruby Gulch tailing would only be used for reclamation or construction material. A suggested revision is Ruby Gulch tailing would only be used for reclamation or construction material. (342)

RESPONSE: The Ruby Gulch tailing should be used in reclamation covers or as part of the construction materials. The mitigation concerning the Ruby Gulch tailing has been revised. This action is based on information collected during the latter part of 1995 which indicates the tailing would be suitable for some reclamation or construction uses. See Appendix F for a description of the Ruby Gulch restoration as a mitigation project for impacts to waters of the U.S.

45. COMMENT: The removal of Ruby Gulch tailing and restoration of the stream channel is an excessive, unnecessary mitigation. The tailing in Ruby Gulch is historic and Pegasus (ZMI) is not responsible for it being there. The tailing in the Gulch is "clean" and does not contribute to water contamination. In addition, removal of the tailing would necessitate extensive excavation and disruption in the town of Zortman, since many houses and facilities are constructed on tailing, and the removal of significant vegetation that has been established after many years. Partial removal could cause downstream impacts during spring floods or storms. If the tailing are safe (i.e., not toxic or ARD generating) more flexibility should be allowed so that the tailing can be used in reclamation or construction. (10, 12, 20, 33, 35, 37, 43, 50, 59, 131, 164, 167, 168, 169, 171, 176, 178, 180, 205, 207, 210, 217, 226, 229, 235, 236, 237, 241, 242, 243, 248, 249, 270, 325, 333, 339, 358, LO-4, LO-8, LO-9, LO-13, LO-15, LO-23, LO-27, HA-12, HA-18, HA-25, HA-26, HA-27, HA-29, HA-32, MA-2, MA-8, MA-12, MA-13, MA-15, MA-17, LA-1, GF-5, GF-8, GF-20, GF-32, GF-35, GF-57)

RESPONSE: This mitigation has been developed for two reasons. First, the tailing in Ruby Gulch contributes to the high suspended sediment loads in Ruby Creek during high precipitation events. Second, restoration of the stream channel would in part serve as mitigation for impacts to waters of the U.S. from mining during the years 1979 to the present. Specifically, some reaches of upper drainages have been lost by the placement of waste rock dumps and/or leach pads. Removal of all of the tailing which has been deposited in the town of Zortman would not be required, but rather the material extending approximately from the mine gate up through the drainage. This material has been approved for use in reclamation covers. Some material would have to be removed downstream from the mine gate to facilitate a gradual change in gradient. In addition, the channel would need to be anchored. The tailing removal would need to be designed to ensure that significant effects are not caused downstream as the new gradient in Ruby Creek establishes equilibrium.

46. COMMENT: In the Draft EIS, the seventh bullet under Section 2.11.2, why is it necessary to allow surface runoff to freely drain to Ruby Gulch in that area when the waste rock cap will cover that drainage? (342)

RESPONSE: If the area in question would be covered with waste rock, the "drainage" requirement of the mitigation would not apply. The mitigation objective is that the reclaimed pit area not impound water which might stagnate or infiltrate and contribute to groundwater degradation.

47. COMMENT: In the Draft EIS, the eighth bullet under Section 2.11.2, the OK waste rock dump would be mined during pit expansion. If testing shows the waste rock to contain sufficient recoverable gold, it would be sent to the Goslin Flats leach pad. Otherwise it would be integrated into the waste cap repository or pit backfill. (342)

RESPONSE: This mitigation has been modified to allow leaching of waste rock from the OK dump if sufficient quantities of gold are present.

48. COMMENT: Is Section 2.11.2.1 stating that all coversoil salvaged at Goslin Flats will be stockpiled on Ruby Flats and the company proposed location east of the Goslin Flats leach pad will not be used? Or would only additional soils salvaged beyond what is proposed by the company be stockpiled in Ruby Flats? (342)

RESPONSE: The use of Ruby Flats as a potential cover soil borrow source has been eliminated from Alternative 7. The construction of the heap leaching facility would not change significantly from that described in Alternative 4, including stockpiling of coversoil salvaged at Goslin Flats.

49. COMMENT: In the Draft EIS Section 2.11.2.1, page 2-236, note that the changes to the waste rock characterization program may result in changes in the quantities of available non-acid generating materials. It is likely that the quantity of syenite porphyry will decrease, while the quantity of amphibolite would increase. The revised characterization program may also require an increase in the amount of quarried reclamation materials (e.g., limestone). Does Alternative 7 take into consideration the revised characterization program? (342)

RESPONSE: Yes, the quantities of waste rock which may be available have been calculated bearing in mind the more stringent geochemical classification of "suitable" NAG material. Please see Sections 4.1.3 through 4.1.9. Under Alternative 7, sufficient quantities would be available for use in reclamation covers at the Zortman Mine. However, it is assumed that no waste rock generated during expanded mining at Landusky would be suitable for use in reclamation covers, based on the expected geochemistry of the rock types mined. The shortfall in reclamation materials would have to be made up from existing waste rock stockpiles, material derived from excavation of the drainage notch, increased use of limestone in reclamation covers, and/or the use of suitable waste rock produced at the Zortman Mine.

50. COMMENT: In the Draft EIS Section 2.11.2.1, page 2-236, ZMI recommends clay be considered as interchangeable with the GCL if the clay could be protected from desiccation and freezing. (342)

RESPONSE: Clay cannot be used interchangeably with GCL in the reclamation covers, for a variety of reasons, including: GCL is easier to install, with few quality control concerns, GCL is not as susceptible to desiccation and freezing as clay, and there are fewer associated environmental impacts at the project area when GCL is used. For instance, eliminating clay from the reclamation covers would mean that the Seaford and Williams clay pits are disturbed no further. In addition, fewer trucks would be needed to transport GCL to the mines, resulting in reduced air emissions in the towns of Zortman and Landusky, and less noise.

51. COMMENT: In the Draft EIS Section 2.11.2.2, page 2-236, third paragraph, it seems as though the filter fabric has a greater chance of clogging with fine grained particles than the two feet of capillary break material? Wouldn't this diminish the value of this type of cover? Is the filter fabric really necessary? Greg Richardson's study recommends a water balance cover for the Zortman/Landusky mines which consists of a base of 12 inches of capillary break material, a geotextile layer, a field capacity layer and vegetation. No filter fabric is included in his design. (342)

RESPONSE: The filter fabric is intended to catch the fine material for the precise purpose of preventing the capillary break or drainage layer from clogging. Please note the revised reclamation covers in Alternative 7. The geotextile in Dr. Richardson's report is a filter fabric.

52. COMMENT: In the Draft EIS Section 2.11.2.4, page 2-239, the use of a barrier cap, as proposed by Greg Richardson, should be considered. (342)

RESPONSE: A water barrier cap would be used on those areas of the leach pad and other potentially acid generating disturbances with slopes less than 25 percent. The text has been revised.

53. COMMENT: Discussions with engineering firms indicate technology is not available that will provide a fail-safe seal of a perforated leach pad. As such, the requirement that the perforation be reversible is technologically questionable and should be removed. Additionally, as discussed in Section 2.7.2.4, no perforations would occur for a minimum of 10 years after detoxification was initially accomplished. That time frame should be sufficient to determine if water quality will deteriorate within the leach pad after reclamation has occurred.

It is unclear from this reference if bonding would be required to reverse perforations in the leach pad. What is the agencies intent regarding bonding for this requirement. Commentor suggests that the agencies remove the requirement that liner perforations be reversible, or at a minimum require them only to the limit it would be technologically feasible. (342)

RESPONSE: This mitigation remains as a component of leach pad reclamation and closure. The BLM and DEQ understand the difficulties inherent in the requirement and understand that it may be implemented only to the extent that it is technologically feasible. Bonding would not be required as the need to reverse the perforations is not reasonably foreseeable given the 10-year pre-perforation monitoring proposed.

54. COMMENT: In the Draft EIS, the first bullet under Section 2.11.4, based on Greg Richardson's review of the water balance and barrier type covers, ZMI can defend use of either cover or a combination of the two for final reclamation. The agencies proposed water balance covers are excessive as costs increase greatly for no benefit. Additionally, more mining of material would be required if the water balance covers were used as suggested under Alternative 7. Reclamation cover requirement should not be designated either as a water balance or barrier type cover, only designated as a cover that will limit infiltration to no more than 5% of precipitation. The 5% infiltration criteria can be demonstrated with HELP modeling or demonstration trials.

A suggested revision is to combine bullets 1 and 2 be combined to read "Reclamation covers would be used on the expanded Gold Bug waste repository and other existing reclaimed or unreclaimed facilities, where testing indicated acid generating potential. The performance criterion of the reclamation covers would be to limit infiltration to not more than 5% of precipitation. (342)

RESPONSE: Please note the design requirements of the agency-mitigated covers have been further refined in the Final EIS. Other factors, besides infiltration modeling results are integral to the cover design. These factors include revegetation success, minimizing maintenance and soil loss, as well as long-term cover integrity. Minimizing offsite disturbance and hauling impacts are also important. It is important to note that the water balance and water barrier covers are not interchangeable. A barrier cover is especially important on relatively flat slopes, where surface water may pond and have more opportunity to infiltrate. A barrier provides additional surety that infiltration water does not reach the encapsulated waste rock or spent ore.

55. COMMENT: In the Draft EIS, the fourth bullet under Section 2.11.4, please clarify the statement to indicate reclaimed facilities that do not exhibit acid generating potential will not require a reclamation cover.

A suggested revision is "Other facilities not used as pit backfill would be tested for acid generating potential. Should testing indicate the facility to be potentially acid generating, a reclamation cover will be installed. If the facility does not exhibit acid generating potential, no additional reclamation would be required." (342)

RESPONSE: The text has been clarified in Alternative 7 concerning testing and cover requirements. Please see Section 2.11.2.

56. COMMENT: In the Draft EIS Section 2.11.4, the agencies proposal to backfill the Landusky pit complex is an extreme departure from past and currently permitted activities and imposes burdensome reclamation costs on ZMI. An alternative the agencies could consider is the use of evaporation ponds constructed on the floor of the pit. Large, shallow evaporation ponds would eliminate the need for further disturbance to construct a notch into King Creek. The evaporation ponds would be constructed above the groundwater elevation and be lined with a low permeability liner system. Evaporation ponds are possible in this area due to the net loss of precipitation (evaporation exceeds precipitation).

Additionally, ZMI is concerned about routing of pit floor water into King Creek and construction of additional water capture systems and settling ponds. This may require changes to the Compliance Plan and additional MPDES permits. Currently, no impacted water is reporting to the reservation and this alternative would create this possibility. Mine activities have only impacted approximately 2,000 lineal feet of King Creek and 89 acres of drainage basin. Based on these relatively minor disturbances, reestablishment of pit drainage into King Creek is not necessary or desirable. (342)

RESPONSE: The backfill requirements for the Landusky pit complex have been modified in Alternative 7. The pit would be backfilled to an elevation of 4,740 feet. Less backfill is required, and drainage would be routed to capture and treatment systems in Montana Gulch instead of King Creek. Development of the notch would produce 3 to 4 million tons of waste rock which could be used as pit backfill. The proposal to use shallow evaporation ponds in the pit bottom has been considered and eliminated based on concerns with water control, maintenance, sludge production and disposal, risks to wildlife, and doubts as to the overall long-term effectiveness of the technology.

57. COMMENT: ZMI strongly objects to removal of portions of the Landusky 85/86 leach pad and dike for pit backfill and to unblocking the western tributary of Montana Gulch. The leach pad location and construction was approved when the facility was permitted and to require its removal would be costly and burdensome. (342)

RESPONSE: The mitigation for unblocking of the western tributary of Montana Gulch remains in Alternative 7. It is recognized that the facility was developed under permit; however, the underdrain system has become blocked and is not functioning as permitted. A drainage trench to route runoff around the blocked underdrain is part of this alternative. The actual amount of spent ore that would need to be moved is minimal.

58. COMMENT: Section 2.11.4, page 2-244, column 2, paragraph 2 (2nd bullet). The agency requirement for reclaimed facilities to be recontoured to provide a topography that blends into the surrounding landscape is general and open to interpretation. ZMI recommends a closure plan with final reclaimed contours be provided to the agencies for review and comment at the cessation of mine activities. ZMI will incorporate natural features into reclamation to the extent practical. Commentor suggests incorporating the use of "To the extent practical, reclaimed facilities would be recontoured." (342)

RESPONSE: The mitigation in the text has been revised.

59. COMMENT: In the Draft EIS Section 2.11.4.5, page 2-246, the fourth sentence states a water balance cover would be used on the Gold Bug waste rock repository. As a portion of the dump already has been reclaimed with the Company Proposed Action Reclamation Cover B, it should be clarified that a revised reclamation cover would be placed on portions not already reclaimed. (342)

RESPONSE: The revised reclamation cover requirements do not apply to those portions of the Gold Bug and Mill Gulch waste rock repositories that have already received enhanced interim reclamation covers; unless subsequent monitoring indicates environmental performance objectives are not being met.

60. COMMENT: Section 2.11.4.9 - Revegetation Procedures, page 2-48, paragraph 1, last two sentences. Vegetative cover of "90% of that demonstrated in adjacent, natural communities of similar composition and location" may be very difficult to achieve under the best of conditions. What is the 90% cover based on? The vegetative cover is considered to be a component of the reclamation cover which will be designed to:

- limit surface water infiltration through the final cover to 5 percent or less of annual precipitation, and
- limit soil surface erosion loss to less than 2 tons/acre/year.

Based on past successful reclamation at the Zortman and Landusky mines, vegetative cover requirements should be in the range of 60%. (342)

RESPONSE: The requirement has been misunderstood. The 90% refers to 90% of the cover in adjacent undisturbed areas. If the reference area only has 70%

vegetative cover, then successful revegetation would be 90% of that reference value, or 63% cover.

61. COMMENT: The box inset on page 2-31 of the Draft EIS states in the first paragraph that the proposed reclamation plans would not take place for this alternative. The second paragraph states that this alternative would not void or alter the Water Quality Improvement Plan presented in Appendix A. Which is it? This discussion also needs to explain how other requirements dealing with violations will influence this alternative and the others. Will not requirements resulting from violation settlements be a component, and indeed an identical component, of each and every alternative? (346)

RESPONSE: Reclamation plans include many of activities not associated with the Water Quality Improvement Plan. It is expected that revised, better reclamation of facilities and disturbances would enhance the potential for water quality to improve, but the programs do not require integrated implementation.

Chapter 2.0 is not the appropriate place in the EIS to discuss regulatory actions or agency responsibilities. Section 1.5 of Chapter 1.0 includes an expanded discussion of ongoing regulatory actions. Measures needed to achieve and maintain water quality are a component of every alternative.

62. COMMENT: Section 2.5.1.6 should reflect the new single, larger pond structure as now proposed by ZMI. Also, the EIS needs to explain why capture ponds were designed for drainage from a 10-year, 24 hour event as opposed to a 25-, 50-, or even 100-year event. Page 2-47 states that <u>interim</u> drainages were built to meet <u>immediate</u> needs of ARD control; and as such, they were not intended to deal with flows in excess of a 10-year, 24 hour storm event of 2.5 inches. What will be the design of final drainages to meet ultimate needs of ARD control? (346)

RESPONSE: Section 2.5.1.6 has been revised to note that a single pond has been constructed in Ruby Gulch. Part two of the comment requests an explanation of the rationale used in design decisions, for water capture ponds. Under Alternative 1, the 10-year, 24-hour storm event was used to provide capture capacity for the short-term until final plans were approved. It is recognized that this is insufficient capacity. Under Alternative 4, the Company Proposed Action, water capture systems would be upgraded and/or constructed to meet the 6-inch, 24-hour storm event. Water capture systems would have to be upgraded and/or constructed to meet the 6.33 inch, 24-hour storm event under Alternatives 3, 5, 6, and 7.

63. COMMENT: In the Draft EIS page 2-47, an overlay on an aerial photo should be provided to show where the referenced LAD's are located. What testing has been done to conclude that Carter Butte has been loaded to nearly maximum metal attenuation? What are the limitations of application based on weather conditions (i.e., freezing conditions or saturated soils)? (346)

RESPONSE: Maps have been provided showing current and proposed LAD areas (Figures 2.5-1, 2.8-1, and Exhibit 1). Schafer and Associates (1993a) has evaluated attenuation capacity of the proposed LAD areas. The Carter Butte LAD area has little capacity due to its small size and past use to retain metals onto soils. This is of concern because metals not captured by soil particles would remain in solution, and end up in the area water resources. Operational conditions and limitations are described in Schafer and Associates, 1993a.

64. COMMENT: In the Draft EIS Section 2.5.3.4, page 2-63, what is the location of the several smaller sites used to dispose of waste rock? A map should be provided. Were any waters of the U.S. impacted? (346)

RESPONSE: Smaller sites include the August #1 and August #2 waste rock dumps; these are shown on Exhibit 2 in the map pocket of the Final EIS. If any waters of the U.S. were affected, these were accounted for in the acreage figures provided in Chapter 4.0, Section 4.4, impacts to vegetation, wetlands, and other waters of the U.S.

65. COMMENT: In the Draft EIS page 2-74, what assurance is there that the perforations would continue to function in the long term considering the potential for fines to build up and reseal the 6-inch diameter, 5-foot long drains? If ARD conditions begin to show in the long term, who will be responsible? Will any monitoring of these drains be conducted? (346)

RESPONSE: If perforations seal or become clogged new drain holes could be drilled. The potential for long-term degradation of water resources is assessed in Section 4.2.3. Responsibility for subsequent corrective action would rest on the owner/operator. Monitoring of the drains is not required under the current permit after final bond release.

66. COMMENT: With reference to the Draft EIS Section 2.5.5.2, pages 2-83 and 2-86, what "other facilities" will be evaluated? What is the projected time frame for completing these evaluations? Will stages 3 and 4 be completed for any of the other alternatives in consideration of the pending lawsuit? (346)

RESPONSE: The reference is not to the evaluation of other facilities, but to provide long-term information that could be applied to reclamation at other facilities. The evaluations are ongoing; some information is currently being compiled on data collected at the Mill Gulch dump. Stages 3 and 4 would be completed as part of any expansion alternatives. The pending lawsuit has no relevance to the performance studies.

67. COMMENT: In the Draft EIS Section 2.6, the statement is made that "This alternative limits the reclamation requirements and cover capabilities to materials such as cover soils and clay which are available." Should the statement read "which are <u>not</u> available"? However, such materials do appear readily available as described under other alternatives without the need for additional <u>mining</u> as stated. (346)

RESPONSE: The statement is correct as written.

68. COMMENT: In the Draft EIS Section 2.6.1, page 2-89, it is stated that final rinsing solution would be disposed at the Goslin Flats LAD. Where is this located? A map should be provided specifically outlining the area. Is such a site authorized at this time? (346)

RESPONSE: Figure 2.5-1 outlines the pending LAD area at Goslin Flats. This site has not been approved for LAD, at this time.

69. COMMENT: With reference to the Draft EIS on pages 2-93 and 2-96, who would be responsible for perpetual collection and treatment? What are costs of these actions? A summary of contractor and ZMI testing on reclamation quality tests conducted (moisture, density, thickness, revegetation) should be provided. (346)

RESPONSE: The mine operator would be responsible for collection and treatment of water until discharge would no longer degrade water quality. A discussion on the bonding process has been provided in Section 1.5.1. There is no requirement for documentation of reclamation quality control, as Section 2.6.2.8 clearly states. Therefore, a summary of such documentation is not possible for this alternative.

70. COMMENT: With reference to the Draft EIS Section 2.6.3, page 2-93, what is the fate of the rinse waters that are obtained during rinsing until desired WAD levels are reached? What volumes of waters are generated? What are costs associated with this action? Are the water capture systems mentioned successful in capturing and treating 100% of ARD waters? Would these measures be implemented regardless of which alternative is being evaluated, considering state and federal requirements? (346)

RESPONSE: As shown on Figure 2.5-5, heap rinse waters are pumped through the carbon circuit to collect metals and monitored for cyanide content. The same rinse solutions are recycled (with the addition of fresh water as needed to account for evaporative loss) until cyanide concentrations are below the specified level. Water is not generated in the process, since the solution is recycled. Costs to conduct the rinsing are included in the bond calculation. It is unknown what percent of ARD water is collected, but it almost certainly is not 100%. These measures have already been implemented.

71. COMMENT: In the Draft EIS Section 2.7, page 2-98, the statement is made that "without expansion approval, there <u>may</u> (emphasis added) be insufficient waste rock of this type available at the mines to construct the caps"; thus, suitable materials would have to be generated from off-site sources and transported to the mines. It needs to be specifically determined whether sufficient waste rock is available. It should also be noted where such materials are present (Goslin Flats, for example) and the costs for obtaining such materials should be identified. (346)

RESPONSE: Additional information has been provided to this section to disclose what type of reclamation materials would be required and the locations of sources for these materials. It is important to note that reclamation covers have been developed which eliminate the need for mining of reclamation materials from most off-site sources. Costs for these actions would be included in the reclamation bond once the preferred alternative is selected.

72. COMMENT: Have any other sites been evaluated for obtaining limestone? Are other practicable sites available? (346)

RESPONSE: Yes, other sites have been evaluated and Alternatives 3 and 7 have been revised to require that limestone be obtained from the LS-2 site at the Zortman Mine, and from the Montana Gulch site at the Landusky Mine. These sites would reduce potential impacts to water quality, soils, and air quality stemming from use of the King Creek and LS-1 quarries.

73. COMMENT: On Table 2.8-1 of the Draft EIS, addition of the second and third columns does not always add up to the amounts identified in the first column. (346)

RESPONSE: Although somewhat confusing, the table is correct. The reason Already Disturbed Area (Column 2) added to Proposed-Previously Undisturbed (Column 3) does not always equal the Proposed Total Disturbance (Column 1) is that some facilities would be constructed on top of or envelope existing facilities of another type. For example, the proposed total disturbance of mine pits is 200 acres, more than the existing mine pit disturbance (97 acres) added to the proposed-previously undisturbed mine pit area (52 acres). This is because the mine pit complex would also consume about 51 acres that is disturbed by <u>other facilities</u>, such as leach pads or waste rock dumps.

74. COMMENT: The amounts of total waste rock do not add up on Table 2.8-2 of the Draft EIS. (346)

RESPONSE: The waste rock numbers in this table do not add up. This is because while ZMI is permitted (for capacity in the waste rock dumps) to have 11.3 million tons of waste rock, the mine facilities only hold about 7.8 million tons of waste rock. This value, added to the proposed 60 million additional tons, would add up to the value in the third column, 67.8 million tons.

75. COMMENT: Section 2.8.1.1, page 2-120/121, E-W/N-S Sections Zortman. Groundwater elevations should be plotted also (past, present, projected). (346)

RESPONSE: Please see information provided and analyzed in Sections 3.2 and 4.2; in particular Section 3.2.4 for a discussion on groundwater elevations.

76. COMMENT: Section 2.8.1.1, page 2-124, last paragraph. Does table 2.8-4 reflect the results of the tests completed to date? What number of tests have been conducted to date? If not, a table showing results should be provided. (346)

RESPONSE: Table 2.8-4 of the Draft EIS (now Table 2.8-6 of the Final EIS) reflects information submitted by ZMI with the mine expansion permit application. For more information concerning geochemical testing, please see Section 3.2.

77. COMMENT: The statements are made in Section 2.8.1.5 that "the amount of waste rock generated could be greater than anticipated" and "some potential exists for mining beyond that proposed in this action." Testing should be conducted to determine the extent of waste rock removal and any additional mining should be clearly identified and discussed. A clear understanding of the geology, hydrology, and geochemistry is necessary before such a proposal could be evaluated. The bedrock exposed for construction of a repository should also be characterized. (346)

RESPONSE: Testing has been conducted to determine the extent of waste rock <u>expected</u> to be generated during mining. The additional capacity built into the waste rock repository underscores the need for conservatism, should the estimates not be exact. In addition, Pony Gulch has been identified as a reasonably foreseeable development for mining. Should this occur, the additional capacity in Carter Gulch could be used for waste rock, as opposed to disturbance elsewhere for a new repository.

78. COMMENT: Under Alternative 4, how long would drainage from the August Adit need to be amended (lime added)? What volumes are expected to be applied? (346)

RESPONSE: Drainage from the August Adit would require treatment until it (the Adit drainage) is of acceptable quality for direct discharge to receiving waters. It is unknown what volumes of lime would need to be applied; this would depend on the drainage water quality and could vary significantly depending on mine operations and reclamation activities.

79. COMMENT: The reasonably foreseeable future actions in Section 2.8.6 (Alternative 4) appear speculative without additional information. Is a written proposal under development to mine the ore deposit in Pony Gulch? Are any written proposals under development for the development or enlargement of limestone quarries? Are written proposals under development for the construction of passive water treatment systems? If the construction of passive water treatment systems are thought to be necessary "as a means of <u>mitigating</u> effects from acid rock drainage", why is this not a component of Alternative 7? Are the projections really of a "softness" that the need for additional limestone is reasonably foreseeable? The remaining discussion in this section discusses the potential need for additional capture ponds, storage ponds, settling ponds, constructed wetlands, a water treatment plant at the Landusky Mine, and a sludge disposal area based on "ongoing discussions between ZMI and the DEQ." It seems that such needs should be determined before any major permits and approvals are decided. Those items that were determined to be necessary would then become mitigations, as opposed to reasonably foreseeable future actions. And then, such mitigations would have additional impacts to waters of the U.S. that would need to be addressed in the Corps of Engineers permit decision. (346)

RESPONSE: The reasonably foreseeable future actions are supposed to be speculative. There is no written proposal which has been submitted for mining of the Pony Gulch deposit. The BLM and DEQ are not aware of a proposal in development for this action. Concerning the limestone quarries and passive treatment systems, it is certainly reasonable to anticipate that additional limestone could be used in reclamation of mine facilities and for treatment of degraded waters. The Draft EIS reads that such treatment systems are "reasonably foreseeable as a means of mitigating effects from acid rock drainage." The discussion of reasonably foreseeable future actions for Alternative 7 indicates that activities would be very similar to those described under Alternative 4.

Capture ponds, storage ponds, and treatment systems are described by alternative in Appendix A. The environmental consequences, Chapter 4.0 of the EIS, evaluates the cumulative impacts from the reasonably foreseeable future actions along with past and present actions.

80. COMMENT: More details on the Pony Gulch site should be provided. Estimated area of disturbance, impacts to waters of the U.S. or wetlands, extent of ore deposit, vertical horizontal information, access, (etc.) are needed to enable some evaluation of impacts. The same for the exploration program mentioned. Where has exploration been conducted? Where is the most likely deposit to be developed? The proposals for new limestone sources should also provide some estimate of area of disturbance, vertical/horizontal dimensions etc. (346)

RESPONSE: The level of detail in the EIS on reasonably foreseeable future actions is adequate for an evaluation of cumulative impacts. Additional detail or specifics cannot be developed without a specific proposal for exploration or mining. If such a proposal is submitted, it would undergo a specific NEPA/MEPA analysis as a proposed action.

81. COMMENT: Because ZMI withdrew its proposal for long-term exploration of the Little Rocky Mountains, the discussion of exploration activities seems to be speculative and not reasonably foreseeable. What other entity would conduct such exploration, and when would they begin and end? (346)

RESPONSE: If the proposal had not been withdrawn, it would be a proposed action and not a reasonably foreseeable activity. ZMI's withdrawal of the long-term exploration proposal could stem from a number of reasons, including a concentration on mining of the known ore bodies at the Landusky and Zortman sites. The Little Rocky Mountains are demonstrated to be mineralized in locations other than where ZMI is currently and proposing to mine. This geologic evidence suggests a potential for additional exploration which is beyond "speculative." The BLM and DEQ are unaware of what other entities would conduct such exploration, but certainly there are many mineral exploration firms with the capability to undertake such exploration, including ZMI. Without a specific exploration proposal, one cannot reasonably predict when exploration would occur and when it would end.

82. COMMENT: Map(s) should be provided in Section 2.8.6.3 showing potential exploration and/or expansion disturbances. (346)

RESPONSE: The Pony Gulch deposit is shown on Figure 2.8-1 and Exhibit 1. The enlargement of the Green Mountain and King Creek limestone quarries are shown on Figure 2.5-2 and Exhibits 1 and 2. Specific information is not available to produce useful maps of the other reasonably foreseeable future actions, such as exploration activities.

83. COMMENT: It is stated in Section 2.9.4.7 of the Draft EIS that final requirements are being developed. This data should be available in the Draft EIS for review and before regulatory decisions are reached. (346)

RESPONSE: Appendix A describes measures that would be used to achieve and maintain compliance with water quality standards under all alternatives.

84. COMMENT: It is stated in Section 2.9.6.2 of the Draft EIS that generation of a significant amount of waste rock is likely. The estimated amounts should be provided. (346)

RESPONSE: It is unknown how much waste rock would be generated, but the percentage of waste rock to ore typically varies from 35% to 60%. It is likely that ZMI would propose to mine an additional 12.2 million tons of ore and 8 million tons of waste rock at some future date, as some evidence exists that additional mineable ore is present at the Landusky Mine.

85. COMMENT: Where are mineralized areas near the Upper Alder Gulch leach pad? A map should be provided. (346)

RESPONSE: The Upper Alder Gulch leach pad is shown on Figure 2.9-1 and Exhibit 1. Mineralized zones could be expected in many areas in this vicinity.

86. COMMENT: Where would an alternative water source for bats be located? A map should be provided with the mitigation plan. Details on the source should be provided (size, source of hydrology, permanence, quality, etc.). (346)

RESPONSE: The proposed mitigation pond to serve as an alternative water source for bats would be located northwest of the Goslin Flats leach pad. The location is now shown on Figure 2.10-1, and Exhibit 1. Details are provided in Appendix F, and are also contained in the 404(b)(1) permit application for the Zortman Mine, submitted to the U.S. Corps of Engineers in September, 1995.

87. COMMENT: In Section 2.10.4.7 of the Draft EIS (page 2-226), it is stated that "Where access allows, portions of the pit walls that are potentially acid forming and cannot be capped would have diversions installed above the highwall." What percentage of the pit wall(s) could potentially be capped? What percentage of the pit wall(s) could be "protected" via diversions? What percentage of the pit wall(s) have the potential to become acid generating? What percentage is accessible and what impacts would the diverted highwall surface runoff, which will be directed down Montana Gulch, have on downstream aquatic resources? (346)

RESPONSE: Under Alternative 6 and other agency mitigated alternatives, pits would be backfilled to designated levels (which vary, depending on the alternative). Above the backfill level, pit walls would not be capped. It is assumed that half of the existing pit benches cannot be accessed and covered. All new pit benches in the expansion alternatives would be covered. Diversions would be installed around virtually all pit highwalls to reduce surface water contact with potentially acid generating surfaces. It is unclear what percentage of pit walls have the potential to become acid generating. The BLM and DEQ have assumed all pit walls could generate acid in the right conditions, and therefore all effort would be made to install diversions. Runoff which is diverted and does not contact highwalls should be relatively clean, and would be treated as stormwater prior to discharge in Montana Gulch.

88. COMMENT: The repository construction will include diversion ditches built along the edges of the facility (page 2-232 of the Draft EIS). Will rock blankets be placed in receiving streams? What are the names of the receiving streams? (346)

RESPONSE: It is likely that rock blankets, other channel armoring, or energy dispersion devices would be necessary at discharge locations. Discharge would be in Ruby Gulch, at the Zortman Mine, and Montana Gulch, at the Landusky Mine.

89. COMMENT: Section 2.11.3.6 implies that a new water treatment plant at the Landusky Mine is a component of Alternative 7. Section 2.11.6.2 states that new or expanded water treatment facilities would be foreseeable, and refers the reader to Section 2.8.6.1. It seems the reference should be to Section 2.8.6.2, which states that a water treatment plant at the Landusky Mine would probably be necessary to mitigate residual impacts. A less confusing presentation is needed. (346)

RESPONSE: The water treatment plant for the Landusky Mine is not a reasonably foreseeable development but part of all alternatives. The text has been clarified.

90. COMMENT: There is a concern that limestone mining above Lodgepole Creek drainage could impact waters flowing into the Fort Belknap Indian Reservation. An alternative limestone quarry site in the permit area could be expanded to provide the materials needed for reclamation. (185, 203, 275 through 319)

RESPONSE: Limestone mining in the Lodgepole Creek drainage could degrade water quality flowing into the Reservation. These effects are discussed in Section 4.2.6. Because of concern over potential impacts to water quality in this drainage (and King Creek, north of the Landusky Mine) Alternatives 3 and 7 have been modified to require that limestone mining be conducted, as necessary, at LS-2 south of the Zortman Mine and the Montana Gulch quarry, southwest of the Landusky facilities. Both of these sites are within current permit boundaries of the two mines and areas where runoff would drain to the south.

91. COMMENT: Data from existing land application disposal areas shows that soil, vegetation, and ground water have been impacted. Will the LADs be monitored and subject to compliance with ground water quality standards? (203)

RESPONSE: This issue was addressed in Section 2.7.5.1 of the Draft EIS, and the mitigations incorporated into all mitigated alternatives (3, 5, 6, and 7). This section (now 2.7.3.1 of the Final EIS) describes the monitoring program specifically developed for LAD areas.

92. COMMENT: The Draft EIS identifies the water balance cover as the most effective reclamation cover. Yet, there is no alternative incorporating a mine expansion refusal with the best reclamation tool. The alternatives in the Draft EIS therefore violate the mandate in the Federal Land Policy Management Act to avoid "unnecessary and undue degradation of public lands. (211, 320)

RESPONSE: The water balance reclamation cover can improve the potential for reclamation success, whether mine expansion is permitted or not. Therefore, Alternative 3 now incorporates the agencies' water balance and water barrier covers, consistent with Alternative 7.

93. COMMENT: Alternative 7 requires the Landusky Pit complex to be backfilled to approximately 4,850 feet mean sea level (msl) to allow free drainage into King Creek. However, Exhibit 2 of the Draft EIS displays a 4,900 foot elevation contour between the Queen Rose pit and the King Creek drainage. This would preclude free drainage, as the backfill elevation would still be below the 4,900 foot "crest." (11)

RESPONSE: The "divide" between the north side of the Queen Rose pit and King Creek is at an elevation less than 4,900 feet msl; it is estimated that backfill to 4,850 feet msl would allow for unobstructed drainage to King Creek. Alternative 5 has been modified to make clear that the backfill elevation is an estimate, and the requirement is to backfill sufficiently to create a free draining surface to King Creek. Alternative 7 has been modified to require backfilling to an elevation of 4,740 feet to create a free draining surface to Montana Gulch.

94. COMMENT: Capture systems and settling ponds in Upper King Creek should be designed to treat surface water from the backfilled surface of the pits, not the backfilled pit floors. Reclamation covers should prevent water from getting into the pit, and water that gets to the pit floor should not be able to flow to King Creek. (11)

RESPONSE: Reference to "pit floor" means the level to which the pit is backfilled. Therefore, the comment is in agreement with the mitigation in Alternative 5. Surface water allowed to flow to King Creek would have contact only with reclaimed and/or clean surfaces.

95. COMMENT: It should not be necessary or required to have ZMI rehandle existing, already reclaimed facilities (waste rock dumps and leach pads) at the mines. (12, 53, 59, 131, 167, 168, 169, 225, LO-4, HA-32, MA-8)

RESPONSE: Many of the facilities at the Zortman and Landusky mines are releasing contamination to the environment, particularly in the form of acid mine drainage, or have the potential to cause such problems. Therefore, these facilities require some form of re-reclamation. Complete removal of an existing or potential problem would have the greatest likelihood for reclamation success. The existing facilities provide a logical source of fill to partially backfill the mine pits.

96. COMMENTS: A problem with the Goslin Flats leach pad is that it will be a visual disruption in that area. The leach pad (and other facilities outside the mountain mining areas) should be contoured to match existing land structures. (27)

RESPONSE: Artists renditions provided by ZMI and visual simulations incorporated in the Draft EIS (Appendix D) illustrate that the leach pad would be quite visible on the Goslin Flats. Alternatives 6 and 7 would require that portions of the leach pad be varied in thickness and location at reclamation to create a variable skyline (see Sections 2.10.2 and 2.11.2).

97. COMMENTS: The description of facilities in Chapter 1.0 is not definitive. For instance, it states that the proposal includes a waste rock disposal area, expanded mine pits, a 2½ mile conveyor system, a leach pad and limestone quarry and *other associated facilities.* More information is needed on the other facilities in order to comment on them. (34, 181)

RESPONSE: Chapter 1.0 is only intended to provide a brief oversight of the proposed project. A complete description of the proposed action, and other alternative actions, is contained in Chapter 2.0. Information on all facilities and facility disturbances for the proposed action may be found in Sections 2.8.1 and 2.8.2.

98. COMMENTS: Existing reclamation on the Mill Gulch and Gold Bug waste rock facilities should be left alone. (163, 240)

RESPONSE: Existing reclamation covers would be maintained on these two facilities. However, they may require supplemental cover soil to ensure long-term reclamation cover performance objectives.

99. COMMENTS: The proposed reclamation plan will require additional mining to provide sufficient material to properly install reclamation covers. Continued mining will provide needed capital for implementation of the upgraded reclamation procedures. (163, 240, 259)

RESPONSE: Additional gold and silver mining is not necessary to develop and implement a suitable reclamation operation of existing disturbances. However, some new disturbance would be needed if non-acid generating waste rock is not available. This may occur at limestone quarries, the Goslin Flats, Ruby Gulch, clay pits, or other potential borrow sources. The necessary reclamation procedures would be implemented regardless of the funding source.

100. COMMENTS: Any additional activities such as limestone mining in the Lodgepole Creek or Beaver Creek drainages will impact the drainages with silt, sediment runoff, and acid rock drainage. (181)

RESPONSE: Limestone mining in undisturbed drainages risks degradation of surface water, primarily through sediment loss to the streams. An evaluation of impacts resulting from these activities is incorporated in Sections 4.2.6, 4.2.7, and 4.2.8. In part because of this concern, reclamation requirements have been developed in Alternatives 3 and 7 that would require any materials needed from off-site locations for use in reclamation covers to be mined from drainages that do not discharge to the north.

101. COMMENTS: If Alternatives 1, 2, or 3 are selected as the preferred alternative, all people in the area would suffer. Reclamation and water quality would be back to the way it was before these problems started to be dealt with. (216)

RESPONSE: Alternatives 1, 2, or 3 would cause impacts to the area's economic base, as described in Sections 4.10.3, 4.10.4, and 4.10.5. Alternative 3 was developed to ensure that reclamation continues and water quality improves, even if the mines are not allowed to expand operations.

102. COMMENTS: The Carter Gulch oxide reject material (i.e., waste rock) should be removed during Zortman Mine expansion. This would facilitate maintenance of the needed oxide/sulfide ratio for the leach pad. (217)

RESPONSE: This material could be selectively handled to increase mine efficiency while still requiring removal of the facility.

103. COMMENTS: The EIS should provide more information concerning land application. Is it possible to accurately predict how long it will be necessary to monitor the LAD areas for impact? How will monitoring and treatment be financed? A summary of the success of previous attempts to use land application at the mine should be presented. (326)

RESPONSE: It is not possible to accurately predict how long land application areas would be monitored, since monitoring would be required for a limited time after solution disposal stops. Monitoring and any treatment of degraded waters would be conducted and paid for by the operator. Please see Section 2.5.1.5 for information on land application disposal areas which have been used at the two mines.

104. COMMENTS: A plan for long-term water quality monitoring is needed since impacts to water resources may continue for many years. (328)

RESPONSE: All of the alternatives include water quality monitoring requirements. The Water Quality Improvement Plan in Appendix A also includes monitoring requirements.

105. COMMENTS: All of the alternatives would leave mine pit highwalls exposed to precipitation, likely resulting in acid mine drainage. (320)

RESPONSE: Precipitation on pit highwalls can result in acid rock drainage. This is a particular problem for rock types which have not yet oxidized. These are generally found below about 5,000 ft. msl at both mines. The following actions would be required in Alternatives 3, 5, 6 or 7 to mitigate the production of ARD. First, pits would be partially backfilled; those highwalls covered by backfill would not be exposed to precipitation. Surface water diversions would be installed above the pits to prevent water from running into the pits and contacting highwalls. In-pit drainage systems would be constructed to capture runoff from the highwalls and prevent it from ponding on the pit floor. This captured water would be routed to a treatment system. Finally, accessible highwall benches would be covered with 12 inches of non-acid generating material and 12 inches of topsoil, and revegetated. These actions would reduce the amount of water that contacts surfaces that may cause ARD and prevent runoff or seepage that may be acidic from discharge into a drainage until after treatment.

106. COMMENTS: The EIS needs to consider the cumulative effects of all the mining expansions since 1979 and those that could occur in the future. (320)

RESPONSE: The impacts resulting from large-scale mining since 1979 are disclosed near the beginning of the impact analysis for each resource (see, for example, Section 4.1.2, Impacts from Mining, 1979 to Present). The Draft EIS and this Final EIS described reasonably foreseeable future actions (RFFA) that could also effect the resources studied. These RFFAs included mine expansions (for instance, deepening of the Landusky pits) or development of other ore deposits (such as the Pony Gulch ore body). Exploration activities have also been described. These RFFAs are reviewed in the analysis of environmental impacts for each resource. The cumulative impacts analysis in each resource includes effects from past and present activities, proposed actions, and reasonably foreseeable future actions.

107. COMMENT: All existing and proposed land application areas should include downgradient groundwater monitoring wells. These should be included in the compliance monitoring program. (337, LO-38)

RESPONSE: The expanded groundwater monitoring program would require one or more wells downgradient of the land application disposal areas. See Section 2.7.3.1.

108. COMMENT: Page 4-48 of the Draft EIS suggests that acidic highwall runoff would most likely require perpetual treatment. (337)

RESPONSE: Highwall runoff in some areas may become acidic, and treatment could be required for the foreseeable future. Agency-modified alternatives require that diversion structures be installed to prevent, to the extent possible, surface water contact with potentially acid-generating highwalls. Highwall runoff would be captured and treated to reach MPDES limitations prior to discharge.

109. COMMENT: On page 2-240 of the Draft EIS it notes that water management systems would be dismantled as water quality (naturally) meets discharge standards. However, this is an unlikely event for some sources at the mines that would probably never provide runoff water that could be discharged without treatment. This problem should be discussed and methods established for perpetual treatment. (337)

RESPONSE: The need for perpetual treatment has been considered in conjunction with the water management processes described in agency-modified alternatives (see, for instance, Sections 2.7.1.7 and 2.9.1.7). The reclamation bond would be established to ensure that water treatment is funded for as long as necessary.

110. COMMENT: Would one foot of freeboard prevent winds from blowing ditch water over the top of ponds in the design storm event? (337)

RESPONSE: The ponds to be constructed under any of the alternatives are relatively small, and it is unlikely that there would be sufficient fetch (area of water over which the wind travels on the pond) to create waves which could overtop the structures.

111. COMMENT: The map for Alternative 7 shows that the proposed land application disposal area completely encompasses the site of the replacement wetland. Even though a 200-foot buffer would be used to protect drainages, there is no indication that the agencies considered the consequences of land application on the wetlands. (340, 344)

RESPONSE: The proposed replacement ponds would not be within the boundary of the LAD area in Goslin Flats, but rather upgradient, in the Ruby Creek drainage and west in Goslin Gulch. Disposal of spent process solutions (land application) would not occur in wetlands or waters of the U.S., because of the 200-foot buffer zone.

112. COMMENT: The agencies should have considered an alternative that incorporated the use of the "water balance" cover, since information provided in the Draft EIS indicates that this cover would have the best potential for reclamation success. (340, 344, 347)

RESPONSE: Alternatives 3 and 7 in the Final EIS now requires use of the "water balance" cover on slopes $\geq$25 percent. Please see Section 2.7.2.

113. COMMENT: It is unclear how much topsoil would be used in the reclamation covers. The illustration (at page 2-237 of Draft EIS) refers to a minimum of 8 inches, while the text refers to one foot of cover soil. However, the DEQ's own consultant acknowledges neither of these quantities is sufficient. (344)

RESPONSE: The reclamation cover referred to has been revised, and 12 inches of topsoil is a minimum depth. Please see Section 2.7.2.1 and Figure 2.7-1. For this geographic and climactic region, 9 to 33 inches of topsoil/cover soil promote the highest rates of plant establishment and productivity (see Section 4.3.1).

114. COMMENT: The alternatives would allow large amounts of surface area within the pits to be in contact with moisture, creating objectionable effluent which would run down into the pit floor and, without treatment, into August Adit and then Montana Gulch. (344)

RESPONSE: The Company Proposed Action incorporates runoff diversions to limit the amount of water that would contact pit areas to reduce the direct precipitation. Mitigated alternatives would require a number of actions to be taken to reduce the amount of surface water which comes into contact with areas that could cause contamination. In addition, waters flowing into the pit and those which contact pit walls would be captured and treated prior to discharge. This would be required for both mines. Please see Sections 2.7.1.7, 2.9.1.7, 2.10.1.7, and 2.11.1.7 for Alternatives 3, 5, 6, and 7.

115. COMMENT: The proposed action (for instance, page 2-168) does not consider the large rainfalls which occur every 50 to 100 years, nor the ability of the drain into the August Adit from the pit to accommodate increase volumes of water during these storm events, nor the feasibility of the apparently perpetual nature of this pond. (344)

RESPONSE: Additional water management (water diversion, capture, treatment and discharge) provisions would be needed to provide assurance that contaminated waters would not be discharged without treatment during large storm events. These additional water management measures are outlined in Sections 2.7.1.7, 2.9.1.7, 2.10.1.7, and 2.11.1.7 for Alternatives 3, 5, 6, and 7.

116. COMMENT: The proposed action makes no provisions to ensure the perpetual function of the engineered drain proposed to be constructed into the existing August Adit. Although the Draft EIS states that the pit complex floor will be graded to flow into the engineered drain, there is no discussion of what type of grade would be required to ensure the perpetual success of such a flow. (344)

RESPONSE: The proposed action does not specify the grade of the drain nor the provisions that would be undertaken to ensure perpetual functioning of the engineered drains. The development of a pit drainage plan would be required under the various agency-mitigated alternatives.

117. COMMENT: The Draft EIS claims on page 2-68 that minimal maintenance will be required for the ponds because storm water is to be diverted away from the pond area. The Draft EIS fails to account for the periodic, significant storm events which occur every fifty to one hundred years wherein it will likely be impossible to divert all storm water away from the ponds, thereby resulting in contamination of surface and groundwaters. (344)

RESPONSE: The reference is to the existing water management systems in place at the two mines. Additional measures may be required to control storm water; hence, modifications to upgrade systems for no mine expansion (Section 2.7.1.7 for Alternative 3) and mine expansion alternatives (Sections 2.9.1.7, 2.10.1.7 and 2.11.1.7 for Alternatives 5, 6, and 7) have been identified. Diversion design criteria are established based on storm event intensity and frequency.

118. COMMENT: Backfilling the open pits with mined materials, as proposed in the Draft EIS, is likely to degrade the water quality even if the waters do not become acidic. The Draft EIS contains no provisions for treating and monitoring groundwaters contaminated from the pit. (344)

RESPONSE: The pit backfill requirements outlined in Alternatives 3, 5, 6, and 7 would be designed to reduce the potential for groundwater contamination in a number of ways. First, the amount of water collecting in the pits would be limited to that which falls as precipitation directly on the reclaimed surface and infiltrates through the cap, plus groundwater inflows. (Diversion structures would be installed to prevent runoff from highwalls or outside the pit form reaching the reclaimed pit surface). Second, the reclamation covers would limit infiltration by maximizing plant uptake and evapotranspiration, and routing infiltration water through a drain layer on top of a low permeability layer to collection systems. Therefore, the quantity of water collecting in a backfilled pit would be much less than would collected in a flooded open pit. In addition, an enhanced monitoring program would be implemented to track groundwater quality and provide early detection of water quality degradation in order to direct any remedial action.

119. COMMENT: Where are the land application disposal areas? Soils should be monitored for contaminant accumulation. (348)

RESPONSE: Land application disposal areas have been used at Carter Butte and Gold Bug Butte. ZMI has proposed the use of additional land on Goslin Flats for land application disposal of process solutions (see Exhibits 1 and 2). Alternatives 3, 5, 6, and 7 would require ZMI to monitor LAD areas for, among other things, contaminant attenuation on soils. Please see Section 2.7.3 for additional information.

120. COMMENT: What is being done to improve the decreased pH resulting from ARD on the spent ore of the 80/81 leach pad? Were the liners punctured on this leach pad? (348)

RESPONSE: This leach pad has not been punctured. Additional surface reclamation, as described in Section 2.5.2.4, has been instituted to reduce surface water infiltration and the formation of ARD.

121. COMMENT: Why was the cyanide concentration at the 85/86 leach pad not reduced to below the 0.22 mg/l standard? (348)

RESPONSE: This pad is still being rinsed, until cyanide concentrations are reduced to acceptable levels.

122. COMMENT: ZMI should use noxious weed free grass seed mixtures in reclamation. (348)

RESPONSE: The seed mix and seeding rates are shown in Tables 2.8-11 and 2.8-12. Use of noxious weed free seed is proposed.

123. COMMENT: What happens to waste rock with high sulfur concentrations? Are the sulfur contents monitored where these wastes are stockpiled? (348)

RESPONSE: Waste rock use and disposal is described in Section 2.5.2. Under existing conditions at the Landusky Mine, waste rock with high sulfur concentrations is segregated within the waste rock repository during disposal. This "isolation" of waste rock with high sulfur concentrations may reduce the potential for contact with infiltration water and the resultant formation of ARD. Waste rock surrounding the high-sulfur waste rock may help to buffer any ARD which is generated.

124. COMMENT: How will waters sealed from adits be monitored for cyanide and heavy metals? (348)

RESPONSE: The purpose of sealing the adits in the mine pits would be to prevent acidic pit water from flowing out through the tunnels to locations where capture and treatment would be difficult, and to prevent the spread of groundwater degradation. Water draining from daylighting adits would be monitored for quality.

125. COMMENT: How would untreated waters be reclaimed if found to be leaking through the heap leach pad? (348)

RESPONSE: A water collection and pumpback system would have to be installed if leaks in a leach pad impact groundwater quality. The specific technology to be employed would be determined after identification that such a problem exists.

126. COMMENT: There is no direct relationship in the Draft EIS between impacts and mitigations. In other words, what impacts are the mitigations designed to reduce or eliminate, and to what degree would this mitigation work? (350, 364)

RESPONSE: In the Final EIS, additional information is provided in the agency-mitigated alternatives to explain why each mitigation would be imposed. In other words, the impact is noted that the mitigation is designed to alleviate. Please see the bulleted list of mitigations at the beginnings of Sections 2.7.2, 2.9.2, 2.10.2, and 2.11.2. The extent to which each mitigation would work is presented in the separate resource impact analyses in Chapter 4.0.

127. COMMENT: The agencies' preferred alternative is nearly identical to the Company's proposal, raising the question of whether the agencies have adequately researched the proposal and alternatives independent of ZMI's research. In turn, this raises the question of whose interests are being protected. (351)

RESPONSE: The preferred alternative differs from the proposed action in a number of ways. A list of the most significant differences from the proposed action is presented at the beginning of Sections 2.11.1 and 2.11.2. Extensive research and consideration has gone into the development of alternatives. While three non-mine expansion and four mine expansion alternatives were analyzed, it should be noted that identification of a preferred alternative has to consider the purpose and needs discussed in Chapter 1.0.

The decision before the agencies is not whether ZMI gets to mine, but rather what mitigating measures would be imposed so that they could mine and still meet the requirements of Federal and State environmental laws. Alternative 7 is identified as the preferred alternative because it satisfies these objectives.

128. COMMENT: The only alternative which addresses a minimally reasonable approach to reclaiming the pits is Alternative 3, which provides for backfilling to an elevation of 4,900 feet. (351)

RESPONSE: Alternatives 3, 5, and 6 would require that the Zortman Mine pits be backfilled to approximately 4,900 feet msl. Under Alternatives 4 and 7, the Zortman pit would be backfilled to an elevation of 4,800 feet. Landusky Mine pits backfill would vary, depending on the drainage designated to receive treated pit water. The Landusky pits would be backfilled to an elevation of 4,740 feet under Alternatives 3, 6, and 7 and to an elevation of 4,850 feet under Alternative 5.

129. COMMENT: On page 2-99 of the Draft EIS it says final rinsing solution would be disposed on Goslin Flats land application disposal area, but it does not mention that under this alternative (#3) there would be no expansion, therefore no LAD area on Goslin Flats. (352)

RESPONSE: ZMI has applied for use of the Goslin Flats as a LAD area for disposal of spent solution generated under the current mining permit. Therefore, if approved, Goslin Flats would be used for LAD under any of the non-mine expansion alternatives.

130. COMMENT: Page 2-105 of the Draft EIS states that the Landusky Mine 85/86, 87, 91, and 87/91 leach pads are still being leached, but does not mention if they have been continuously leached or have they been reloaded and leached. (352)

RESPONSE: The pads have been continuously leached, although the 87/91 is an expansion and merging of two previously separate pads, the 87 and 91. Additional loading has occurred at this pad.

131. COMMENT: The Draft EIS states that equal portions of oxide and non-oxide ore are to be placed on leach pads, but if fails to note that the original application was for mining of lower sulfide ores that, when exposed to the environment, are a major producer of ARD. (352)

RESPONSE: There is no restriction in existing permits against mining sulfide bearing material. The connection between sulfide-bearing ore and the production of acid drainage is well described and documented in the EIS. For example, see the Acid Generation figure in Chapter 1.0, and the text in Section 3.2.2. The terms oxide and non-oxide are not synonymous with the terms acid generating and non-acid generating.

132. COMMENT: Page 2-236 of the Draft EIS mentions two different kinds of leach pad liners, but fails to mention which one would be used with the expansion. (352)

RESPONSE: The text on page 2-236 of the Draft EIS refers to reclamation covers used on reclaimed facilities, not liner systems placed at the bottom of the proposed leach pad. The leach pad liner would be constructed as described in Section 2.8.1.4.

133. COMMENT: The EIS does not disclose what would happen to areas scheduled for reclamation should reasonably foreseeable exploration and development occur, especially if ZMI decides to use these areas for future mining. (352)

RESPONSE: It is difficult to predict with certainty how future exploration and mining could affect existing disturbances. However, exploration activities should require little use of areas such as waste rock dumps or leach pads. Exploration needs would include some small area for disposal of waste generated during drilling, and staging areas for equipment, topsoil, etc. A new mine, such as the Pony Gulch reasonably foreseeable future development, would require the use of existing facilities or the construction of new facilities. The Pony Gulch deposit is small, and the Goslin Flats leach pad would probably be expanded, if necessary, to accommodate the additional volume of ore. The operator would probably propose to dispose waste rock at a new facility in the vicinity of the deposit or in the Goslin Flats area. Any proposals for amending the mine permits to authorize actions described as "reasonably foreseeable" would be subject to additional NEPA/MEPA analysis.

134. COMMENT: If the agencies decide on a non-mine expansion alternative everyone would suffer, reclamation would not be as good and water quality would degrade back to the way it was before corrective actions began to be implemented. (LO-24)

RESPONSE: Reclamation to meet regulatory requirements would take place whether mine expansion is approved or not. This includes the improvement of discharge waters to acceptable quality and maintenance of high quality waters.

135. COMMENT: A genuine No Action alternative was not considered as required by NEPA. Alternative 1, closing the mine and instituting reclamation measures that do not comply with the Clean Water Act or the other statutes, does not fulfill this requirement. Therefore, the No Action alternative is not a viable alternative. A no action alternative involving mine closure and complete legal reclamation must be given full consideration. (211, 273, 340, 345, LO-11)

RESPONSE: The EIS must include the No Action alternative (40 CFR § 1502.14(d)). There are two interpretations of "no action" that can be considered (46 CFR 18026, Mar. 23, 1981). The first interpretation involves an action where ongoing programs initiated under existing regulations will continue and the "no action" is "no change" from current management direction. The second interpretation involves federal decisions on proposals for projects where "no action" means the proposed activity would not take place. Alternative 1 in the EIS is the No Action alternative and continues permitted operations/reclamation but mine expansion plans (extensions and/or revised reclamation) would not take place. The No Action alternative is "no change" from current management direction initiated under existing regulations (Operating Permits 00095 and 00096) and the proposed activity (mine expansion plans) would not take place. However, compliance with the Federal Clean Water Act and Montana Water Quality Act is required to prevent unnecessary or undue degradation and is an element of all alternatives. The regulations require the analysis of the No Action alternative even if the agency is under a court order or legislative command to act. This analysis of the No Action alternative provides a benchmark, enabling decision makers to compare the environmental effects of the action alternatives. It is also an example of a reasonable alternative outside the jurisdiction of the agency which must be analyzed. Alternatives involving mine closure and proposed or mitigated reclamation were given full consideration under Alternatives 2 and 3 in the EIS.

136. COMMENT: The Draft EIS implies that reclamation success can be achieved only by expanding mining operations. Alternative 7 is preferred because "there would be a greater probability of reclamation success and correction of existing water quality problems." The EIS should explain why this is the case. According to NEPA regulations, long term reclamation is a requirement under all the alternatives in the Draft EIS and should be discussed. Based on the expected impacts under the status quo (current reclamation), how can the public possibly believe the agencies will enforce compliance of more stringent standards? An alternative contemplating the benefits of bringing mining in the Little Rocky Mountains to an end and cleaning up existing environmental damage is needed for EIS review. (211, 320, 329, 341, 351, 353, GF-23)

RESPONSE: Reclamation is discussed under each alternative in the Draft EIS. Alternative 1, the No Action alternative, involves continuation of permitted operations including implementation of existing reclamation plans. The action alternatives in the EIS address proposed changes by ZMI to the existing reclamation plans (Alternatives 2 and 4) and agency mitigated reclamation plans (Alternatives 3, 5, 6, and 7). Reclamation success can be achieved whether or not mine expansion is approved. Alternatives involving mine closure and proposed or agency mitigated reclamation were given full consideration under Alternatives 2 and 3 in the Draft EIS.

Under the 1971 Montana Metal Mine Reclamation Act, the DEQ has the authority to inspect facilities and operations for compliance with applicable laws, and to confirm the company's self-monitoring. The BLM has similar authority on federal lands. Monitoring is discussed for each alternative under the section "Monitoring Programs and Research Studies." Under the preferred alternative, ZMI must monitor the continued performance of such features as reclamation covers, revegetation success and permanence, erosion control measures, and water treatment effectiveness.

137. COMMENT: The cumulative effects of each incremental expansion of this mine, and additional expansions that are likely, need to be considered. Permitting of this mine since 1979 has been piecemeal. With mining it is obviously difficult to predict future expansions, but at a minimum possible future scenarios should be discussed. (320)

RESPONSE: Reasonably foreseeable future actions are discussed for each alternative in Chapter 2 of the EIS. Foreseeable actions include exploration and expansion at both the Zortman and Landusky mines. The cumulative impact analysis addresses past, present, and reasonably foreseeable future actions. This includes: 1) historic mining disturbances in Montana Gulch, Beaver Creek, Pony Gulch, and the Hawkeye Mine; plus mill tailing in King Creek, Alder Gulch, and Ruby Gulch; 2) impacts from 1979 through 1994; 3) impacts resulting from full implementation of the alternatives; and 4) reasonably foreseeable future actions as described in Chapter 2.0 of the EIS.

138. COMMENT: Was an alternative explored that included returning lands not needed for mining to the Fort Belknap Indian Reservation to address cultural resource impacts? (346)

RESPONSE: Through the EIS, agencies shall "rigorously explore and objectively evaluate all reasonable alternatives" including "alternatives not within the jurisdiction of the lead agency" (40 CFR § 1502.14(a) and 1502.14(c)). Transferring lands not needed for mining to the Fort Belknap Indian Reservation is not a <u>reasonable</u> alternative to the proposed expansion and reclamation since it would not modify the proposed action and would not be in conformance with the BLM's Judith-Valley-Phillips Resource Management Plan/EIS. This alternative is not within the scope of the EIS since it is not another reasonable course of action to the proposal. While mitigation can include replacing or providing substitute resources or environments transferring lands with cultural properties and/or traditional lifeway values would not replace or substitute the resources impacted.

139. COMMENT: If there are alternative deposits examined by the applicant which are beyond the exploration stage and could be mined as an alternative to mining at the Zortman and Landusky mines, the EIS may have to evaluate them as viable alternatives. If the proposed expansion was the only reasonable alternative examined, then the array of alternatives (alternative designs at the project site) presented in the EIS appears adequate. However, the EIS must explain why other alternatives examined by the applicant were not reasonable. (346)

RESPONSE: While Zortman Mining, Inc. (ZMI) has gathered substantial geologic data in connection with its properties in the Little Rocky Mountains and has identified mineralization in the Pony Gulch area as discussed in the Draft EIS, ZMI's exploration efforts have not identified additional deposits which could be considered as reasonable alternatives to development of the existing deposits at Zortman and Landusky. A discussion of alternate mining project locations has been included in the Final EIS, Section 2.2.

Alternatives which were considered but eliminated from detailed study are discussed in the section "Development of Alternatives" in Chapter 2 of the Draft EIS and summarized in Table 2.2-1. Several alternatives were considered regarding the major facility components of the Zortman and Landusky mines: the waste rock storage facility sites and the location for the ore heap leaching facilities.

140. COMMENT: Was an alternative explored that evaluated mining only a portion of the known/proposed ore instead of mining all the ore as proposed to address water quality and reclamation concerns? (346)

RESPONSE: One of the purposes and needs of the EIS is for mining of 80 million tons of ore at Zortman and 7.6 million tons of ore at Landusky. Mining a lesser amount has not been proposed by ZMI nor considered as an alternative to the proposed action other than not approving the project under Alternatives 1, 2, and 3 in the EIS. Mining a lesser amount would not meet the purpose and need for the project. A discussion of mining a lesser amount has been included in the Final EIS under the section on "Development of Alternatives."

141. COMMENT: No alternatives involving a bond covering 100 percent of the foreseeable reclamation and monitoring costs were considered. (273)

RESPONSE: All of the alternatives would require bonding to cover 100% of the anticipated reclamation costs. The actual reclamation bond amount is determined after completion of the Final EIS. Before the DEQ can issue an operating permit, the reclamation bond must be posted with the agency, and must be of sufficient amount for the state to complete reclamation in the case of default by the operator. An itemized list of costs for applicable tasks is prepared using information derived from the approved operating and reclamation plan. Bonds for reclamation of lands disturbed under a mine operating permit are based on requirements for water treatment, demolition and removal of surface facilities, earth moving, soil replacement, seedbed preparation, and revegetation. Bond amounts are subject to review at least every five years but can be reviewed at any time. In addition, the BLM can require additional reclamation bond if it deems the State's bond inadequate.

142. COMMENT: Alternatives to mineral expansion in the Little Rocky Mountains have never been seriously considered by the BLM. (356)

RESPONSE: Alternatives 2 and 3 evaluate impacts associated with no mine expansion and reclamation of existing mine operations. However, multiple use of federal land has been evaluated in the Judith-Valley-Phillips Resource Management Plan/EIS (BLM 1992).

143. COMMENT: All action alternatives involved mining and reclamation. No alternative involving purchase of the ore body in situ was considered. (273)

RESPONSE: Under the United States mining laws, claimants and operators have been authorized to develop locatable mineral resources on public lands that are open to operation of the Mining Law. The majority of the BLM land in the Little Rocky Mountains are open to operation of the Mining Law in conformance with the Judith-Valley-Phillips Resource Management Plan. An alternative to purchase the ore body, or existing gold and silver deposits at the Zortman and Landusky mines, is not a reasonable course of action to the proposal nor does it provide mitigation for the proposal. Alternatives 1, 2 and 3 in the EIS involve mine closure and existing, proposed or mitigated reclamation of existing facilities. To implement one of these alternatives the agencies may be required to compensate ZMI (purchase the ore body) for not allowing them to develop their mineral property rights. A discussion on implementation has been included in Chapter 2.0 of the Final EIS.

144. COMMENT: There is nothing in the Draft EIS, beyond the interests of Pegasus Gold Inc., that logically suggests Alternative 7 should be preferred. (320)

RESPONSE: The preferred alternative identification is discussed in Chapter 2 of the Draft EIS. Alternative 7 was identified as the agencies' preferred alternative. Alternative 7 satisfies the purpose and needs described in Chapter 1.0 of the Draft EIS. Of the seven alternatives considered and analyzed in detail, a mine expansion alternative was identified that met the need of providing ZMI a means to develop their precious metal deposits at the Zortman and Landusky mines and reclaim both mine facilities. Of the various possible waste rock and leach pad facility locations for mine expansion at the Zortman Mine, Alternative 7 is preferred. The water balance approach to reclamation covers is preferred over the barrier type construction, for both existing and new facilities. These measures, together with the other mitigation detailed in Alternative 7, would be used to address existing environmental problems, prevent unnecessary or undue degradation, and provide comparable stability and utility. Rationale for the selection of a preferred alternative will be provided in the Record of Decision for the EIS.

145. COMMENT: The Final EIS should analyze the option of: Requiring ZMI to document the feasibility and effectiveness of water balance reclamation caps, best management practices, capture and treatment systems, and passive treatment measures on a demonstration project as a condition for receiving final approval to expand the mining operation. (337)

RESPONSE: The suggested option would require a decision on reclamation of existing facilities with no mine expansion. This option is essentially Alternative 3, mine closure with agency-mitigated reclamation (Alternative 3 has been modified to include the use of water balance covers) or delayed implementation of Alternative 7. Monitoring is part of each alternative and includes evaluation of continued performance of such features as reclamation covers, revegetation success and permanence, and erosion control measures. The agencies cannot issue a decision on expansion based on the results of a future study.

146. COMMENT: The Draft EIS identifies the most effective reclamation as the "water balance" cover, but no alternative is presented which offers both no expansion and a water balance cover. The BLM's failure to combine the most environmentally sound reclamation option with the most environmentally sound expansion option (no expansion) violates the BLM's duty under NEPA to present a full range of alternatives and violates FLPMA's mandate to avoid "unnecessary and undue degradation" of public lands. (320, 340, 344)

RESPONSE: The alternatives in the EIS provide a reasonable range of options for mine expansion and reclamation consistent with MEPA and NEPA. Alternative 3, mine closure and agency mitigated reclamation, has been modified to include the use of water balance covers. A final determination as to the adequacy of the proposed mine plan, or a preferred alternative, in preventing unnecessary or undue degradation will be made in a Record of Decision after completion of the Final EIS.

147. COMMENT: The Montana DSL sent a copy of a preliminary Draft EIS to Gregory N. Richardson, a consulting engineer. The Draft EIS fails to disclose the fact that Mr. Richardson responded with several concerns about the use of water balance covers at the Zortman/Landusky sites. First, Richardson states that an eight-inch topsoil layer would be inadequate to ensure vegetation survival, suggesting instead that thirty inches be used (Richardson Report, page 5). The illustration in the Draft EIS indicates that a minimum of only eight inches of topsoil would be applied. (344)

RESPONSE: In the engineering peer review, Richardson examined water balance covers that included a capillary break with topsoil thicknesses of 8, 12, and 18 inches. Richardson felt "that the 'agricultural' layer required for vegetation survival is much thicker" and estimated "for the Zortman/Landusky sites, a minimum thickness" would be 30 inches. Under Alternative 7 in the Draft EIS, the preferred alternative, water balance reclamation covers include 8 inches of topsoil plus 24 inches of subsoil above a filter fabric and capillary break (Figure 2.11-3). The "agricultural" layer includes the topsoil and subsoil which is a depth of 32 inches. The revised water balance cover for Alternative 7 in the Final EIS specifies a minimum of 12 inches of suitable topsoil material over 24 inches of subsoil for a thickness of 36 inches.

148. COMMENT: The Draft EIS violates 40 CFR 1502.24 by failing to provide references for the proposed water balance reclamation cover. To comply with NEPA, an EIS "must ensure that environmental information is available to public officials and citizens" (40 CFR 1500.1(b)), discuss all significant missing information, and rigorously explore and objectively evaluate the water balance reclamation cover (40 CFR 1502.14). Such information must include "accurate scientific analysis." By failing to provide public officials with a basis for selecting a water balance reclamation cover over a water barrier approach, the Draft EIS violates NEPA. (340, 344)

RESPONSE: The reference section (Chapter 7.0) in the Final EIS includes sources of information on reclamation covers. These include: A Water Balance Study of Two Landfill Cover Designs for Semiarid Regions, Journal of Environmental Quality, Vol. 19, no. 2, April-June 1990 (Nyhan, et. al). The concept of using thick layers of cover soil to maximize evapotranspiration and decrease infiltration is a standard engineering concept. It has been used worldwide at landfills, hazardous waste sites, and for reclamation of mining waste.

The EIS rigorously explores and objectively evaluates the water balance reclamation cover as a reasonable alternative to a water barrier cover. The environmental impacts of a water balance reclamation cover are included in the environmental consequences (Chapter 4 of the EIS). This was presented to provide a clear choice among the options by the decision maker and the public.

149. COMMENT: The Draft EIS fails to identify the environmentally preferred alternative as required by 40 CFR 1505.2(b) of NEPA regulations. (343, 353)

RESPONSE: The rules and regulations require the agencies, in preparing the Record of Decision, to identify all alternatives that were considered specifying the alternative or alternatives which were considered to be environmentally preferable (40 CFR § 1505.2(b) and MCA 26.2.658(3)(d)). The environmentally preferred alternative is identified in the Record of Decision for an EIS not the Draft or Final EIS.

150. COMMENT: In expressing a preference for an alternative, the lead agencies should provide clear evidence that they understand that there are two decisions to be made, one to dispense deprivations and one to grant an entitlement. They can do this through clear expression of conditional preferences, e.g.: • If acid drainage controls are to be imposed, but the mine expansion is to be denied, then Alternative X is the preferred alternative; however, • If acid drainage controls are to be imposed, and the mine expansion is to be approved, then Alternative Y is the preferred alternative. (350, 364)

RESPONSE: All the action alternatives, Alternatives 2 through 7, address measures to control acid rock drainage. As stated in the Draft EIS, "The purpose of the modified reclamation plans and proposed mine expansions is to address two different types of needs. The first is the need to correct inadequacies in the existing reclamation plans. The second purpose is to consider ZMI's need to develop their mineral property rights. To consider these in a comprehensive fashion, the scope of the EIS includes alternatives that address both these needs" (page ES-1). The agencies identified one preferred alternative, Alternative 7.

151. COMMENT: In the Executive Summary, there is only the statement, "The agencies may approve the application as submitted, or they may approve a modified application and/or approve the application with stipulations." This is an incomplete description of the NEPA decision-making process because there is no mention of the null (No Action) alternative and its critically important function. It is recommended that applicable text be revised in the EIS volumes to describe the required consideration of the null alternative in the decision-making process. (350, 364)

RESPONSE: The Executive Summary also provides a description of the No Action alternative (continue permitted operations and reclamation) as required by MEPA and NEPA. The No Action alternative was given full consideration in the Draft EIS in terms of its description in Chapter 2.0 and the analysis of its environmental impact potential in Chapter 4.0.

With respect to the existing reclamation plans, it would have to be determined that these plans were adequate to prevent unnecessary or undue degradation; achieve successful reclamation; achieve comparable utility and stability; or to prevent other significant environmental impacts. Given the definition of "unnecessary or undue degradation," such a determination by the BLM is not likely, and in fact has already been made in decisions issued during April of 1993.

Regarding additional mining, the decision before the agencies is not whether ZMI is entitled to mine, but how the mining has to be conducted to meet Federal and State environmental laws. While the NEPA/MEPA process requires analysis of a No Action alternative, the State and Federal mine permitting regulations presume the legitimacy of the land use and are only concerned with how it might be conducted to meet the applicable standards.

152. COMMENT: The proposed pit reclamation plan does not comply with the Montana Constitution or State Law. The Montana Constitution requires reclamation of all disturbed lands. Article IX, Section 2 of the Montana Constitution ... Montana's Metal Mine Reclamation Act ... Section 82-4-336(7), MCA. ...the law requires that the Draft EIS examine the possibility of fully reclaiming the pits. It is your duty under law to fully disclose the geotechnical, social, and economic consequences of reclamation including full pit backfilling. The proposed reclamation plan also violates the Metal Mine Reclamation Act (MMRA), which requires that when the composition of the floor or walls of an open pit exceeding two acres are likely to cause formation of objectionable effluents, the reclamation plan must include provisions that adequately provide for insulation of all faces from moisture or water contact by covering to a depth of two feet or more with material not susceptible itself to generation of objectionable effluents. Mont. Code. Ann. § 82-4-336 (5)(a)(1995). (340, 344, 345, 347, 351, GF-1)

RESPONSE: While the Montana Constitution requires that all lands disturbed by the taking of natural resources shall be reclaimed, it leaves determination of reclamation standards to the legislature. The MMRA does not prescribe complete pit backfilling as the only valid reclamation approach. Section 82-4-336 MCA provides insulation of all faces capable of generation of objectionable effluents as an option in lieu of treatment.

Complete pit backfilling of both the Zortman and Landusky pits would require removal and transport of existing pads and waste rock dumps, as well as material generated by the proposed mine expansions. The EIS examines the possibility of complete pit backfilling in Section 2.2.5. While a considerable amount of partial backfilling of the pits is proposed under both the applicant's proposal (Alternative 4) and the agency mitigated alternatives, pit backfilling to near the pre-mining configuration is dismissed as unnecessary to meet the primary environmental performance objectives. Cost was considered a factor in eliminating an alternative or mine modification (such as complete pit backfilling) where the alternative or modification would result in an uneconomic mine project and equate to a non-mining alternative.

153. COMMENT: The Draft EIS fails to analyze the feasibility of complete reclamation of the open pit and instead assumes that the only feasible reclamation alternative for the pit is the bench approach, which would leave vast amounts of potentially acid-forming surface area exposed to precipitation. By ignoring the constitutional requirements in this manner, the Draft EIS not only violates NEPA but also adds to BLM's violation of FLPMA's prohibition against undue degradation. (344)

RESPONSE: Under Rules and Regulations Governing the Hard Rock Mining Reclamation Act, the term "reclamation" does not mean restoring the landscape to its pre-mining configuration (26.4.101B (19)). Furthermore, the MMRA does not require complete backfilling of pits if complete backfilling is not necessary to render the pit structurally competent to withstand geologic and climatic conditions in order to protect public safety and the environment and if complete pit backfilling is not feasible. The MMRA specifically requires measures to prevent water pollution. The EIS analyzes the feasibility of complete pit backfilling in Section 2.2.5. Mitigation for poor quality runoff generated by exposed pit highwall consists of partial backfill of the pits, pit floor and bench capping, runon control, and capture and treatment of direct precipitation contacting unoxidized highwall surfaces.

154. COMMENT: The mine pit reclamation falls far short of true reclamation: pit walls will be steep and may not remain covered with soil and vegetation, and the agencies' use this as justification for developing peregrine falcon habitat. This falls far short of Montana Constitutional requirements. (351)

RESPONSE: The pit reclamation plans incorporated in agency-mitigated alternatives meet requirements for mine and mine pit reclamation. The pit walls were not left steep to create peregrine falcon habitat. Peregrine habitat development was considered in the Draft EIS because the pit highwalls may present many features conducive to peregrine repopulation. All pit benches that are accessible would be covered with 24 inches of soil and NAG rock. Only inaccessible pit benches would be left uncovered because they are not feasible to reclaim (MCA 82-4-336(7)).

155. COMMENT: The Draft EIS does not include an explanation of the economics of this project, the methodology for determining whether or not an alternative is economical, or an analysis of why the rejected alternatives are uneconomical. (211, 320, 346, 347, 361, 362, LO-11)

RESPONSE: In Section 2.2.5, of the EIS, costs are discussed relative to the development of alternatives to be considered or eliminated from detailed analysis when the primary reason for their elimination is economics. Additional economic analysis of Alternatives 1 through 7 regarding potential profit, operating costs, capital investment, rate of return on investment, etc. is not appropriate for this EIS as it is not relevant to the choice among alternatives. The mining proposal is a private enterprise funded by private dollars. The permit decision will be based upon the requirement to prevent/correct *unnecessary or undue degradation* and to achieve successful reclamation; and not on how much profit the operator would make. If the operator feels that meeting these requirements would cost too much, then they always have the option of not proceeding with the project. Cost analysis is used only where an alternative was eliminated from detailed study as "unreasonable" based upon economics.

156. COMMENT: The EIS should present a cost benefit analysis comparing benefits incurred by society from Zortman-Landusky gold against the costs of its extraction to an Indian community and culture and to the environment. Regulatory costs should also be included in this discussion, as well as cleanup and long term reclamation costs that may be foisted upon the public. (320)

RESPONSE: The permit decision will be based upon the requirement to prevent/correct *unnecessary or undue degradation* and to achieve successful reclamation; and not on how much profit the operator would make. If the operator feels that meeting these requirements would cost too much, then they have the option of not proceeding with the expansion project. While the EIS does disclose potential socioeconomic, environmental and cultural impacts of mining, it would be extremely subjective to attempt quantifying the monetary benefits of gold mining versus the cultural and environmental costs. These are value judgements that individuals must make for themselves based on the information presented in the EIS. The lands involved in the existing/proposed mining are either private lands or public lands administered by the BLM and open to mineral entry. The weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary analysis and should not when there are important qualitative considerations (40 CFR § 1502.25). The analysis assumes that the reclamation plans under the various alternatives would be implemented as described. Financial assurances (reclamation bonds) are required to ensure that this occurs and the reclamation cost is not shifted to the public. Please see Section 1.5.2 of the EIS for an explanation of the regulatory authority and responsibilities. Agency regulatory costs are outside the scope of the EIS process.

157. COMMENT: In the Draft EIS on page 2-141, Section 2.8.2, first column; the statement is made that "Reclamation of individual facilities is contingent upon a number of economic and operational factors." What are the economic and operational factors mentioned? Costs associated with various reclamation features should be specifically identified. (346)

RESPONSE: This statement is referring only to the timeline under which final reclamation would occur. As leaching of ore continues, the content of precious metals in the leachate decreases. At some point, recovery of the precious metals from solution becomes uneconomic and reclamation proceeds. Factors which determine optimum leaching time include: gold price, grade of leachate, recovery plant efficiency, and reagent costs. The exact extent to which these factors would influence reclamation timing can not be determined at this time; however, the reclamation schedules presented in Table 2.8-6 and Table 2.8-12 of the Draft EIS would not be significantly altered.

158. COMMENT: The Final EIS should present a cost and feasibility analysis for the alternatives. The feasibility and costs of the reclamation and mitigation measures are an important factor in understanding the reasonableness and practicality of the proposed measures. This will enable a better comparison of alternatives, and enable a determination if any alternative is approaching the cost threshold for an uneconomic mine project. Financial costs, benefits, risks and trade-offs must be disclosed--both in the short term and long term per 40 CFR 1502.23. (273, 337, 346, 357)

RESPONSE: A cost and feasibility analysis is not relevant to the decisions that must be made by the agencies. The mining proposal is a private enterprise funded by private dollars. A project feasibility cost analysis is more appropriate where a public expenditure of funds is proposed. The permit decision will be based upon the requirement to prevent *unnecessary or undue degradation* and to achieve successful reclamation; and not on costs to the operator. If the operator feels that meeting these requirements would cost too much, then they always have the option of not proceeding with the project. Furthermore, different operators have varying levels of efficiency and use different assumptions to calculate project economics. There is nothing to restrict the transfer of mine permits from one operator to another (subject only to posting an adequate bond). A permit transfer could likely render any previous mine cost feasibility analysis invalid. Mine cost screening for reasonable alternatives is used in Chapter 2.0, under the section on alternatives considered and eliminated, when the overriding basis for elimination of the alternative is cost. For complete pit backfilling, a semi-quantitative cost analysis has been prepared regarding why it was not a reasonable alternative, and that it would essentially be the same as a non-mine expansion alternative. Neither state nor federal regulations at 40 CFR 1502.23 require a cost-benefit analysis, in fact the federal regulations recommend against it when there are important qualitative considerations which must be taken into account.

159. COMMENT: In the Draft EIS on page 2-76, Section 2.5.4.6, "What are potential costs of the different disposal methods?" (346)

RESPONSE: It is assumed the commentor is referring to pond sludge disposal. Potential costs depend on the exact character of the residual sludge. Sludge tested to date does not require any special handling and is suitable for onsite disposal. If special handling, treatment or even offsite disposal is required, then the unit cost increases.

160. COMMENT: In the Draft EIS on page 2-76 and 77, Section 2.5.4.6, "What measures may need to be implemented to improve soil to a condition suitable for revegetation? What are potential costs associated with such efforts?" (346)

RESPONSE: Measures that may be used to improve soil conditions would be directed at decreasing the Sodium Adsorption Ratio (SAR) which can increase as a result of land application. Agricultural soil amendments are available for this purpose. Potential costs would depend on the price of the amendment and the amount required to achieve the desired conditions. It should be noted that, in the history of using land application at mine sites in Montana, no impacts to soils and vegetation have been experienced that would require the use of these reclamation measures. They are not anticipated to be necessary at the Zortman and Landusky mines' land application areas, but are available as a contingency measure.

161. COMMENT: In the Draft EIS on page 2-125, Section 2.8.1.3, last paragraph, "What is the initial and annual operational cost of the conveyor system?" (346)

RESPONSE: The BLM and DEQ did not obtain that information as it is not relevant to the permitting requirements. Please direct this inquiry to ZMI.

162. COMMENT: "The rehandling of waste rock and pit backfill in Zortman and Landusky would increase this cost to a point where it could become economically unfeasible to pursue this project. There is some common sense involved here as well. If you are to backfill the pit areas with material, where will the mine be mining? The enhanced reclamation capping, as stated in Alternative 4, is a feasible and effective plan that would eliminate the need to rehandle material to this point. There has to be a balance between costs and effectiveness." (225)

RESPONSE: Material rehandling costs were one of the economic screens used to identify reasonable alternatives. In Section 2.11.1.1 of the Draft EIS it was not our intention to create a sequencing requirement for waste handling that would preclude pit operations. That text has been corrected. The preferred alternative does require some changes to the reclamation capping proposed by ZMI in Alternative 4. This is necessary to insure successful reclamation. We understand that costs are important to the operator; however, the permit decision will be made upon the requirement to prevent *unnecessary or undue degradation,* and to achieve successful reclamation with comparable stability and utility to adjacent undisturbed lands; and not on costs to the operator. If the operator feels that meeting these requirements would cost too much, then they have the option of not proceeding with the project.

163. COMMENT: The use of Pony Gulch ore at the Goslin Flats leach pad should be removed from the Draft EIS. Development of the Pony Gulch deposit is currently a "Reasonably Foreseeable Development" and is not proposed to be mined at this time. (342)

RESPONSE: The rules for implementing MEPA and the regulations for implementing NEPA require an analysis of cumulative impacts which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions (MCA 26.2.642 (7) and 40 CFR § 1508.7). Zortman Mining, Inc. presently considers the Pony Gulch area "which is believed to contain oxide ore reserves worthy of further evaluation" a reasonable foreseeable development (Application for Amendment to Operation Permit 00096, Zortman Mining, Inc., Vol. 1, page 2-94). The development of the estimated 2-million ton ore deposit in the Pony Gulch area was identified as a reasonably foreseeable future action under Alternatives 4, 6, and 7 since the proposed conveyor system passes near this deposit and it is likely it would be proposed for mining in the future.

164. COMMENT: An aerial photo of existing/ proposed mining should be provided in Section 2.8.1.1 on page 2-118 and Section 2.8.3.1 on page 2-159. The maps provided (Figures 2.8-3 and 2.8-17) do not clearly allow a reader to understand more precisely where boundaries for existing and proposed mining are located. (346)

RESPONSE: The figures referenced in the sections on Mine Pit Expansion (Figures 2.8-3 and 2.8-17) show the ultimate pit complex for the Zortman and Landusky mines and are used to help the reader with the discussion on expansion of the mines. The existing and proposed facility locations for Alternative 4 are shown on Figure 2.8-1 and referenced in the previous sections on "Zortman Mine: Company Proposed Expansion" and "Landusky Mine: Company Proposed Expansion." The existing and alternative facilities location for the Zortman and Landusky mines, along with the permit boundaries, are also shown on Exhibits 1 and 2 located in the map pocket of Volume 1 of the Draft EIS. The text in the EIS has been revised to reference the Exhibits along with Figure 2.8-1 to help the reader identify today's facilities and proposed development.

6.3 GEOLOGY

1. COMMENT: The statement on page 4-2 of the Draft EIS "The clays and limestones used in construction and reclamation are available in large quantities locally, and virtually limitless quantities regionally" appears to be in contrast to earlier statements that expansion is necessary to acquire such materials needed for reclamation. (346)

RESPONSE: The statement may be misleading, and has been modified for the Final EIS to eliminate any confusion. Mine expansion is not necessary to acquire materials needed for reclamation. Clays and limestones are available in large quantities locally, but clays are not available within the current or proposed permit boundary. The important point from this discussion is that in order to supply clay for construction and/or reclamation, an off site borrow source would have to be developed or expanded (such as the Seaford and Williams clay pits). Alternatives 3 and 7 have been revised to require the use of reclamation covers without clay; reclamation covers on surfaces with a slope less than 25 percent would use a geosynthetic clay liner. Therefore, the borrow sources would not be expanded for reclamation materials under Alternatives 3 and 7; some disturbance would occur at the Seaford clay pit for construction of the Goslin Flats leach pad under Alternative 7. Limestone is available at outcrops within both the Zortman and Landusky mines permit boundaries. Alternatives 3 and 7 have been revised to require quarries at the Montana Gulch and LS-2 sites as opposed to the use of King Creek and LS-1.

2. COMMENT: Discussions and data pertaining to the conveyor system should be included in Section 4.1. For each of the alternatives, potential quantities of ARD producing ore and rock should be provided. (346)

RESPONSE: There are no related geologic or topographic modifications resulting from installation of the ore conveyor other than the cut and fill construction to site the conveyor. There are, however, potential effects to vegetation, soils, and visual resources. The conveyor's impacts to these resources are discussed in the applicable sections.

Potential quantities of ARD producing ore and waste rock have been provided, in Tables 2.8-6 and 2.8-7 for the Zortman Mine, and Section 2.8.1.1 for the Landusky Mine. Section 2.9.1.1 now provides an estimate of how much waste rock generated during expansion of the mines would meet the agencies criteria as suitable, non-acid generating for use in reclamation covers.

3. COMMENT: It is stated on page 4-15 of the Draft EIS that it is assumed the volume of limestone estimated by ZMI for reclamation of the Goslin Flats leach pad would also be appropriate for Alternative #5. This factor should be verified. (346)

RESPONSE: The volume of NAG or limestone required for reclamation of the Upper Alder Gulch leach pad would be approximately 790,000 yd^3.

4. COMMENT: The statement is made in Section 4.1.7 of the Draft EIS that facilities would be constructed on bedrock. Has the bedrock been characterized geochemically to determine if the bedrock itself could be an ARD contributor? (346)

RESPONSE: The bedrock has not been characterized through quantitative geochemical testing. Visual examination in the area of Upper Alder Gulch suggests that bedrock could in fact have the potential for causing acid rock drainage after topsoil and unconsolidated materials are removed. A discussion has been added to the impact analysis in Section 4.1.7 concerning this potential hazard.

5. COMMENT: The geologic maps/figures presented in the EIS are so general as to preclude an evaluation of mining impacts. The scale is such that no specific geologic information can be discerned, particularly structure such as faults, joint patterns, strike and dip of formations, etc. A complete understanding of the structural geology of the area is necessary to analyze and predict groundwater flow and the distribution of acid generating waste rock. A better scale for Figure 3.1-1 would be as provided for Exhibits 1 and 2. In addition, Figure 3.1-2 should include the designation of Paleozoic and Mesozoic rocks. Tertiary syenite porphyry should be labeled Tsp on Figure 3.1-3. On the same figure, the Precambrian lithologies should be labeled PCu, and the Tertiary Breccia should be noted as part of the mineralized zones and active mining. (17)

RESPONSE: Except for scale and detail, the figures in Section 3.1 have been revised in accordance with the comments above. The figures in the EIS are simple, and not to a scale or level of detail that a geologist or scientist would wish to have available for analysis. However, both the scale and detail are appropriate for this document, which has been developed in large part as a disclosure report to the general public. It would be difficult and possibly impossible to present a detailed geologic map of the mining complex, with structures and lithologic relationships, to a scale easily presentable for public review. To provide some additional level of detail, a new figure has been added to Section 3.1 (Figure 3.1-4) showing major features of the geology pertinent to mine operations: faults, present mine workings, intrusive porphyries and dikes.

As discussed in Section 4.2, there is the potential for some anisotropic groundwater flow as a result of fractures and joints. Concerning impact analysis, it is not necessary to know the geologic distribution of acid generating waste rock. What is important is the post-mining distribution of such material. The EIS contains sufficient documentation of the types of rock which may generate acid conditions when mined and discarded. There are many references in Section 3.1 and 3.2 which could provide the knowledgeable reader with more detailed information about area geology.

6. COMMENT: Most of the geologic information in the EIS is very generalized. More details from the "extensive" database need to be included before an adequate evaluation of the EIS can be made. (17)

RESPONSE: As described in the response index number 6.3-5, the level of information provided in the EIS is appropriate to understand the effects of the alternatives. Nevertheless, much geologic information is included in Sections 3.1 and 3.2 of the EIS, and many references have been provided should the reader desire more detail.

7. COMMENT: The Draft EIS has drawn conclusions for the location of acid generating rock, waste rock facility and leach pad stability, and flow and infiltration of groundwater without an adequate understanding of the regional geology. (320)

RESPONSE: Sufficient information has been presented and evaluated on the regional geology for the agencies, and the public, to reach informed decisions concerning future operations of the Zortman and Landusky mines. Specific site information on foundation geology and leach pad stability is contained in Appendix 1 of ZMI's Permit Application.

8. COMMENT: Page 3-5, 6th line, notes the "Flathead sandstone." This formation should be shown on Figure 3.1-2. (17)

RESPONSE: The Flathead sandstone is the oldest of the Paleozoic sedimentary units. Figure 3.1-2 has been revised to note this.

9. COMMENT: Figure 3.1-1 does not show the Madison Group, contrary to the reference in Section 3.2.4. (17)

RESPONSE: The reference in Section 3.2.4 has been modified, since Figure 3.1-1 does not show the Madison Group. Figure 3.1-2 does show the relationship of the Madison limestones to other lithologies.

10. COMMENT: The proposed leach pad on the Goslin Flats appears to cover the outcrop of rocks to the east of the old Goslin Buildings in Section 21, T25N, R25E. This outcrop holds the Star crinoids, fossilized stems of a water lily. These are supposedly located in just a few locations of the world. Belemnites are also located here. (46)

RESPONSE: It is unclear as to the exact location being referred to in the comment, but it appears the Goslin Flats leach pad would be constructed south of the expressed area of concern. There are no outcrops to be covered by the leach pad which hold rare or unique fossils. The crinoids and belemnites discussed are found in many other outcrops all over the world.

11. COMMENT: The leach pad could fail for a number of reasons, including earthquakes, storms, etc. A result of this could be tremendous environmental impact downstream of the pad, similar to what happened in Guyana a few weeks ago as a result of cyanide spilling from mine facilities. (58)

RESPONSE: It is unlikely that the leach pad in Goslin Flats would fail in a catastrophic manner; meaning, it would not fall apart from earthquake or a storm event. Section 4.1.6 discusses reasons why the Goslin Flats is a relatively safe location to construct and operate such a facility. However, if a failure were to occur, the environmental effect would be much different from those resulting from recent cyanide spills or releases at mine sites in Idaho and South America. There is no perennial stream adjacent to the Goslin Flats to carry chemicals long distances. Because there is no perennial surface water there is no habitat for fish or other aquatic species of concern. A facility failure could cause impacts to local ground water, but the Goslin Flats should be amenable to corrective action and cleanup. It is worth noting again that the facilities at Goslin Flats would be designed to preclude failure, including leak detection systems, double liners, and impoundment capacity for the 100-year storm event. A stability analysis for the Goslin Flats leach pad is contained in Appendix 1 of ZMI's Permit Application. This analysis shows the leach pad would meet appropriate factors of safety for stability.

12. COMMENT: Limestones are virtually the best kind of rock for reclamation, due to their high neutralization potential. There are no questions about using limestone for reclamation and consequently no need for a sulfur guideline. (220)

RESPONSE: Limestones generally are excellent lithologies for reclamation. This is why the underdrains must be constructed of limestone (to help neutralize captured leachate). It is unlikely that limestones would have a sulfur content higher than 0.8 percent, or a Paste pH less than 6.0. However, limestone from mineralized areas within the pit complexes may not be suitable and limestone which failed one or both of these tests would not be acceptable for use in reclamation covers or construction. Hence, the stipulation remains in the agency-mitigated Alternatives 3 and 7.

13. COMMENT: The Draft EIS says that "no facilities that have already been constructed and loaded to capacity have failed." The Draft EIS also asserts that "studies were conducted to design existing facilities to standard engineering safety and stability factors." These statements may have been true at the time the Draft EIS was written, but they are no longer true. In July, 1995, the Carter Gulch Waste dump partially collapsed. The Carter Gulch failure raises two possibilities: One, ZMI has not consistently built waste rock facilities according to standard engineering practices; and two, these standard engineering practices are inappropriate for construction of rock repositories in the Little Rocky Mountains. In either case, the Draft EIS has not provided a "full and fair" discussion of geologic hazards present at the mine, nor has it discussed even the most obvious environmental impacts of a waste rock dump collapse. The Draft EIS merely states that proposed construction under alternative 7 "would be designed to accept standards of engineering safety" (Draft EIS at 4-22), and that the new waste rock facility was "projected to meet the appropriate safety factors." Draft EIS at 4-23. In light of the Carter Gulch failure, neither of these statements can be assumed true. Slope stability and impacts from possible future blowouts must be addressed in the final EIS.

The possibility of other waste rock failures significantly and substantially impacts continued operation of the current mine facility, the planned reclamation efforts, and the proposed expansion. The public official who will be deciding whether to approve the proposed expansion and all affected citizens must be fully informed of the Carter Gulch Waste Dump failure and its impacts. This cannot be accomplished in the context of comments received on this Draft EIS. To comply with NEPA, a second round of scoping must take place, followed by the preparation of a second Draft EIS that contains a full discussion of the waste dump failure, re-analysis of the current construction techniques, and examination of the probability of future failures. The public would, of course, be provided with a second opportunity to submit comments. (340, 344)

RESPONSE: As reported by ZMI staff and inspected by DEQ and BLM officials, on July 13, 1995 at the mines a large rainfall deposited about 1.5 inches within about 1.5 hours. A storm water channel upgradient of the facility was blocked by a fallen tree, causing storm water to break out of the channel and form a gully down the slope. The excess storm water increased infiltration along the margins of the facility, as evidenced by substantially greater seepage at the facility toe for several days following the storm. Capture sumps below the dump were destroyed. Temporary capture sumps were constructed shortly thereafter, and more recently extensive re-engineering of the storm water capture, control and treatment systems at this facility have taken place. New storm water management structures have been designed to pass a 100-year storm event.

There was no geotechnical failure at the Carter Gulch waste rock dump or incipient instability. However, there was inadequate surface water control, as evidenced by the increased seepage and dump surface gullying. The erosion at the facility did result in sediments and gravels being carried down the drainage; increase gravel deposition was noted at the Carter Spur/Carter Gulch confluence.

The event described above demonstrates that some of the waste rock dumps at the Zortman and Landusky mines have been constructed to less-than-adequate design criteria in regard to slope steepness, slope length, and runoff volumes. However, this is not the same design criteria used in construction of leach pads. In particular, the water control and management systems at the mines need to be upgraded to handle large storm events. This re-engineering will take place independent of mine expansion. The Carter Gulch event does not have any bearing on inherent stability of the facilities, particularly with regard to earth shaking events.

The erosion from the Carter Gulch waste rock dump during the storm in July does not alter any of the conclusions presented in the Draft EIS. In fact, it substantiates agency concerns about water management.

If the reader desires additional information on this subject, the following references should be reviewed:

Department of Environmental Quality, 1995. Field Inspection Report of the Zortman and Landusky Mines, Operating Permits 00095 and 00096, conducted on August 22 and 23, 1995. September 29.

Smith, Steve. 1995. Memorandum from S. Smith, Zortman Mining, Inc., to Ken Wallace of Woodward-Clyde. 1 page. December 4.

14. COMMENT: The results of the geotechnical studies should be included in the EIS. (17)

RESPONSE: The results of the geotechnical studies have not been included, but a reference has been added to guide the reader to the appropriate publication if more information is desired.

15. COMMENT: "We own mineral rights in sections 21, 28, and 33 that potentially may be directly impacted by any future development of the proposed Goslin Flats Heap Leach Pad. We are further opposed to any other mining and attendant activities that might jeopardize our mineral rights interest in the above referenced sections." The Goslin Flats leach pad would jeopardize substantial gold and possibly other mineral values in two ways. First, the cyanide from the leach operation could leach out gold naturally present in the materials at the Goslin Flats. Second, the heap leach pad, once loaded, would make it impossible to ever access these economically viable minerals. (138)

RESPONSE: The potential for the Goslin Flats leach pad to cover or displace placer deposits was evaluated by Onstream Resource Managers, Inc. (1993). The highest concentrations of gold assays done for samples from Goslin Flats are well below the lowest grade for gold placer deposit which is being commercially mined today. The samples with the highest grades are from an area which would not be affected by the Goslin Flats leach pad and supporting facilities. There would be no significant impact to mineral resources of any value by construction and operation of a heap leach pad in the Goslin Flats. Please refer to Section 4.1.6 in the EIS for more discussion on this topic. Also, approval of ZMI's expansion proposal does not convey any mineral property rights.

16. COMMENT: In Table 2.3-1, the anticipated gold production of 960,000 ounces Au is incorrect. The figure was revised to reflect the higher break-even cut-off grade due to the increased costs of waste handling. The figure should be 146,000 ounces less than Alternatives 4, 5, and 7 (or 814,000 ounces Au) for Alternative 6. Please reference the May 26, 1995 correspondence from ZMI to Planning Information Corporation. (342)

RESPONSE: Under Alternative 6 the waste repository constructed on Ruby Flats would increase handling costs, particularly for waste transport. The lower grade ore (about 146,000) would not be mined because of these increased costs. Table 2.3-1 has been revised.

17. COMMENT: Please explain how the figures in Table 2.3-1 for gold production were arrived at. There would be residual gold production under Alternatives 1 through 3 from currently permitted operations of approximately 95,000 from 1996 on. ZMI disagrees with the anticipated cumulative gold production for Alternatives 1 through 3. If a permit is denied, it is unlikely any additional gold production would occur in the Little Rocky Mountains in the reasonably foreseeable future. (342)

RESPONSE: Anticipated cumulative gold production refers to the total gold produced by ZMI at the two mines: past production, present operations, and reasonably foreseeable production. Because it is unlikely there would be additional gold production in this area under Alternatives 1, 2 or 3, the figure of 1.4 million Troy ounces is the sum of past operations and anticipated production under current permit conditions.

6.4 GEOCHEMISTRY

1. COMMENT: The Draft EIS notes on page 3-20 that the Pony Gulch deposit was not acid generating under the conditions of the short-term kinetic testing. It does not appear that the kinetic testing done provides a basis for less conservative treatment of the Pony Gulch ore, should that deposit be developed. It would be beneficial for the Draft EIS to describe the additional testing necessary to make such a determination. (347)

RESPONSE: Less conservative treatment of Pony Gulch ore is not being considered. The preferred alternative does not treat Pony Gulch ore any differently than acid producing ore. All ore would be loaded on a lined pad, leached, rinsed, and capped with the preferred reclamation cover.

2. COMMENT: The Draft EIS states that "Lower sulfate and higher pH results indicated that the use of a low-sulfur waste as a cover would be preferred rather than the limestone. Results for the low sulfur waste cover with a limestone underdrain were most favorable" (page 3-27). The referenced figures (3.2-2a and 3.2-2b) appear inconsistent with this statement, showing the "neutral cap/ls base" series cell achieving a final pH of about 3.2, and the "ls base/ls cap" maintaining the highest pH and lowest cumulative sulfate production of the four serial cells. This needs to be clarified, as the data have obvious significance to waste rock management and reclamation cover design. (347)

RESPONSE: The legend for Figures 3.2-2a and 3.2-2b was drafted incorrectly. The errors have been corrected and the data indicate that the neutral waste cover/limestone underdrain scenario is more favorable than the other scenarios tested.

3. COMMENT: The NNP values for limestone sources are listed without citation or description of their origins. The source for these estimates should be provided. (347)

RESPONSE: The sources for the limestone are ZMI's proposed limestone borrow pits shown on Exhibits 1 and 2.

4. COMMENT: Static tests are performed using different protocols producing some variation in results. The Draft EIS should fully describe the methods used, particularly since the proposed action involves allowing the use of marginally acid-generating materials with low to very low positive NNP values in reclamation covers. (347)

RESPONSE: The method to evaluate acid producing potential was multiplying 31.25 times percent total sulfur. This was considered to be the most conservative method since it assumes all sulfur is pyritic sulfur. The neutralizing potential (NP) was estimated using an experimental protocol which evaluates only the carbonate fraction of the NP. The Sobek and modified Sobek methods were not considered to be conservative in this case as these methods consign NP from oxides, silicates, feldspar, etc to the total NP. The investigation instead used a method which incorporates dissolution of an aliquot of sample in a strong acid and measures the evolution of carbon dioxide gas with a liquid manometer. This method only measures the NP which is contributed from the carbonate fraction of the rock. Therefore, this method was considered to be more conservative and therefore more appropriate. A copy of the protocol is available at the Department of Environmental Quality - Hard Rock Bureau, Helena, MT or in Miller (1995) which is referenced in the EIS.

5. COMMENT: The proposed classification of syenite waste rock as suitable for certain reclamation purposes does not reflect an appropriately conservative approach to AMD prevention. (347)

RESPONSE: The classification criteria, both parameters and cutoffs, were developed after extensive (over 2000 samples) rock classification, paste pH analyses, and static analysis. When a portion of the data indicated that acid formation was possible, especially for the igneous rock types, over 30 humidity cells were conducted to substantiate or refute the static data. Based on results from the kinetic testing, the classification criteria were defined. Although the results were definitive, the interpretation is entirely subjective. Therefore, the use of igneous rock types has been further restricted in any construction, fill, or underdrains.

6. COMMENT: The average NNP for syenite samples meeting the proposed criteria is only 2.7 T/kT (3-26), well within the range of uncertainty described for ARD potential. It is questionable whether the sampling program proposed will effectively distinguish waste rock with low positive NNP from waste rock with low negative NNP. (347)

RESPONSE: Kinetic testing was used when sample results fell within the +20 to -20 NNP "area of uncertainty." Also, this area of uncertainty is meaningless when very large NP and AP values are encountered. This is not the case for the Landusky and Zortman deposits but the illustration serves to illuminate the fact that these "draft guidelines" are not entirely appropriate for all deposits in every climate. The NP/AP ratio of > 3 is simply an imposed safety factor and is not substantiated in the literature (see Ferguson 1994) as being valid and defensible. For this analysis extensive kinetic testing was completed and the results indicate that the NNP ≥ 0 cutoff is appropriate. The BC Acid Mine Drainage Task Force criteria of NP/AP > 3 and NNP > +20 are guidelines. These are to be used when other data, i.e. kinetic data, are not available or there is insufficient funding to acquire kinetic data. In this instance neither is the case. Kinetic testing substantiates that the cutoffs used in the Draft EIS are adequate and defensible. ZMI was required to conduct an additional set of kinetic testing at very low total sulfur levels for the major rock types. These results indicate that the parameters and related cutoff values chosen are appropriate.

7. COMMENT: The Draft EIS indicates that water quality may be affected where material meeting the proposed criteria is contacted by surface water (3-42). Even if employed only where water contact is in theory minimized, performance shortcomings in reclamation covers may allow unintended exposure to infiltration. Unexpected acidification of syenite waste used in reclamation covers could cause new water quality degradation and require expensive reclamation corrections at a later date. (347)

RESPONSE: The amount of infiltration that will report to the capillary break material will be limited by the reclamation cover. If infiltration is not acidified by the capillary break it will probably be acidified by the underlying waste material. Anticipating this, it is required that each facility have a capture system installed below the toe so that impacted infiltration can be captured and treated. The metals levels from leachates out of the syenite porphyry humidity cells were not considered to be high enough to affect revegetation success. The soil in the area carry some buffering capacity, as the soil in the area contain significant carbonate. In fact there are reclaimed leach pads at Zortman which show very good reclamation success with only 1' of soil placed over rinsed ore. Based on this information the risk involved with using very low total sulfur syenite waste as a capillary break in the reclamation covers is acceptable.

8. COMMENT: A more conservative approach would be to disqualify all syenite waste rock as reclamation material, since it is at best marginally suitable for constructing nonreactive reclamation covers. (347)

RESPONSE: The BLM and DEQ did not wish to exclude all syenite as it is the dominant waste rock lithology and to replace the available volume of syenite with other reclamation material could result in additional disturbances in previously undisturbed areas. However, the use of syenite is confined to reclamation covers and not as riprap in runoff channels or underdrains, so that potential contact with water is limited. Syenite waste rock must also meet the other geochemical restrictions if used in reclamation.

9. COMMENT: In the Draft EIS pages 2-57 and 2-59, Waste Rock Characterization, what percent and volume of the waste rock is blue, yellow, and green? Since the percent sulfur of yellow waste is uncertain, how will yellow waste be monitored? The text indicates "unoxidized or partially oxidized porphyries" for yellow waste; partially oxidized felsic porphyries...for green waste; and felsic porphyries for blue waste. For consistency, the blue waste felsic porphyries should be identified as oxidized or unoxidized. (346)

RESPONSE: It is not known what percent and volume of the waste rock mined to date is blue, yellow, or green, since until fairly recently ZMI did not characterize waste according to acid generating potential. The percent sulfur of yellow waste is not uncertain; yellow waste would contain 0.2 to 0.5% sulfur. What is uncertain for this category of waste is whether or not it will generate acid. The editorial corrections have been made to the Final EIS.

10. COMMENT: In the Draft EIS on page 2-59, is the crushed waste rock used for road bed surfacing or other purposes of the same mineralization capable of producing ARD? (346)

RESPONSE: Because waste rock was not, until recently, assessed for acid generating potential it is unknown if some road surfaces have been paved with material capable of generating ARD. Under all agency-mitigated alternatives road surfaces would have to be tested to determine ARD-generating potential, and capped with the appropriate reclamation cover.

11. COMMENT: In the Draft EIS on page 2-59, it is stated that the pad foundation was stripped of all soil and weathered rock, including removal of vegetation and compressible soil and rock. Were any static or kinetic tests conducted on the remaining bedrock that was exposed during excavation? What were the results of any such testing, and what are the implications? (346)

RESPONSE: Static geochemical tests were not conducted on leach pad foundations. Leach pad foundations only had to meet accepted engineering competency requirements for the projected leach pad loads.

12. COMMENT: The history of AMD development at the ZMI facilities and the uncertainties in water budget estimates for the mine site suggest that great care should be taken in the use of waste rock for reclamation covers. The Draft EIS should evaluate other potential sources for the moderate volume of potential reclamation materials involved. (347)

RESPONSE: The EIS does evaluate other potential sources for reclamation materials. Borrow areas with additional gravels and subsoil have been identified. Testing indicates that most of the tailings in Ruby Gulch could be used as reclamation materials. Additional areas for mining of limestone or amphibolite have been identified as well. The preferred alternative would include the mining of additional suitable reclamation materials which are not waste rock associated with ore. There is an inherent risk associated with using the igneous rock types for reclamation purposes at these mine sites.

There is risk involved with using <u>any</u> parameter or cutoff to restrict or facilitate waste segregation. These risks are decreased when more than one parameter/cutoff is required to be met. The BLM and DEQ would impose rock type, total sulfur, paste pH, and NNP as parameters to be used in conjunction to reduce the risk that one or another parameter would not adequately define suitable waste. Furthermore, the sampling frequency that was proposed by ZMI was based on an analysis of variance, i.e. every blasthole versus every third blasthole. The results indicated that the data did not show a significant variance when samples were taken of every third blasthole. Even so, the agencies would require that every blasthole be sampled when mining would occur in potentially suitable waste rock.

13. COMMENT: Use of syenite porphyry with a total sulfur content less than or equal to 0.2% total sulfur and a paste of pH of 6.5 or greater will sufficiently characterize the material as non-acid generating. Review of static and kinetic test data performed by ZMI and provided to the agencies indicate syenite porphyry typically has an NNP of 5 to -5, with the average value being slightly positive, 0 to 2. Due to the low amount of total sulfur in this category, it is unlikely to produce acidic conditions within the waste rock regardless of the NNP. It is not clear why the agencies have placed additional restrictions on syenite porphyry meeting the no more than 0.2% total sulfur and paste pH of equal to or greater than 6.5 criteria. (342)

RESPONSE: Data are available which indicate the possibility of acid formation or dissolution even with the $\leq$ 0.2 % total sulfur and > 6.5 paste pH restrictions (Chemac Environmental Services, 1995). Therefore the NNP restriction was imposed. At least three replicate humidity cells show that unless the sample contains neutralizing potential sufficient to offset the acid producing potential, acid could be generated or dissolved. That is sufficient evidence to warrant the use of the NNP $\geq$ 0 requirement.

14. COMMENT: Item #2 in Section 2.10.2 of the Draft EIS indicates "total sulfur content less than 0.8%." An explanation should be provided as to why such rocks would be allowed to exceed the 0.5% rating as indicated previously (page 2-59). (346)

RESPONSE: The criteria for non-acid generating material are based on statistical analysis of laboratory and kinetic tests for various lithologies. This information is presented in Section 3.2.2. This information indicates that, for these lithologies (amphibolite, mafic gneiss, shale, dolomite, or limestone), an appropriate sulfur content cutoff for non-acid generating (NAG) classification is less than 0.8%.

15. COMMENT: The requirement that all blastholes meet the "Non-Acid Generating" criteria does not allow operational flexibility. If the agencies require a more restrictive interpretation of non-acid generating waste rock sufficient flexibility should be allowed to accept a minimum of 90% of samples from a material block meeting the non-acid generating criteria. ZMI could still sample every blasthole, but could consider the material to be non-acid generating if out of 10 blastholes sampled, the block contained no more than 1 blasthole not meeting the non-acid generating criteria. If that is not acceptable, then 1 of every 3 blastholes should adequately characterize NAG material blocks. (342)

RESPONSE: The blasthole sampling plan does need more flexibility. The criteria have been adjusted to provide for identification of material in 25' x 25' minable blocks. However, all blast holes within this block would still have to meet the criteria.

16. COMMENT: Section 2.5.1.5 of the Draft EIS states that every third blasthole is checked for total sulfur. The results of this effort should be summarized and a notation on availability of this data should be provided. (346)

RESPONSE: This information is available, and summarized in Section 3.2.2. Please see Tables 3.2-4 through 3.2-7.

17. COMMENT: Please clarify which uses for construction the Thermopolis shale in Goslin Flats might be restricted. It may be possible to use the shale as a compacted clay layer for the leach pad and process ponds and should be considered if it can demonstrate a 10^{-7} cm/sec permeability requirement. (342, 346)

RESPONSE: Geochemically the Thermopolis shale is considered suitable as a leach pad or pond liner material as it has been determined that, although it contains sulfide in sufficient quantity to form acid, the shale is considered to have such low permeability that it would not transmit significant amounts of water. Geotechnical specifications would be the same as for the Seaford clay. The Thermopolis shale would not be suitable for use in any part of the reclamation covers due to the increased permeability that the layer could acquire with each year's freeze-thaw action. It should also not be used for underdrain material due to its inherently high sulfur content.

18. COMMENT: The restrictions on syenite porphyry are excessive. It would be extremely burdensome to perform total sulfur, paste pH and NNP tests for all blastholes during operations as it would likely delay mine production. Additionally, if the material is to be used as a capillary break only, it is unlikely to have significant movement of water through it as the soil cap will have high water retention characteristics. Testing by ZMI indicates syenite porphyry with less than 0.2% total sulfur is non-acid generating. Use of NNP as a primary indicator of acid generation potential can be misleading, particularly in the zone of -20 to +20. (342)

RESPONSE: The restrictions on syenite segregation are not excessive. This lithology is most suspect with regard to acid generation due to its inherent low neutralizing capacity. There exists however a small subpopulation of syenite which does have some NP which makes it acceptable as reclamation material. The use of this material only as a reclamation cover has been considered because of this inherent characteristic. Testing of every blasthole is not required; the mine geologist must make that determination. When mining will occur in material the mine geologist believes potentially suitable for reclamation use, then every blasthole will be sampled and tested. If the material is not going to be used in reclamation covers, the increased testing frequency is not necessary.

19. COMMENT: Limestones, dolomites, and other carbonate rocks are the best reclamation materials available, and have high neutralization potential; therefore, the sulfur cut-off needs to be flexible to allow for natural variability that does not affect the overall suitability for these materials. (342)

RESPONSE: Total sulfur restriction will be reconsidered for these carbonate rock types. If during the process of mining ZMI can show that the 0.8% cutoff is restricting the salvage of otherwise suitable reclamation material, this parameter and its associated cutoff criteria will be reevaluated.

20. COMMENT: Geologic and sulfur content data from ZMI indicate that 0.2 percent total sulfur is an effective indicator of acid producing potential, and the paste pH of 6.5 or greater would provide a safety factor. The proposed NNP requirements are expensive, cumbersome, and not clearly necessary. In addition, facilities constructed with these materials will be capped with either barrier or water balance covers, and seepage capture systems will be located down gradient. Also, there must be some flexibility built into the program to account for natural variability. Commentor suggests that if syenite, must have a total sulfur content less than or equal to 0.2 percent, and a paste pH of 6.5 or greater. A minimum of 90 percent of blast hole results for a material block must meet this criteria for the block to be accepted. (342)

RESPONSE: The restrictions on syenite segregation are not excessive. This lithology is most suspect with regard to acid generation when compared to other rock types due to its inherent low neutralizing capacity. The BLM and DEQ consider the use of this material only as a reclamation cover because of this inherent characteristic.

21. COMMENT: The sampling frequency proposed in the Draft EIS is not adequate to precisely delineate spatial changes in geochemistry, and will not ensure the exclusion of acid-generating material from rock classified as NAG under the proposed method. Any rock classification performed under the proposed testing regimen therefore will not be capable of treating all soil with the potential to generate ARD. (367)

RESPONSE: It is unclear what the commentor means with regard to "treating all soil." Nowhere in the proposed plan or any alternative would the soil be treated. Neither would the waste rock be treated, i.e., blended, unless the company proposes to do so at sometime in the future. The interpretation for effectiveness of the proposed sampling frequency, i.e., every third blasthole, included an analysis of variance regarding the sampling frequency, i.e. every blasthole versus every third blasthole. The results indicated that the data did not show a significant variance when samples were taken of every third blasthole when compared to every blasthole. Nevertheless, testing every blasthole is required to identify suitable rock for use in reclamation. A more controlled sampling frequency, i.e. more than every blasthole, can possibly be achieved by decreasing the distance between blastholes. However, this does not seem prudent because the machinery used to mine cannot distinguish a smaller block.

22. COMMENT: The Draft EIS failure to cite <u>any</u> sources relied on for its choice of methodology for detecting ARD potential. This violates NEPA. The Draft EIS fails to cite sources relied upon for the waste rock analysis methodology. 40 C.F.R. 1502.24. This failure throws the proposed methodology into question. (367, 340)

RESPONSE: The professional/scientific integrity of the discussions and analysis has been ensured by submitting the discussion and interpretation to peer review. The Draft EIS does cite the methodology used for estimating or predicting ARD potential, Saskatchewan Environment and Public Safety (1992) page 3-19 of the Draft EIS. The Saskatchewan Environment's <u>Mine Rock Guidelines</u> (1992) were used. The Draft British Columbia Acid Mine Drainage guidelines have never been finalized so it is inappropriate to continue using draft guidelines as a final document. A member of the AMD task force has advised the use of the Saskatchewan guidelines because they are final (Andy Robertson personal communication). The methodology includes a suite of analyses to be used in conjunction: petrographic analysis, static testing, kinetic testing, bottle-roll tests, field-scale leachate extraction test plots, etc. All of these methods were used. Neither guidelines prescribe exactly what methodology must be used but rather suggest various tests which might contribute to the interpretation when used as a suite. The source for interpretation of results is Miller (1995).

23. COMMENT: The guidelines at page 3-27 of the Draft EIS were derived from a series of kinetic tests performed on waste rock and ore from Zortman. Of particular note is the fact that the guidelines proposed in the Draft EIS are less conservative than the guidelines for determining potential acid generating rock published in most of the technical literature (Draft EIS 3.2.2.4, p. 3-17). This is of concern for two reasons. First, the guidelines are based on a limited number of kinetic tests. If these tests are not truly representative of the characteristics of the waste rock in particular, the resulting contamination problems could be unmanageable. Second, these guidelines are being applied to both Zortman and Landusky. However, "only limited test was conducted on the Landusky materials" (Draft EIS Section 3.2.2.6). A "geologic comparison method" was used to validate the Landusky guideline applicability. Again, in an area with such a significant AMD problem, this is somewhat risky. A series of kinetic tests with Landusky rock would have been justified. (362)

RESPONSE: The Landusky sampling/analysis included over 1000 static and paste pH samples with a limited number of kinetic cells (5) when compared to the number done for Zortman (over 30). The very low sulfur, 0.20-0.24%, Landusky syenite was tested in three replicate cells and found to produce acidic conditions in the humidity cell. This replicate sample had an NNP = -4.8 and a paste pH of 7.7. This was considered to be justification for imposing the NNP $\geq$ 0 requirement. For all other kinetic samples which had NNP $\geq$ 0, an acidic environment did not develop during the extended period of leaching, close to 600 days total. The BLM and DEQ consider these results and the interpretation to be adequate and defensible. The general guidelines cited are for use when only static data are available which is not the case in this situation.

24. COMMENT: In an area that has the AMD potential demonstrated at Zortman-Landusky, use of the published AMD guidelines would be more prudent, unless there is some other overriding consideration which was not discussed in the Draft EIS. (362)

RESPONSE: The document referred to is the British Columbia Acid Mine Drainage Task Force Guide (1989). This document may have been published for review; however, it has not been finalized. Therefore, the Saskatchewan Environmental Mine Rock Guidelines (1992) have been applied. The general guidelines cited are for use when only static data is available which is not the case in this situation.

25. COMMENT: The static test results, which ultimately form the basis for segregating acid producing from non acid producing rock, were not listed in the Draft EIS. It is very important for any reviewer to see these results, at least in table form. (362)

RESPONSE: The entire data set consisted of over two thousand samples tested for rock-type, paste pH, NP, AP, NNP, and total sulfur; also included in the data are sample location, drill-hole number, and grade (i.e., waste or ore). The results are included in Miller (1995). In addition, summary tables containing the static test results by lithology for ore waste rock are included in Section 3.2. Publication of the entire data set was restricted by the volume of material which would have had to be included which would be restrictive when considering the publication and distribution costs. Finally, NEPA requires that data should be incorporated by reference (40 CFR 1502.21) and that the length of document should be restricted (40 CFR 1500.4).

26. COMMENT: What type of static test was employed? (362)

RESPONSE: Acid-base account. The method to evaluate acid producing potential was multiplying 31.25 times percent total sulfur. This was considered to be the most conservative method. The neutralizing potential (NP) was estimated using an experimental protocol which evaluates only the carbonate fraction of the NP. The Sobek and modified Sobek methods were not considered to be conservative in this case as these methods consign NP from oxides, silicates, feldspar, etc to the total NP. The investigation instead used a method which incorporates dissolution of an aliquot of sample in a strong acid and measures the evolution of carbon dioxide gas with a liquid manometer. This method only measures the NP which is contributed from the carbonate fraction of the rock. Therefore, this method was considered to be more conservative and therefore more appropriate. A copy of the protocol is available at the Department of Environmental Quality - Hard Rock Bureau, Helena, MT or in Miller (1995) which is referenced in the Draft EIS.

27. COMMENT: Over what core-interval were the test samples taken? (362)

RESPONSE: Recovery was variable but a 5' interval was normally achieved.

28. COMMENT: What sort of averaging was used in deriving rock-type sample data? (362)

RESPONSE: Arithmetic averaging and geometric averaging.

29. COMMENT: What was the geographic spacing (location) of the samples? (362)

RESPONSE: 100x100' grid.

30. COMMENT: Does the data analysis take into account the fact that "hot spots" can develop in waste rock piles that can then cause or accelerate acid production in neighboring rock? (362)

RESPONSE: Yes, hence the need for a reclamation cover which to some extent restricts advection of oxygen and precipitation infiltration.

31. COMMENT: In assessing the results from some of the kinetic testing of potential layered disposal sites, the text states that "Results for the low sulfur waste cover with a limestone underdrain were most favorable." (Draft EIS 3.2.2.6, p. 3-27). However, the data in the two figures cited, Figures 3.2-2a and 3.2-2b, indicate that the test data from the limestone cap - limestone base is most favorable in terms of acid producing potential. The Draft EIS would appear to be incorrect in its interpretation of these results from the test data presented in Figures 3.2-2a and 3.2-2b? (362)

RESPONSE: The legend for Figures 3.2-2a and 3.2-2b was drafted incorrectly. The errors have been corrected and the data indicate that the neutral waste cover/limestone underdrain scenario is favorable to the other scenarios tested. The unfavorable results associated with the limestone cap might be related to the condition which develops when ferrous iron is in solution the pH increases. When the solution develops a higher pH the oxidation rate increases (Singer and Stumm, 1970)

32. COMMENT: I'd also like to know what acid rock drainage is. (3)

RESPONSE: Please see Section 3.2.2 of the Draft EIS.

33. COMMENT: Waste handling, placement and reclamation contouring as well as existing leach pad rehandling should be as proposed under Alternative #4. The enhanced reclamation cap, short term water treatment and water capture ponds will ensure that water resources will be protected from these materials whether the materials are placed in pit or a waste repository. (232)

RESPONSE: The reclamation cover has been developed to reduce long-term infiltration and also to help protect vegetation from the effects of underlying material. It is not clear from the statement which aspects of the cap are disputed.

34. COMMENT: Within the confines of the active pits it is recommended that the current total sulfur classification remains intact according to current mining practice. The one exception requested is where weighted total sulfur averages from blast hole assays show that a few extraneous waste holes surrounded by a majority of "non-acid generating" holes can have a total net volume of waste required to encapsulate the "acid-generating" waste. (232)

RESPONSE: The proposed total sulfur criteria used by itself does not adequately provide for identification of material that is considered to represent a low risk of acid formation. Additional criteria have, therefore, been developed.

35. COMMENT: Outside the active pit perimeters, and particularly in the vicinity of unmineralized Paleozoic rocks, it is recommended that the total sulfur content classification be superseded with assay documentation using net neutralization potential as the governing criteria for reclamation purposes. This approach allows suitable materials within immediate proximity to operations to be utilized without undue burdens or cost constraints being imposed while trying to meet our reclamation obligations. (232)

RESPONSE: The criteria are not applicable to mining that occurs outside of the locally mineralized (pit) areas. The text of the Draft EIS has been edited to reflect this. For in pit use, the total sulfur restriction will be reconsidered for these carbonate rock types. If during the process of mining, ZMI can show that the 0.8% total sulfur cutoff is restricting the salvage of otherwise suitable reclamation material, this parameter and its associated cutoff criteria will be reevaluated as a minor revision.

36. COMMENT: The impact upon the Fort Belknap Reservation from limestone mining has not been analyzed. (343)

RESPONSE: Potential impacts resulting from limestone mining have been evaluated. Please see, for instance, Section 4.2.6 which describes the potential for increased sediment loads in drainages, primarily resulting from the construction/widening of haul and access roads to the quarries. The preferred alternative has bee changed in the Final EIS. The limestone quarry sites have been located in Montana Gulch and the LS-2 site near Zortman. This removes any potential impacts associated with limestone mining out of watersheds that involve lands on the Fort Belknap Indian Reservation.

37. COMMENT: In the Draft EIS on page 2-54, is the "sulfide stockpile" still ARD active or capable of producing ARD? Has any recent testing been done to determine success of amendment with 20,000 pounds of lime? (346)

RESPONSE: The sulfide stockpile still presents a risk to water quality. Therefore, this material would be excavated and used as pit backfill or leached or placed in the core of the waste rock repository under Alternatives 3-7. No testing has been done to determine the success of amendment with lime; however, visually this was not successful and surface reclamation has failed.

6.5 WATER RESOURCES

1. COMMENT: The box inset on page 1-10 states that low levels of cyanide have been detected in groundwater at the mine sites. A map of where cyanide has been detected should be presented in the EIS. The accompanying data should identify to what extent surface and/or groundwaters were affected. (346)

RESPONSE: The wells that have had cyanide detections are identified and discussed in the text and summarized in the tables in Section 3.2.5.2. Maps illustrating the location of these monitoring stations are shown in Exhibits 1 and 2.

2. COMMENT: Page 2-42 of the Draft EIS states that two wells are presently in use at the Zortman Mine. When were these wells installed, and at what depth? The EIS needs to address what effect these wells have on groundwater, seeps, and springs. (346)

RESPONSE: RG-101 is located within the headwaters of Ruby Gulch within the valley northeast of the water treatment plant and upstream of the Ruby Gulch capture system. It was completed in March of 1982 at a depth of 330 feet. RG-101 is no longer monitored. ZL-163 is located within the headwaters of Ruby Gulch next to the water treatment plant. It was completed in March of 1994 at 443 feet. Water quality is currently monitored quarterly.

No drawdown data from adjacent wells is available. Water extraction from the wells would have some localized impacts on water levels, although no data is available from which to assess whether there has been any discernible impact to springs or seeps. Also please see Section 4.2.6 of the EIS.

3. COMMENT: Estimates of the percent of seepage, drainage, and runoff collected and treated should be provided. Is it the intent to develop systems that collect and treat all such waters? Also, what is the total character and ultimate fate of the sludge pumped to the containment trench? Does disposal in this manner present any potential problems? (346)

RESPONSE: Estimates of seepage and drainage from the reclaimed facilities can be found in Section 4.2. Under all alternatives this seepage water would be captured and recirculated or treated. Surface runoff of good quality from reclaimed surfaces would be diverted to bypass the capture systems designed for the poor quality waters. At closure the sludge stored in a trench on the 89 pad would be tested for RCRA characteristics and depending on the results of this characterization it would either be mixed with cement and fixed on site or shipped to an approved offsite facility. The sludges produced to date pass the toxicity characteristic leaching procedure tests. As the sludge would be stored in a lined facility on top of an existing liner below the 89 pad no potential problems are anticipated.

4. COMMENT: Section 2.5.2.7 discusses the long-term collection and treatment of mine waters. Long-term needs to be defined. What is really anticipated time-wise based upon the literature and professional judgement? Would bonding be involved? Sections 2.5.6.1 and 2.7.6.1 (Alternative 3) state construction of permanent treatment facilities are foreseeable. What would the permanent treatment facilities consist of? Would they consist of the facilities discussed in Section 2.8.6.1 --the construction of passive water treatment systems such as wetlands or anoxic limestone drains? (346)

RESPONSE: Section 4.2 states that under all alternatives there is the potential that capture and treatment would be required in the long-term (i.e., the foreseeable future). Permanent treatment facilities would consist of mechanical treatment systems that would require at least some oversight and management and bonding would take this into consideration.

5. COMMENT: The discussion on page 2-61 brings to mind a general question -- how is it known that the network of monitoring wells have been drilled to the appropriate depths and placed in the appropriate locations to adequately monitor for leaks and ARD? (346)

RESPONSE: The existing monitoring network is recognized as being lacking in some drainages. Section 2.11.3.1 also discusses additional monitoring wells that will be placed where data collection is to be supplemented.

6. COMMENT: Will there be any ARD monitoring of the Gold Bug Shear? Will the amendment with 100 tons of lime last in perpetuity? (346)

RESPONSE: Please see Section 2.7.3.1 and Section 2.11.3.1 for additional monitoring that would be required at the Gold Bug Shear. No, the amendment with lime will last for a finite period of time at which the neutralization potential of the lime will be used up.

7. COMMENT: Section 2.6.5.1, page 2-96. What wells or surface monitoring sites would need relocation? What is the effect of this requirement? Could such existing sites be left in place to allow for continued monitoring? (346)

RESPONSE: It is difficult to retain monitoring wells when there is heavy earthwork being done. Existing monitoring wells that cannot be protected would be grouted and abandoned. Replacement wells would be installed as close as possible to the original site and would target the same unit to provide as much continuity of the water quality record as possible.

8. COMMENT: The term "phreatic surface rise" should be defined. (346)

RESPONSE: In this case, the phreatic surface rise is the level or elevation at which the voids between the spent ore are saturated with liquid.

9. COMMENT: It is unclear if the Goslin Flats shale groundwater samples (now moderately high sulfate content) are due to ongoing oxidation of metal sulfides at the mine sites also. (346)

RESPONSE: The moderately high sulfate concentration recorded in the groundwater wells at Goslin Flats are due to oxidation of the marine shales. The concentrations represent background levels.

10. COMMENT: The statement on page 3-99 of the Draft EIS that "However, the long distance and resulting long duration of time (possibly thousands of years) will result in the recharge chemistry equilibrating with the regional groundwater," needs clarification. The basis or data to support the statement needs to be provided. How is it known that degradation in the long term will not occur? (346)

RESPONSE: The near vertical flow path discussed in the text refer to flow down through the core of the intrusive rocks, where it is likely that hydraulic conductivities would be low as would be the potential for karst-like features in the limestone. See Section 3.2.6.

11. COMMENT: The last paragraph on page 3-102 of the Draft EIS states that exceedances should now be avoided due to the construction and expansion of capture systems in the headwaters of the drainage's. It seems more accurate to state that due to efforts to construct and proposals to expand capture systems, the frequency of exceedances have been reduced. However, structures in place at this time do not capture all seepage or runoff events. (346)

RESPONSE: Please see Section 3.2.7.2 of the EIS which states that due to efforts to construct and proposals to expand capture systems in accordance with the Water Quality Improvement Plan, exceedances have been reduced.

12. COMMENT: It is stated on page 4-25 that "due to the many assumptions inherent in the modeling, the calculated volumes of infiltration and discharge should be considered as estimates only." Knowing the volumes of infiltration are a critical aspect of the ZMI complex. Some factor of reliability should be provided for the HELP model used or other methods should be evaluated and used in conjunction with the HELP model for verification/comparison. (346)

RESPONSE: The HELP model is considered a useful tool for making alternative comparisons as required in the EIS process, a discussion of the input assumptions and the variance of the outputs is provided in the new Appendix G of the Final EIS.

13. COMMENT: The extensive reclamation plans in all alternatives must be dismissed because they are based on faulty water quality projections derived from the HELP computer model. The methods used to derive these plans are flawed. (345)

RESPONSE: Methods used to project impacts from alternatives are appropriate in scope and application to this EIS. Appendix G in the Final EIS provides information about the assumptions and input into the HELP model and how the output was analyzed.

14. COMMENT: Is the released decant water of acceptable quality for discharge? Who monitors the flow and water quality of this discharge? (348)

RESPONSE: Decant water must be of suitable quality (within MPDES discharge limitations) prior to discharge. ZMI monitors the flow and water quality, and provides periodic reports to the agencies concerning the monitoring program.

15. COMMENT: Section 4.2.1.3 states that predictions of post reclamation water quality cannot be made given the current state of the art; that predicting the potential for acid rock drainage is currently difficult, costly, and of questionable reliability; and given that some wastes have had lime or limestone added to them, reliable prediction is made even more tentative. The discussion then states that estimates of post-reclamation water quality have been made primarily by professional judgement. More discussion is needed of estimates made by professional judgement, given the preceding statements. The reader needs to be given some sense of the probability. Figure 4.2-2 is presented in the text on page 4-65 as schematic summarizing the "expected" long-term trends, yet the figure itself presents the trends as estimates. How "soft" are these estimates -- might they occur, could they occur, or would they occur? (346)

RESPONSE: These projections are the best estimates given the water quality monitoring data, an extensive review of the mine water quality literature, and the use of the HELP model. A discussion of the HELP model input assumptions and the variance of the outputs is provided in Appendix G of the EIS. Further quantification by attaching a percentage likelihood or probability that these estimates would occur is not appropriate. However, it is considered likely that the post-reclamation water quality would be within the ranges specified. It is also considered likely that projected water quality trends would occur.

16. COMMENT: Section 4.2.1.4 refers the reader to schematic figures in Sections 4.2.5.6 and 4.2.8.6. The two referenced sections do not exist. Table 4.2-1 needs to better address sediment loads. The last paragraph of Section 4.2.1.2 states that mining activity in general and acid rock drainage in particular can result in high sediment loads which can smother bottom-dwelling aquatic organisms and destroy their habitat. Have there been and will there be increases in sediments above naturally occurring concentrations which have or will create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife? (346)

RESPONSE: The referenced figures are in Sections 4.2.10.1 and 4.2.10.2; please see EIS for edited text. Data is restricted to suspended solids, not entrained solids and may not be representative of sediment loads and impacts to bottom dwelling aquatic organisms.

17. COMMENT: The statement on page 4-36 is made that "water...is currently being captured and treated before being discharged to Ruby Gulch." It should be clarified that not <u>all</u> waters (seepage, surface and runoff included) are being captured. One pond is under construction to assist in the capture and treatment of such waters. (346)

RESPONSE: Please see Section 4.2.2.1 for clarification that some poor quality water bypassed the capture system during 1995.

18. COMMENT: The statement in Section 4.2.3 of the Draft EIS (page 4-37) is made that "Under all the alternatives, impacted water would be captured in ponds, sumps, and recovery wells below the facilities and treated or returned to the process circuit." Based upon present efforts, is it accurate and possible to capture <u>all</u> such waters? What is the effect upon each drainage and upon and receiving drainage(s) if all such waters are captured, transported, treated, discharged elsewhere? For each alternative, what are the estimates of volumes of water that will need to be treated in the long term? Who will be responsible for such treatment? What are the estimates costs associated with treatment, present and projected long term? (346)

RESPONSE: As part of the Water Quality Improvement Plan, groundwater and surface water would be monitored below the capture systems and if impacted drainage is found to be bypassing the capture system, water extraction wells and or additional capture systems would be installed. Such an approach is expected to capture the majority of impacted seepage. See Tables 4.2-2 (a) and (b) for estimated volumes of water that would require capture and treatment in the short-term. As the long-term water quality of drainage from each facility would differ, long-term estimates of the volume that may require treatment cannot be made with any confidence. ZMI is responsible for operating the water treatment plant. The cost of that operation is outside the scope of this EIS, but would be included in bond cost calculations.

19. COMMENT: It is stated on page 4-50 that Montana Gulch could become intermittent, impacting its use as a recreational area and limiting its potential as an aquatic habitat. Table 4.2-10 does not identify these potential effects. (346)

RESPONSE: After further consideration of the available data, it is no longer anticipated that Montana Gulch would become intermittent under any of the alternatives.

20. COMMENT: Section 4.2.6 (page 4-53) of the Draft EIS discusses the potential impact of sediment buildup in the Goslin Flats/Ruby Creek drainage from the salvaging of soil. It is stated that if this construction/operation is not controlled by efficient sediment traps, there is potential for a significant local impact degrading macroinvertebrate and potential fish habitat in the short- and long-term. A description of what constitutes an efficient sediment trap is needed. How will the traps be designed for major storm events? Also, this potential accumulated effect can occur from runoff from access roads, haul roads, placement of soils during reclamation, and any other earth moving activity. A discussion is needed that explains how this potentially significant effect will be dealt with throughout the Zortman/Landusky mine complaisant throughout the life of the mine and reclamation work. (346)

RESPONSE: After further consideration of the available data, the potential impacts in Goslin Flats/Ruby Creek drainage due to salvaging soil are not considered significant due to the relatively poor quality of the receiving waters and the lack of any fishery or significant macroinvertebrate population. Examples of Best Management Practices (BMPs) that may be used during construction of the leach pad at Goslin Flats to control sediment runoff are: creation of sediment control ponds that would intercept drainage from disturbed areas; or installation of short- and long-term erosion control features/structures such as hay bales, water bars, benches, and interception and conveyance ditches/channels to slow runoff and to capture and direct excess water to acceptable release points. Design and operational information for sediment control systems are provided in Section 2.5.1.6.

21. COMMENT: Section 4.2.9.1 refers the reader to the cumulative impacts discussion for Alternative 5 instead of Alternative 4, which is more similar (Goslin Flat leach pad verses Alder Gulch leach pad). This confusion should be cleared up. Cumulative impacts under Alternative 7 are rated low negative, while cumulative impacts under Alternative 4 are rated high negative. It seems that this rating is based heavily on the specific impacts of the alternative, and is not really at all based on the true cumulative effects. Further, the significance of the effects of the reasonably foreseeable future actions is not identified. Still further, the significance of the effects of past actions is not identified. A concise basis for the significance determinations should also be provided. (346)

RESPONSE: After further consideration of the available data, cumulative impacts resulting from Alternative 7 are rated as low negative. Please see Section 4.2.9.1 of the Final EIS where cumulative impacts associated with Alternative 7 are discussed in detail.

22. COMMENT: Section 4.2.10.2 states that even with Alternative 7, long-term capture and treatment of impacted waters may be necessary. What is meant by long-term? How may this be accomplished, and what all may it entail? (346)

RESPONSE: Long-term or "in perpetuity" as used elsewhere in Section 4.2 means for the foreseeable future. Treatment would require operational supervision and maintenance and would be bonded accordingly after selection of an alternative.

23. COMMENT: Table 4.2-10 does not provide an impact summary for water resources as the title implies. Impacts to beneficial uses are not specifically addressed. (346)

RESPONSE: See Table 4.2-10 for more appropriate title "Impact Analysis Summary." Impacts to beneficial use have been added to the table in the Final EIS.

24. COMMENT: Section 4.2.10.3, page 4-70, penultimate bullet item. Unless data exists, and the data is based upon testing and monitoring sufficient to support the statement made, this item appears conjecturable. (346)

RESPONSE: These statements regarding reclamation are based on observations at mines with similar reclamation covers.

25. COMMENT: Section 4.2.10.3, page 4-70, last bullet item. It should be added that similar data is needed regarding groundwater resources. (346)

RESPONSE: See Section 4.2.10.3 of the Final EIS; please see Sections 2.7.3.1 and 2.11.3.1 for the additions to the monitoring program.

26. COMMENT: ZMI should be required to further investigate the potential hydrologic connection between the Madison aquifer that receives stream water along the south flanks of the Little Rocky Mountains and Big and Little Warm Springs. (337)

RESPONSE: It is considered unlikely that recharge in the vicinity of the mining activities would impact the volume or quality of the discharge at the Big Warm Spring due to the presence of significant topography between the mine and the spring. Hydraulic communication between these two points across a topographic divide would require flow along a major structural feature. No such structure is apparent from the surface topography or available structural maps and karst communication over that distance is considered unlikely.

27. COMMENT: The Draft EIS should include a discussion of Montana's regulatory requirements and criteria related to compliance with groundwater quality standards. Discussions related to mine expansion operations and proposed reclamation for Alternatives 4 and 7 should include information on compliance with applicable groundwater standards and strategies for achieving compliance. (337)

RESPONSE: Please see Section 3.2.8 for an expanded discussion of Montana groundwater regulatory requirements.

28. COMMENT: The Draft EIS should provide a more adequate strategy for mine expansion operational groundwater monitoring, compliance monitoring and post-operational monitoring. The post-operational monitoring schedule proposed on page 2-177 is inadequate. Period 2 quarterly monitoring should continue for 5 years and Period 3 semi-annual monitoring should extend for 10 years. (337)

RESPONSE: See Section 2.11.3.1 Water Resources Monitoring for agency proposed monitoring program. The proposed frequency of monitoring is adequate given that the schedule would only advance if "no water quality changes were detected." A final design of the post-operational monitoring plan would be prepared near the end of the mining operation.

29. COMMENT: You should focus on groundwater flow direction and orientation based on the distribution of fractures. (337)

RESPONSE: See Sections 3.2.4 and 3.2.6 for expanded discussion on the relationship between geological structures and groundwater flow. Information on geologic structures has been used to site additional monitoring wells as described in Sections 2.7.3.1 and 2.11.3.1.

30. COMMENT: Section 3.2.4 should include a table with the estimated minimum and maximum thicknesses of alluvium in the drainage's of interest. (337)

RESPONSE: Available monitoring wells logs show the drainage's to be similar to Alder Gulch in that the alluvium is limited in thickness in the drainage's steep upper headwaters increasing in thickness as you move downstream. Although this is useful information; in the interest of keeping the EIS as concise as possible, such a table is not considered necessary to understand the impacts associated with the proposed alternatives.

31. COMMENT: Exhibits 1 and 2 should show the approximate location and orientation of those structural features that are thought to control groundwater flow, including the Suprise shear Zone, the Narrows Fault Zone, August drain and major fracture systems. (337)

RESPONSE: Please see Figure 3.1-4 in the EIS for structural features of the Little Rocky Mountains and the expanded discussion of structural control on groundwater flow in Sections 3.2.4 and 3.2.6.

32. COMMENT: The discussion on page 3-46 regarding vertical gradients in the Madison is correct but would be more complete if it included a more detailed description of where the vertical gradient is downward and where it is upward. (337)

RESPONSE: While the suggested additional information would provide a more detailed description of recharge/discharge to the Madison aquifer, the existing information is adequate to understand the effects of the alternatives.

33. COMMENT: In Section 3.2.4, the fourth key point listed in the summary is misleading. Springs are groundwater discharge features but do not necessarily indicate an upward gradient. (337)

RESPONSE: See Section 3.2.4 for edited text, removing reference to upward gradients.

34. COMMENT: In Section 3.2.5.2, the trilinear diagrams shown in Figures 3.2-22 and 3.2-23 indicate that groundwaters in the alluvial deposits, the metamorphic and volcanic rocks and the limestones are similar with respect to hydrochemical facies type. What is the explanation for this? (337)

RESPONSE: As well as illustrating that the groundwaters are of a similar hydrochemical facies type. Figures 3.2-22 and 3.2-23 illustrate that a percentage of each groundwater type has been impacted by ARD and a percentage of samples are non-impacted. ARD contamination results in higher sulfate concentrations thus shifting the location of the sample on the plot along the sulfate axis. This similarity may be the result of the high degree of mixing between the groundwaters in this steep terrain and the recent nature of the groundwater being dominated by bicarbonate derived from the soil zone and the calcium from dissolution of calcite from the limestones.

35. COMMENT: In Section 3.2.5.2, it is apparent that cyanide is infiltrating into groundwaters and is being detected in bedrock wells, including the limestone wells.

The reasons for this should be discussed as well as possible steps for cleanup and prevention of future discharges. (337)

RESPONSE: See Section 3.14.4 for an expanded discussion of cyanide spills or releases and Section 3.14.5 for a discussion of the ZMI Emergency Response and Spill Contingency Plan.

36. COMMENT: In Sections 3.2.5.2, monitoring wells ZL-107R and ZL-110 are referenced on page 3-86 but are not shown on Exhibit 1. Please add to Exhibit 1. (337)

RESPONSE: Please see Exhibit 1 for location of the monitoring wells.

37. COMMENT: In Section 3.2.5.2, what is the explanation for the apparent period of groundwater degradation in 1991 at wells AG200 (syenite/volcanics) and well AG-201 (limestone)? (337)

RESPONSE: These elevated concentrations appear to have been the result of high precipitation, resultant high surface water flow volumes, and the associated flushing of reaction products from acid-generating materials. These wells are located in the Alder Gulch alluvium.

38. COMMENT: In Section 3.2.5.2. water quality data for well AG-201 and/or well AG-203 (both completed in the limestone) should be included in Table 3.2-23. (337)

RESPONSE: Please see revised Table 3.2-23, which now includes AG-203 as requested.

39. COMMENT: In Section 3.2.5.2, please indicate from which bedrock unit well TP-4 produces water. (337)

RESPONSE: No construction details are available for TP-4; the unknown completion details of TP-4 make the water quality data questionable. Please see Section 3.2.5.2 for edited text.

40. COMMENT: In Section 3.2.5.2, monitoring wells ZL-136, ZL-137 and ZL-138 are not shown on Exhibit 2. (337)

RESPONSE: Please see Exhibit 2 in the EIS for the location of the monitoring wells.

41. COMMENT: Page 3-98 states that monitoring wells ZL-136, ZL-137 and ZL-138 are alluvial wells. However page 3-95 states that well ZL-136 is developed in sandstone. (337)

RESPONSE: Records show ZL-136 to be completed in sandstone; please see Section 3.2.5.2 for edited text showing ZL-136 to be completed in sandstone above the confluence of Mill Gulch and Rock Creek.

42. COMMENT: Page 3-95 states that the water level in the sandstone (well ZL-136?) is above the sandstone/alluvial contact. What is the explanation for this? (337)

RESPONSE: Either the sandstone has a vertical upward hydraulic gradient in this area or the well may be in hydraulic connection with the overlying alluvium (poor well completion).

43. COMMENT: Page 3-95 states that the water quality data from wells ZL-115 and ZL-116 are representative of baseline conditions in limestone within the Little Rocky Mountains. (337)

RESPONSE: See Section 3.2.5.2 for edited text clarifying that water quality data from these wells could potentially be representative of baseline conditions. Well Z-8A is representative of baseline conditions from the Madison aquifer southeast of Zortman.

44. COMMENT: Section 3.2.5.2 should include a discussion and data on flow and chemistry of water discharging from the Gold Bug Adit. This flow is groundwater flow. (337)

RESPONSE: The flow and chemistry of the Gold Bug Adit is discussed in Section 3.2.5.1. It is acknowledged in Section 3.2.5.1 that this water is groundwater; however as it makes up the majority of flow in Montana Gulch, it is more appropriate to discuss it in the surface water section.

45. COMMENT: In Section 4.2.1.5, p. 4-27, we suggest including predictions of water quality at points of compliance rather than points of interest. (337)

RESPONSE: The locations at which water quality predictions are made are places of beneficial use rather than points of interest. Points of compliance could be used; however the locations that would be used (as points of compliance) in the future have not yet been finalized.

46. COMMENT: In Table 4.2-1, existing conditions should be qualified to indicate that controls must remain operational. Since some of this existing quality is of short duration, the basis should be cited (# of samples over what period). (337)

RESPONSE: See Table 4.2-1 for details of existing conditions.

47. COMMENT: In Section 4.2.3, p.4-37, releases from leach piles may require segregation and different water management/treatment. They should not be assumed to be additive to other captured waters. (337)

RESPONSE: The same capture systems are proposed for drainage from waste rock piles, dikes and leach pads at this time, as they are all assumed to require treatment before discharge. Process water would be treated separately from mine drainage or stormwater.

48. COMMENT: In Section 4.2.5 of the Draft EIS, p.4-48, the first paragraph states "with drainage from the facilities potentially reaching conditions that would not require active treatment." With concentrations based standards at the point of discharge, please cite a quantitative basis for this prediction. (337)

RESPONSE: This prediction is qualitatively based, and the conditions discussed that may allow passive treatment only would primarily be a low flow volume and associated reduction in loads to the extent that water quality objectives could be reached using limestone drains or wetlands.

49. COMMENT: In Section 4.2.10.1, p.4-63, the feasibility and impacts of "passive treatment systems" should be discussed. (337)

RESPONSE: Passive treatment systems (e.g., wetlands and limestone drains) are reasonably foreseeable developments. The effectiveness of such systems would depend on residual water quality requiring treatment after source controls have been applied. Specific analysis of such passive systems adequacy would not occur until residual water quality and quantity data is known. This cannot happen until after source controls have been implemented.

50. COMMENT: In Table 4.2-10, it states that "Eventual source control of ARD is likely." It would be helpful to lay out an approach to this using seepage concentrations and standards. (337)

RESPONSE: Alternatives 3, 4, 5, 6, and 7 on Table 4.2-10 of the EIS refer to the potential for stopping active treatment of the leachate rather than "source control." This statement is based on professional judgment after considering the results of the HELP modeling and results of the rock geochemistry analysis. No geochemical modeling has been used to predict actual effluent concentrations. The intent is to acknowledge that source control through diversion, selective waste rock placement, and enhanced reclamation covers would control the volume and quality of mine drainage. This control may be sufficient to allow active treatment to stop.

51. COMMENT: The Draft EIS understates the past and present ZMI water quality impacts to the Lodgepole and Big Horn Creek drainage's. Water quality changes in Lodgepole Creek are described as "minimal and possibly short-lived" with reference to monitoring stations Z-5, Z-30, Z-28 and Z-29 (3-60). The summary statement regarding Lodgepole Creek again asserts that impacts from mining have been "short-lived" (3-64). Monitoring data for station Z-5, however, show nitrate concentrations from 1990 to at least 1994 persistently elevated roughly tenfold above the levels shown from the limited sampling in 1980 and 1981. Furthermore, elevated nitrate concentrations appear to have been maintained at Z-5 over the period 1990 to 1994. Elevated nitrate concentrations may have first occurred at this station any time during the period 1982 to 1989, when no nitrate analyses were reported. The data reflect what may be a substantial increase in nitrate loading at this station, persisting over several years, which is likely related to mining activities. (17, 347, 361)

RESPONSE: Based on the amount of time between sampling events and the maintenance of elevated nitrate concentration over several sampling events, the comment that the impacts have been short-lived has been removed from the EIS. However due to the maximum nitrite + nitrate concentration at Z-5 being 2.1 mg/l the impact is minimal, despite its occurrence being significant.

52. COMMENT: The Draft EIS presents conflicting and unclear statements regarding water quality changes in South Bighorn Creek and it's tributary, Swift Gulch. Referencing data since 1985, the text notes, "Rising concentrations of sulfate and hardness and fluctuations in nitrate concentrations at surface sites L-19 and L-20 show that drainage from the Landusky Mine may have affected water quality in Swift Gulch, which is a tributary to South Big Horn Creek" (page 3-74). Later, the summary statement for South Bighorn Creek states that chemical parameters are "within the ranges derived for pre-1979 "baseline" water quality data and are currently not adversely affected by mining activity" (page 3-79). (347, 361)

RESPONSE: The maximum sulfate and hardness concentrations observed at Swift Gulch are 183 and 251 mg/l respectively at L-19 and 161 and 232 mg/l at L-20. Pre 1979 regional baseline maximums for sulfate and hardness are 134 mg/l and 245 mg/l respectively. Therefore sulfate and hardness concentrations at Swift Gulch are slightly higher than the range of available pre-1979 surface water quality "regional baseline." Please see Section 3.2.5.1 for edited text.

53. COMMENT: Since none of the monitoring stations referred to in the South Big Horn drainage (L-19, L-20 and L-21) appear to have been sampled prior to 1985, it is not clear what pre-1979 baseline water quality are referred to. Both L-19 and L-20 exhibit sulfate:bicarbonate ratios of 1 or above; the high relative sulfate concentrations shown are characteristic neither of the South Bighorn Creek station L-21 nor of unimpacted streams elsewhere in the Little Rockies, and where found elsewhere indicate ARD or precursors to ARD. Station L-20 shows an increasing trend in sulfate loading during the period of record and may show increasing dissolved solids loading. In their review of the water quality history of the ZMI facilities, SAIC noted that the water quality observed at L-19 and L-20 reflects precursors to ARD. Elevated nitrate concentrations exhibited at both stations further suggest impacts from recent mining activities. (361)

RESPONSE: Please see previous comment response.

54. COMMENT: Although water quality changes in these streams are of low magnitude in comparison to the severe impacts experienced by other drainage's, they are nonetheless important indicators of the possible effects of ZMI's pit development and other mining activities near the drainage divide. There is insufficient information (particularly regarding ground-water flow) to identify the contaminant pathways responsible for these changes or to determine whether pit expansion will lead to further degradation in these headwater streams. (347, 361)

RESPONSE: Please see Sections 3.2.4 and 4.2 of the EIS for an expanded discussion of groundwater flow to the north of the Zortman and Landusky mines.

55. COMMENT: The summary of Zortman Area Groundwater Monitoring Results incorrectly understates the duration of impacts from the 1987 emergency land application of process fluids. The Draft EIS states, with reference to monitoring well AG-202, that the numerous cyanide detection's "may have resulted from emergency land applications of processing solution during 1987," further noting that "cyanide has not been detected at AG-202 since 1992" (page 3-86). By contrast, the summary section states in part "Land application of processing liquids in 1987 adversely affected the groundwater quality in all the shallow wells within Alder Gulch; however, groundwater appears to have recovered to pre-1987 levels within 12 months" (page 3-91).

Monitoring data for AG-202 show cyanide detection's over at least a 4-year period from 1987 to 1991, while dissolved solids appear to have increased on a seasonal basis through 1992. Water quality in this well did not return to pre-1987 conditions within twelve months of the emergency land application. Either the effects of the land application on AG-200 were on the order of five years in duration (rather than 12 months), or other sources of process fluids contribute to the AG-200 data. In either case, the data cited do not appear to support the summary statement minimizing the duration of the land application effects. (347, 361)

RESPONSE: See Section 3.2.5.2 for edited text and revised interpretation. Please note that the total cyanide concentration at ZL-202 did fall to less than or equal to 0.01 mg/l by 1990. Groundwater quality in the Alder Gulch wells may also be impacted from other sources, e.g., Alder Gulch waste rock dump and the Alder Spur leach pads. This makes continuing impacts from LAD difficult to distinguish in later years. Cyanide levels are below the criteria of active toxicity to aquatic organisms.

56. COMMENT: In general, it is impossible to evaluate trends in water quality for those monitoring stations where only summary statistics of the water quality data are provided. Time-series water quality plots should be provided for key parameters at all monitoring stations. (347, 361)

RESPONSE: A combination of summary statistics and time series plots for selected representative monitoring stations and monitoring wells is considered appropriate for an EIS. If more detail is required please refer to the database prepared for this analysis kept on file at the BLM and DEQ.

57. COMMENT: The Draft EIS incorrectly describes the extent of groundwater contamination in the King Creek drainage. While recognizing impacts from mining activities to monitoring well ZL-139, the text states that monitoring well ZL-140 "has not been noticeably impacted by mining related activities" (Draft EIS page 3-99). The three samples reported from ZL-140 range in nitrate concentration from 2.83 to 3.26 mg/l. Nitrate concentrations in the milligram per liter range do not represent natural groundwater conditions in alluvial aquifers of the Little Rockies. These limited data indicate contamination of alluvial groundwater by mining-related activities at this site. It is important to recognize nitrate contamination of groundwater in King Creek aquifers in order to address the apparent problem of nutrient loading of King Creek surface waters. (347, 361)

RESPONSE: See Section 3.2.5 for edited text and revised interpretation stating that the elevated nitrate concentrations recorded at monitoring well ZL-140 indicate that the water quality has been impacted by mining related activities. These impacts are not significant.

58. COMMENT: Key statements in the discussion of groundwater and surface water interactions are inconsistent with data and with expectations for groundwater flow in areas of high secondary permeability. Generally, this section provides a sound (though largely unverified) evaluation of the probable behavior of groundwater recharge received by aquifers underlying and surrounding the mine site. Some important statements are not well supported, however. With reference to groundwater connections between intrusive rocks and the Madison Aquifer, the Draft EIS states in part "the distance and resulting long duration of time (possibly thousands of years) will result in recharge chemistry equilibrating with the regional groundwater" (3-99). This statement appears to ignore the presence of regions of high secondary permeability within the intrusive and metamorphic rocks of the Little Rockies. Zones of relatively high permeability (such as those supporting the medium to high-yield production wells installed by ZMI) may, if in contact with karstic Madison limestone, provide for relatively rapid movement of groundwater and contaminants to peripheral aquifers and, potentially, springs.

The fact that the importance of such inter-aquifer connections is not known, is an indication of the unacceptable level of uncertainty regarding the effects of further mine expansion. (347, 361)

RESPONSE: Such potentially rapid flow paths are illustrated on Figure 3.2-25. Hydro-Geo Consultants (1992) found the Zortman pit shear zones to have hydraulic conductivities between 3.9 x 10^{-1} and 1.2 x 10^{-3} feet per day. The near vertical flow path discussed in the text refers to flow down through the core of the intrusive rocks, where hydraulic conductivities would be low as would be the potential for karst-like features in the limestone.

59. COMMENT: In summarizing the relationship of peripheral Madison Group springs to recharge received in the Little Rockies, the Draft EIS states "Discharge from springs surrounding the Little Rocky Mountains does not preclude recharge from the Little Rocky Mountains to the Madison Group Limestones but suggests it is limited" (3-101). This statement is curiously inconsistent with previous statements on the same page, and with data showing short-term increases of as much as 50% in the discharge of Big Warm Spring in response to recharge events in the Little Rockies. The data available indicate that there is a substantial imprint of local (Little Rockies) recharge over the regional ground-water discharge seen at this spring. This indicates that contaminated recharge water might under the right circumstances effect Big Warm (and possible other Madison springs) relatively rapidly. The Draft EIS fails to fully address the potential impacts of the mine expansion on the local Madison Aquifer, by instead concentrating on the regional aquifer. The report states that "some recharge to the Madison group occurs from precipitation on the flanks of the Little Rocky Mountains and by infiltration from streams, (but) the principal regional source of recharge for the Madison group are (sic) the vast outcrops of the Big Snowy and Little Belt Mountains further to the south (Feltis 1983)." Although this statement is generally true, it belittles the local importance of recharge from the Little Rocky Mountains in the area immediately surrounding the mountains. Data from the same study (Feltis 1983) show that an individual large precipitation event in the Little Rocky Mountains in 1974 led to a 50% increase in the flow rate of the Big Warm Spring and also led to a change in the water quality at the spring. These changes in flow at the spring occurred less than two weeks after the snowfall, indicating that groundwater flow rates between the mountains and the springs are more rapid than the BLM anticipates. High precipitation events such as this 1974 snowfall often lead to some of the poorest quality surface discharges from the mine site. The Draft EIS must present a thorough hydrologic evaluation of the Madison Aquifer in the Little Rocky Mountains and vicinity in order to assess the potential impacts of mine expansion on this important aquifer. (70 through 125, 132, 145 through 157, 165, 166, 275 through 320, 340, 347, 361, LO-38, GF-39)

RESPONSE: The statement that infiltration into the regional aquifer is "limited" was based on the observed vertical upward gradient in the limestones surrounding the Little Rocky Mountains and many springs discharging from the limestone. This suggests that much of the recharge to the limestones within the mountain range will be forced out into stream beds and springs. However this text has been changed to, "The amount of infiltration into the regional aquifer is 'unknown'; although the vertical upward hydraulic gradients and presence of the springs discharging from the limestone around the periphery of the mountains suggests that much of the recharge to the limestones within the mountains reports to the surface at the base of the mountains."

It is unlikely that recharge in the vicinity of the mining activities would impact the volume or quality of the discharge at the Big Warm Spring due to the presence of significant topography between the mine and the spring. Communication between these two points across a topographic divide would require flow along a major structural feature or karstic feature. No such structure is apparent from the surface topography and karst communication over that distance is considered unlikely.

60. COMMENT: The Draft EIS omits significant information in the discussion of Regulatory Criteria. King Creek also carries a B-1 classification and should be listed as such with the other north side drainage's. The Draft EIS also states that "Parameters exceeding the available criteria are generally restricted to metals" (3-102). While the most frequent violations of standards are with metals, Sullivan Creek, Montana Gulch, Mill Gulch and Ruby Gulch all have some history of violation of human health criteria for total cyanide; aquatic life criteria for cyanide have been exceeded in various other drainage's at different times. (347, 361)

RESPONSE: See Section 3.2.8 for edited text stating that the northern creeks (i.e., Beaver, Lodgepole, King, and South Bighorn) are classified as B-1.

61. COMMENT: The HELP model inputs and seepage estimates derived from the HELP model are highly uncertain. The Draft EIS provides an analysis of comparative impacts which relies heavily on the use of the Hydrologic Evaluation of Landfill Performance (HELP) model. The use of the HELP model may be a reasonable approach to making first-order estimates of relative rates of leachate generation. There are, however, numerous questions about the application of the model which are unanswered by the Draft EIS and numerous uncertainties regarding model inputs which suggest that the results should be employed very conservatively in evaluating the alternatives. Furthermore, because the HELP model inputs for the various simulations are not fully documented in the Draft EIS, it is impossible to fully evaluate the various simulations. The Draft EIS should include full documentation of simulation inputs, uncertainty analysis of the model inputs, and an analysis of the potential cumulative error in simulation results. (347, 361)

RESPONSE: Please see Section 4.2.1.1 Infiltration Modeling for discussion of the limitation of the HELP model and disclosure that infiltration and discharge volumes should be considered as estimates only. The primary role and value of the HELP model is that it provides an effective tool for comparing reclamation alternatives and helping to obtain optimal reclamation of this site. See Appendix G for discussion of assumptions and input parameters to the model.

62. COMMENT: The lack of explicit data regarding key water balance components for the pads and waste rock dumps prevents model calibration. Estimated water treatment requirements are sensitive to estimated groundwater discharge to pads and waste rock dumps; these groundwater discharge estimates are themselves derived from simulations incorporating infiltration assumptions which have not been verified and discharge measurements (or estimates) of facility outflow which are of questionable quality (4-25). The net result is considerable uncertainty in estimates of water treatment needs, possibly exceeding the range of modeled leachate production shown by the different scenarios. An error analysis is needed to demonstrate that the modeled leachate volumes summarized on 4-63 and 4-64 are truly distinguishable. Similarly, it is highly doubtful that the HELP model or the available inputs used in it support the level of precision implied by the tabulated infiltration estimates (4-63). The uncertainty inherent in this approach to evaluating the hydrologic effects of alternatives highlights the inadequacy of the available data base for supporting expansion of mining facilities. (347, 361)

RESPONSE: Estimates of water requiring capture and treatment are produced for comparison between alternatives only, not for sizing of capture or treatment facilities. An analysis of the standard deviation associated with the average annual HELP model results can be found in Appendix G and ranges of groundwater seepage are given to reflect the associated uncertainty.

63. COMMENT: The HELP model inputs and results are presented in terms of steady-state, annualized values. There is no indication that seasonality of precipitation and infiltration were a part of the analysis. While some components of the estimated water budgets (such as infiltration through low-k liners) may not be sensitive to annual variability, the performance of the proposed "water balance" cover must accommodate seasonally dynamic water balance components. In particular, the effectiveness of soil water storage in keeping seasonal snowmelt from infiltrating reclaimed facilities, and the capacity for vegetation to effectively transpire heavy spring precipitation need to be analyzed and presented on a seasonal basis. (347, 361)

RESPONSE: An analysis of the standard deviation associated with the average annual HELP model results can be found in Appendix G. An analysis of water storage capacity of the soil and subsoil components of the evaporative cover for Alternatives 3 and 7 is also provided in Appendix G. This was done to check that adequate storage would be available in the soils, during the period of the year when the vegetation is dormant.

64. COMMENT: The HELP model results and, indeed, the overall success of the "water balance" strategy for facility reclamation proposed under the preferred alternative, are sensitive to the very high rate of revegetation success assumed in the analysis (99%). Documentation supporting this assumption is needed. This is particularly important with respect to steeper slopes where revegetation success may be more difficult to achieve and where low-permeability liners are not part of the proposed reclamation covers. Sensitivity analyses of key assumptions employed in the infiltration modeling of the water balance reclamation cover should be provided in the EIS. (347, 361)

RESPONSE: Please see Appendix G for a discussion of the sensitivity analysis of the key assumptions including percent cover. The 99% value used in the Draft EIS referred to overall reclamation success rather than percent cover. Alternatives 3 and 7 water balance covers assume a canopy cover of 70% on slopes greater than 25% with 36" of soil. Slopes of less than 25% would have a barrier cover with 12" of cover soil; on these slopes, vegetative success is expected to be around 60%. Both of these values for each site represent successful reclamation. Please see Appendix G for explanation of how percent cover has been tied to evaporative depth in the HELP model runs.

65. COMMENT: The evaluation of post-reclamation water quality focuses exclusively on surface water. This evaluation is incomplete without considering post-reclamation groundwater quality. The Draft EIS states, in part, "surface water quality usually represents 'worst-case' conditions when compared to adjacent groundwater, particularly bedrock groundwater which is much less likely to be impacted than alluvial groundwater" (page 4-26). This statement lacks validity with respect to open-pit mining operations such as ZMI's where (as is recognized and well described elsewhere in the text) pit development is encouraging enhanced aquifer recharge and geochemical processes leading to bedrock groundwater impacts which may drive continuing surface water degradation. As noted elsewhere in the Draft EIS, contamination of bedrock aquifers has been shown by a number of monitoring wells over the history of the Zortman and Landusky mines. Ground-water pathways from pit recharge areas to the adjacent stream drainage's are poorly understood and are a contaminant pathway of significant concern in evaluating reclamation success. Evaluating the hydrologic success of reclamation requires an explicit analysis of bedrock water quality affects.

Given the uncertainties regarding ground-water flow directions, velocities and rates of geochemical processes, it is likely that this analysis cannot presently be conducted in a meaningful way. Complete analysis of the impacts of the different alternatives is thus impossible until groundwater data deficiencies are corrected. (347, 361)

RESPONSE: The potential impacts to groundwater are identified for each alternative and further discussed in Section 3.2.6 <u>Groundwater Surface Water Interaction</u>. The comment that surface water quality usually represents "worst-case" conditions when compared to adjacent groundwater has been removed. Surface water quality is discussed predominantly in the impact analysis as it provides resolution between alternatives from which to recognize which reclamation alternatives are most protective to all water resources. Because of the higher level of uncertainty associated with groundwater flow and quality, the discussion of groundwater impacts is more qualitative. Please see Section 4.2 for an expanded discussion of groundwater impacts.

66. COMMENT: Estimates of improvements in surface water quality are highly uncertain due to uncertainties in estimated water budget components. Estimates of the magnitude of water quality improvement likely under the different alternatives rely in part on modeled changes in water budgets. These in turn rest upon less than ideal discharge records and upon uncalibrated model assumptions regarding infiltration of recharge. The level of uncertainty contained in each of these estimates should be evaluated and presented as a part of the analysis of anticipated water quality changes. (347, 361)

RESPONSE: Water quality improvement estimates are dependent upon the calculated volumes of infiltration through the facilities in question relative to volume of water derived from upgradient or beneath the facility. Post reclamation water quality estimates have been made primarily by professional judgment after considering the factors mentioned above. Analysis of all alternatives shows that long-term capture and treatment could be necessary; this has been planned for in the alternatives. Therefore, there is little value in undertaking a further analysis of uncertainty.

67. COMMENT: The significance criteria employed in evaluating impacts to water quality should recognize nondegradation. Except where exempted, high quality waters in Montana receive nondegradation protection as well as protection keyed to the criteria cited in Section 4.2.1.4 . Projected impacts to Little Rockies streams subject to nondegradation provisions (particularly the northern drainage's) should not be considered "insignificant" without considering nondegradation provisions. (347, 361)

RESPONSE: For the purpose of recognizing the significance of impacts, the appropriate drinking water and aquatic life criteria are considered to be the most relevant. As the amount of pre-1979 or baseline water quality data is not sufficient enough to establish nondegradation from a compliance point of view, it was not considered appropriate as a significance criteria for this EIS.

68. COMMENT: Deepening of the pits below steady-state water table elevations and subsequent backfilling with reactive material carries an unacceptable risk of long-term AMD generation. The mine expansion proposed under the preferred alternative would bring the floors of the Zortman and Landusky pit complexes to elevations respectively 200 feet and 230 feet below local groundwater elevations (4-50). Partial backfilling of the pits will bring large volumes of potentially acid-generating material into contact with groundwater following reclamation. The location of the pits in natural recharge areas near the Little Rockies divide suggests that groundwater reaching the water table in the backfilled pits will be oxygenated and capable of generating AMD. The proposed diversion of highwall runoff, which is only generally described in the Draft EIS, will be at best partially successful on the steep and fractured highwall slopes. Highwall runoff which is not successfully diverted will provide additional acidic, oxygenated recharge to the backfilled pits, further increasing the risk of damaging ARD. Pit location also makes some northward component of groundwater flow from beneath the pits a strong likelihood, risking serious water quality impacts to Lodgepole, South Big Horn and King Creeks.

The August Drain and Gold Bug adit appear to control potentiometric levels in the area of the August pit and may capture a large component of the outflow from the backfilled Landusky pit complex. Complex, structurally controlled flow paths, however, along with the pit's position near the hydrologic divide, make some northward flow a possibility requiring additional investigation. The Zortman pit complex is even more likely to discharge northward-flowing groundwater due to it's topographic position and the lack of a drain structure analogous to the August Tunnel. The Draft EIS states that preferred flow paths will be to the south from the backfilled pit on the basis of present observations of underflow from the 85-86 pad (4-50). This statement is not convincing, considering the proposed deepening and northward expansion of the pit complex.

The Draft EIS recognizes the likelihood of AMD generation from the reclaimed pits (4-61). Since source controls designed into the pit covers will not prevent the water table surface from rising into the pit backfill after reclamation, the ARD which is likely to be generated will be a long-term feature of mine site's the post-reclamation hydrology. Under the preferred alternative, ARD would be treated as it discharged to adjacent drainage's, and long-term and possibly severe degradation of groundwater flowing through the intrusive rocks would be accepted. Treatment of any pit-generated ARD reaching the surface would probably need to be very long-term, even if source controls succeeded in reducing ARD from other mine facilities to a low enough level to allow so-called passive treatment of their leachate.

As described by the Draft EIS, (3-99) some component of this groundwater flow is expected to follow longer flow paths eventually involving other aquifers. Since the mechanics of flow between intrusive and sedimentary aquifers are not presently understood, the effects of introducing pit ARD along these flow paths cannot be predicted. (347, 361, LO-38, GF-39)

RESPONSE: Currently the groundwater divide appears to be located at the northern end of the existing pit complex (see Figure 3.2-9 of the EIS); the expansion of the pit complex would increase the amount of pit area with a potential to drain to the north. However, the coincidence of significant water volume increase and degradation of surface water quality at the head of Ruby Gulch with the deepening of the Zortman pit complex during 1985, combined with the existence of geohydrologic structures between Ruby Gulch and the pits, suggests that the majority of recharge to the pit complex currently flows to the south (see Section 3.2.5.1 of the EIS). The EIS states that there is also some potential for degraded water within the Zortman pit backfill to flow towards the north.

At Landusky, there is also some potential for groundwater movement and potential discharge to the north; this is clearly shown on Figure 3.2-10 in the EIS. The northern component of groundwater flow is thought to be controlled by the Narrows fault zone and the Suprise shear zone. However, the northern component of flow is expected to be small due to the influence of the August Adit draining water from the pit backfill which will in turn drain water from the surrounding bedrock.

69. COMMENT: The dewatering of the (proposed) expanded pits during mining will have effects on water rights and aquatic communities which cannot be predicted with the available data. Groundwater withdrawals needed to dewater the expanded pits (once below the local water table elevations) will capture groundwater which may in part discharge to the northern drainages. It is likely that this groundwater will be of poor quality and will require treatment. Although the quantities may be relatively small, the effects of small additional depletion's on headwater streams may be significant, and should be assessed as part of a complete evaluation of environmental impacts. The brief evaluation provided does not reflect an adequate understanding of these issues to support a decision to proceed with mine expansion below the water table. (361)

RESPONSE: It is likely that the volume of flow from springs located in the headwaters of drainages would decrease in the vicinity of the two open pit mines. However with the exception of Montana Gulch, the upper reaches of these drainages are usually intermittent or ephemeral. Thus impacts to aquatic organisms should not be significant. See Section 4.2 for discussion of impacts associated with deepening the pits and subsequent backfilling.

70. COMMENT: Generally, the Draft EIS does not provide an adequate description of the structural geology of the mine site, of the type of control on groundwater flow exerted by geologic structures, or of the relationship of mine facilities to hydrologically important structural elements. The Draft EIS alludes to the importance of faults, fractures and shear zones to groundwater flow at a number of points (pages 3-45, 3-46, 4-50, etc.). This is consistent with qualitative observations of groundwater behavior in the Little Rockies and with principles of groundwater flow in areas of crystalline geology. Structural control of groundwater flow is apparently fundamental to the analysis of any groundwater issue in the mine area. Given the apparent importance of the structural geologic framework to the hydrogeology of the mine site, the Draft EIS should provide a comprehensive evaluation of the structural context of the mine site and surrounding areas. Important unanswered questions of pit recharge and leachate generation, contaminant transport rates and direction, and water budgets of active and reclaimed facilities hinge on these relationships.

Without an integrated evaluation of structural controls, the Draft EIS cannot define existing and potential hydrologic impacts well enough to justify alternatives involving expansion, particularly major pit extensions to the north and pit deepening into regions of saturated groundwater flow. (347, 361)

RESPONSE: See Sections 3.2.4 and 3.2.6 for expanded discussion on the relationship between geological structures and groundwater flow. Furthermore, the portions of the pit complexes which would penetrate regions of saturated groundwater flow are well south of the hydrologic divides. No new disturbances are proposed for the northern portion of the Landusky pit complex, and only stripping of near surface materials is proposed for the northern portion of the Zortman pit complex.

71. COMMENT: According to the Draft EIS, "HELP is a deterministic water balance model that uses climatic soil and design data to determine the water budget of a landfill (Schroeder et al 1988). According to the American Heritage Dictionary, determinism is "the philosophical doctrine that every event, act, and decision is the inevitable consequence of antecedents that are independent of the human will." The Draft EIS assumption that a computer model designed for the reclamation of landfills which uses a "deterministic" approach entirely void of human variables is scientifically void. (345)

RESPONSE: See Appendix G for a discussion of the HELP modeling. The approach employed in modeling infiltration is applicable and scientifically based.

72. COMMENT: Most of the water quality data presented in the Draft EIS is completely lacking in any kind of scientific basis. (345)

RESPONSE: Estimates of post reclamation water quality have been based on professional judgment after considering the results of the HELP modeling, experience at other sites and the existing water quality. All of the water quality data presented in the EIS which describes existing conditions were collected according to standard scientific procedures.

73. COMMENT: "Tentative assumptions" do not constitute scientifically prudent criterion for the prediction of acid mine drainage. Kinetic tests and actual field measurements from existing spent ore heaps show that the spent ore heaps show that spent ore is likely to generate acid. (Draft EIS, 4-27).

The current water quality emanating from the base of many of the facilities is the result of the waste rock and foundation material below leach pads having generated ARD. The improvement in water quality resulting from limiting infiltration through the facilities will be different depending on the acid generating potential of the bedrock below the facility, the source and amount of water flowing under the facilities. Omitting to comment on the uncertainty of the water quality predictions would be irresponsible and misleading. Currently every drainage in the mine vicinity has experienced significant degradation by acidity and metal contamination. (345)

RESPONSE: The available surface water quality monitoring data shows that the headwaters of the majority of the southern drainage's receiving runoff from the mine facilities have experienced periods of significant water quality degradation. Degradation of the northern drainage's appears to have been limited to increases in nitrate concentrations in their headwaters. Numerous cautionary statements are made in the EIS concerning accuracy in the impacts analysis.

74. COMMENT: According to the Draft EIS, King Creek water quality is monitored primarily by one well 1/4 mile from the mine site. Another monitoring site is installed, but in such a location that water flows rarely reach the site. The Draft EIS should address the adequacy of the data received from one monitoring site. (340)

RESPONSE: Please see Sections 3.2.5.1 and 3.2.5.2 for statements of surface water and groundwater monitoring data adequacy. Additional monitoring in the King Creek area is required in the Preferred Alternative to address this issue.

75. COMMENT: Under Alternative Seven, ZMI will remove rock fill from the head of King Creek and backfill the pits so they freely drain into King Creek. Currently, most of the water from King Creek is diverted into Montana Gulch. The water in Montana Gulch shows contamination from acid mine drainage. The Draft EIS does not address to what extent contaminated water will flow into King Creek when the rock fill blocking the drainage is removed. If this water will be contaminated, the tribes do not want flows to King Creek restored. (340, 351)

RESPONSE: In the Draft EIS, under Alternatives 5 and 7 the drainage to King Creek is to consist only of runoff from the reclaimed pit floors after reclamation. The cut in the pit wall would only be deep enough to allow free drainage of the reclaimed surface. Highwall runoff that is expected to be of poor quality will be diverted to Montana Gulch and treated. Drainage from the pit backfill is expected to continue to drain preferentially through the August and Gold Bug Adits. Under Alternative 5, the water draining into King Creek would thus be of good quality, although some elevated nitrates would be expected due to the use of fertilizers during reclamation of the pit floor. Some temporary elevated sediment concentrations would also be expected during the earthworks to remove the waste rock blocking the drainage between the pits and King Creek. The Preferred Alternative has been changed in the Final EIS to remove the proposed drainage of runoff to King Creek.

76. COMMENT: The Draft EIS states that water quality will be temporarily impacted in King Creek upon removal of the rock fill. The Draft EIS also states that settling ponds will be installed below the pits to address water quality concerns. King Creek is the primary drainage from the mine site running north to the Fort Belknap Indian Reservation. The adequacy of these measures to protect water quality should be addressed. (340)

RESPONSE: These capture systems would only exist to deal with runoff of sediments during earthworks to remove the pit wall/rock fill (sediment traps). This is described in Appendix A, the Water Quality Improvement Plan. If poor quality water were found to be entering King Creek, capture and treatment facilities would be used to mitigate any further impact.

77. COMMENT: The Draft EIS proposes new quarries to generate the limestone to be used in reclamation, but does not address the impacts from these quarries on Lodgepole, Beaver, and King Creeks. These impacts are of great concern to the tribes because these creeks drain to the reservation. (203, 267, 275 through 319, 338, 340, LO-38)

RESPONSE: See Section 4.2.5 Reclamation Materials for expanded discussion of the impacts associated with the development of these quarries. The Preferred Alternative in the Final EIS has been changed to remove these two quarries as the source of reclamation materials for Alternatives 3 and 7, instead limestones from the L-2 limestone quarry at Zortman and the Montana Gulch limestone quarry at Landusky, would be used.

78. COMMENT: As the summary of the compliance plan in the Draft EIS mentions, there is no final decision yet as to how ZMI will neutralize the pH in the containment ponds that collect acid rock drainage in situ (in stream) or in the pond. In situ treatment can lead to precipitation of the metals into the surface water. The adverse impacts from such precipitation must be addressed, since in situ treatment is a possibility. (340)

RESPONSE: Water treatment by use of treatment plants is proposed, In-situ lime treatment is not proposed or allowed so instream precipitation does not need to be assessed.

79. COMMENT: The Draft EIS states that "surface water quality usually represents 'worst-case'" conditions when compared to adjacent groundwater, particularly bedrock groundwater which is much less likely to be impacted than alluvial groundwater." There is, however, ample evidence that past mining has negatively impacted bedrock groundwater quality as well as surface and alluvial groundwater. Groundwater analysis from the pit areas of both the Landusky and Zortman mines show effects of acid rock drainage (ARD). Wells in the Madison group also show evidence of ARD-impacted waters. Draft EIS at 3-90. Simply minimizing water contamination will not prevent groundwater contamination. These contaminated bedrock groundwaters will migrate downward and outward from the Little Rocky Mountains and "maybe transmitted from the groundwater system to surface water at some lower elevation." This contamination may resurface in areas where monitoring and containment facilities are absent. In order to truly evaluate the impacts of each of the alternatives proposed in the Draft EIS, a thorough analysis of groundwater contamination and flow is needed. (340)

RESPONSE: Available hydrogeologic data and groundwater quality data have enabled a conceptual model of groundwater flow at the site to be developed. It is acknowledged that data regarding the hydrogeologic conditions (especially the influence of structures) is limited. However, the influence of structures on groundwater flow at the site will not be as dominant and in most cases will be consistent with topographic effects.

80. COMMENT: In all of the expansion alternatives (4-7), the expanded pits will be mined below bedrock groundwater levels. During closure of the mine, the pits will then be backfilled with "material--either waste rock or spent ore--(that) is likely to degrade the water quality relative to baseline even if the waters do not become acidic." The backfilled pits will therefore contain 140-200 feet of water-saturated rock that has a high potential for generating ARD or similarly contaminated groundwater.

The Draft EIS's assessment of where contaminated groundwater from the pits will flow is inadequate. At both mine sites the Draft EIS assumes that the groundwater in the pits will flow to the south and into surface drainages where it can be captured and treated in planned capture facilities. The argument that the pit groundwater will flow toward the south is particularly weak at the Zortman mine, where contaminated groundwater "is expected to discharge to the headwaters of Ruby Gulch." This assumption is based not on a thorough hydrologic analysis, but only on the occurrence of an ARD-impacted seep in Ruby Gulch that may currently be draining polluted waters from the pit area. On the Landusky side the Draft EIS states that "the majority of any acid rock drainage generated by the backfill would discharge through the August Adit and be captured." The Draft EIS also mentions that "present day water levels suggest the potential for impacted waters to migrate from the pit backfill towards the northern tributaries." A contaminated seep in a tributary of South Bighorn Creek (L-20) at Landusky mine also indicates the presence of flow to the north. Water Management Consultants 1995. Another potential flow path is downward and outward from the high water levels in the pit area into the surrounding sedimentary rocks. The Draft EIS dismisses the latter without any quantitative basis, stating that it could possibly take thousands of years. Either one of these alternative flow routes (to the north or down) would introduce contaminated waters into areas without monitoring or containment facilities. The Draft EIS fails to quantify these potential impacts in assessing the various alternatives presented. (70 through 125, 145 through 157, 165, 166, 275 through 319, 324, 340, 344)

RESPONSE: The potential for some groundwater flow to the north after backfilling of the Zortman and Landusky Pits is acknowledged and the potential for impacts associated with this hypothesis are reviewed (see Section 4.2). However at Zortman, in the absence of any major structural flow path, the development of a free draining surface to the south will result in the groundwater drainage divide being maintained at the northern extent of the Pit complex. This, combined with the high degree of structural deformation between the pits and Ruby Gulch should continue to channel the groundwater discharge to the south. Also, because of the proposed free draining surfaces for the reclaimed Zortman and Landusky pits, groundwater heads in the wall rock surrounding the reclaimed pit will be higher than the heads within the backfilled material. So flow will be from the wall rock into the backfill and then out either along a structural feature with enhanced permeability and/or out through any pre-existing mine working such as the August drain adit. Hydrologic analysis of the Zortman pit complex has also been performed (Hydro-Geo Consultants 1992).

81. COMMENT: The Kootenai Formation and Eagle Sandstone have been cited as potential sources for drinking water quality groundwater in the area surrounding the Little Rocky Mountains. Feltis (1983). These artesian bedrock aquifers are recharged on the slopes of the Little Rocky Mountains and are therefore susceptible to contamination from mining activities in the mountains. The Draft EIS makes no mention of potential contamination to these important sources for drinking water in the area surrounding the Little Rocky Mountains. (340, 344)

RESPONSE: Please see Section 3.2.7.2 for an expanded discussion of the groundwater supplies in the vicinity of the Little Rocky Mountains and Sections 4.2.3 through 4.2.9 for discussion of potential impacts to the aquifers surrounding the Little Rocky Mountains.

82. COMMENT: The tribes have long maintained that the mine has reduced flows to the reservation. The Draft EIS admits that the mine diverts water from the reservation; specifically, 0.6% of the Lodgepole drainage surface that would normally flow north onto the Fort Belknap Reservation is diverted to the Zortman mine pit to the south, and flow has also been diverted from King Creek. The preferred alternative would increase this diversion; 1.5% of the surface runoff from Lodgepole Creek would be diverted into the expanded Zortman mine pit and would then flow into the Ruby Gulch drainage. The Draft EIS states that the impact of this diversion would be minimal.

More important to year-round stream flow would be the diversion of an unspecified quantity of groundwater flow from the Lodgepole drainage. The Draft EIS states that spring discharges in the upper reaches of the drainages would be "significantly less than those observed today." At the Landusky Mine the preferred alternative would "re-establish the approximate pre-mining King Creek catchment area"; but a capture trench is also planned for King Creek that would carry any containment water to Montana Gulch for treatment, again diverting an unspecified amount of water towards the south. (340)

RESPONSE: The proposal to divert surface water runoff to King Creek under Alternative 7 has been removed; however it remains as an option analyzed under Alternative 5. The water that would drain to King Creek under this alternative would consist only of runoff from the reclaimed free draining pit floor and would thus be limited to storm water runoff. The capture trench proposed is to divert potentially poor quality high wall runoff water to the south for treatment. See Section 4.2.7 for discussion of impacts.

83. COMMENT: Landusky pit expansion would also affect groundwater flows to the north, as the pit is expected to act as a groundwater sink, causing the surrounding groundwater to flow into the pit and out the August adit to Montana Gulch. Some of the groundwater in this area currently drains toward the north and would be diverted to the south. (340)

RESPONSE: Some change to groundwater flowpaths in the immediate vicinity of the expanded pit is expected. Please see Sections 4.2.6 through 4.2.9 for discussion of the potential for diversion of groundwater flow due to deepening and backfilling of the pit complex.

84. COMMENT: The Draft EIS notes the importance of faults and fractures in influencing ground-water flow in the area, but provides no maps delineating the direction and dip of major fracture and fault systems within and adjacent to the mines. Fracture trace analysis and clear mapping of all springs in the area is essential for characterizing the framework for the groundwater flow system. Davis (1995) reported water quality analyses for three springs that lie within a few miles northwest of the Landusky mine, yet they are not even mentioned in the EIS. I would not be surprised if a careful survey identified additional springs in this general area. The limited information in the Draft EIS indicates that the potential for movement of contaminated ground water in the direction of the Fort Belknap Reservation is greater than suggested by the Draft EIS. (267)

RESPONSE: Please see Figure 3.1-4 for a summary of the structural features of the Little Rocky Mountains and the expanded discussion of structural control on groundwater flow in Sections 3.2.4 and 3.2.6. The Davis 1995 report is discussed within the Draft EIS, but under reference to the USGS. Please see Sections 3.2.5.1 and 3.2.5.2 for discussions of the water quality data in the vicinity of the Little Rocky Mountains, and Section 3.2.4 for an expanded discussion on the potential for the movement of contaminated groundwater in the direction of the Fort Belknap Indian Reservation.

85. COMMENT: The Draft EIS presents no potentiometric data that would allow general evaluation of groundwater gradients and flow directions in the area of the Zortman and Landusky mines. The schematic hydrogeology cross-section in Figure 3.2-25 is based on pure speculation. The Draft EIS admits that most monitoring wells are in valley bottoms, so that there are no data to characterize the groundwater flow system from the mountain-top nines to the valleys. (267)

RESPONSE: The Final EIS contains two potentiometric surface maps based on the available water level data in the vicinity of the Zortman and Landusky pits. Please see Figures 3.2-9 and 3.2-10.

86. COMMENT: The Draft EIS presents no information at all on the hydraulic characteristics of different geologic materials in the Zortman and Landusky mine areas. Such information is essential, in combination with potentiometric data, for evaluating the speed with which ground-water contaminants may move in the subsurface. (267)

RESPONSE: Data on the hydraulic characteristics of the geologic materials within the Zortman and Landusky area is limited. An expanded review of the available hydrogeologic information is provided in Section 3.2.4. Also, a study conducted by Hydro-Geo Consultants (1992) showed test sites from the Zortman pit shear zones and from ZL-102 show a range of hydraulic conductivities between $3.9x10^{-1}$ and $1.2x10^{-3}$ feet per day. Adequate data is not available from which to calculate groundwater velocities.

87. COMMENT: The Draft EIS presents evidence that the Madison aquifers are being contaminated by the Zortman and Landusky mines, and that heavy metals are being removed from the contaminant plume by neutralization processes. However, the magnitude and geochemistry of contaminant-Madison aquifer interactions is so minimally characterized as to provide no justification for that statement in the Draft EIS that "it is unlikely that the Madison Limestone groundwaters would become contaminated beyond the margins of the Little Rocky Mountains" (p. 3-101). It is at the margins of the Little Rocky Mountains that the quality of ground-water in the Madison aquifer is best. (267)

RESPONSE: The Draft EIS states that it is unlikely that the Madison Limestone groundwaters would become contaminated beyond the margins of the Little Rocky Mountains. This is due to the neutralization potential of the limestones and the comparatively small amount of impacted recharge relative to the regional recharge to the Madison Limestone. The potential for water quality degradation at the margins of the Little Rocky Mountains is less certain, due to the structural complexity of the mountain range; however the implementation of water capture and treatment in the headwaters of the impacted drainages will significantly reduce the potential of any recharge to the limestones downstream. Contamination in the Madison is suspected to be extremely localized and is limited to sites where contaminated streams (e.g., Ruby Gulch) cross the Madison formation.

88. COMMENT: The Draft EIS fails to present the full magnitude and seriousness of contamination that has been caused by the Zortman and Landusky Mines by omitting information that is relevant to judging the seriousness of contamination and by interpreting some data as indicating no effects, when the data indicate otherwise. For instance, the Draft EIS statement that King Creek well ZL-140 (alluvium) has not been noticeably impacted by mining is incorrect. Elevated sulfates and nitrates are evident, although not as high as well ZL-139 (bedrock). The concentrations of nitrates in ZL-139 (10.5 mg/l) exceeds primary drinking water standards (DWS). Also the Draft EIS fails to note that elevated sulfates (292-640 mg/l) also indicate contamination from mining in this well. In area areas characterized by fracture and conduit flow, as occurs in the vicinity of both mines, springs provide simple and inexpensive points for monitoring ground-water quality. It is unconscionable that the first reported water quality data for the three springs reported by Davis (1995) represent samples taken in late August, 1994. Since there is no baseline data prior to mining it is not possible to assess with any certainty whether these springs have already been affected by the Landusky Mine. However, King Creek, which is closest to the mine have relatively higher sulfate concentrations compared to the other two springs (81 mg/l vs. 32-52 mg/l), which suggests the possibility that this spring has already been affected by contamination from the Landusky Mine. (267)

RESPONSE: No information has been omitted that is relevant to the EIS. Please see Section 3.2.5 for edited text on King Creek water quality. From the available spring water quality data at King Creek it is unclear if the 81 mg/l sulfate represents any impact from mining activities. The difference between this and the other spring water quality data with sulfate concentrations of 32 and 52 mg/l could be entirely due to the type of rock through which the groundwater flows.

89. COMMENT: The Draft EIS states that newly completed monitoring wells ZL-209 and ZL-210 in the Lodgepole Creek watershed (the only wells monitoring ground-water flow in the direction of the Fort Belknap Reservation at the Zortman Mine) show no evidence of impact from mining (pp. 3-45, 3-88). However, the elevated sulfates in both wells (80 to 182 mg/l) do indicate some impact from mining. Sulfate levels in nearby Springs Z-6 show low sulfate concentrations (11-26 mg/l) and pre-1979 water quality of groundwater from sources not impacted by earlier mining in Ruby Gulch, Lodge Pole and Mill Gulch had sulfate concentrations ranging from 5-44 mg/l (see Table 3.2-21). (267)

RESPONSE: The comment in the Draft EIS that the water quality data from ZL-209 and ZL-210 show no evidence of impact from mining has been removed from the EIS. Rather, from the limited amount of data available it is unclear if the groundwaters sampled at ZL-209 and ZL-210 are impacted by mining activities. If affected, the impacts are only minimal. The sulfate concentrations reported (80 to 182 mg/l) could reflect some minor water quality degradation due to mining activities; or these data could be due to materials used during the construction of the wells not being completely removed from the well; or due to metal sulfides in the rock, within which the wells are completed. Note that the source of spring Z-6 is limestone; wells ZL-209 and ZL-210 are completed in mineralized monzonite porphyry.

90. COMMENT: The Draft EIS fails to note that, except where capture and treatment of surface runoff has been initiated (Ruby Gulch and Alder Gulch), the water quality indicator parameters of sulfate and TDS show upward trends at most locations: Rock Creek L-1 (Figure 3.2-16), Mill Creek L-7 (Figure 3.2-17), Gold Bug Adit Discharge L-3 (Figure 3.2-18), Montana Gulch L-2 (Figure 3.2-19), and King Creek L-5 (Figure 3.2-20). It will probably be several years before it will be possible to conclude whether the 1993 removal of historic tailings in King Creek will change the upward trend in sulfate and TDS at King Creek L-5. (267)

RESPONSE: See Section 3.2.5 for discussion of groundwater quality and more discussion of these parameters.

91. COMMENT: The Draft EIS incorrectly states on page 3-70 that since 1979, water quality deriving from the Gold Bug Adit at the Landusky Mine has remained similar to baseline conditions. The graphs of TDS and sulfate in Figure 3.2-18 show a clear upward trend for the Gold Bug Adit. This upward trend is significant because, as a ground-water discharge point, it provides an indicator that the Landusky Mine is causing ground-water quality to become progressively worse with time, and may well continue to worsen. (267)

RESPONSE: Although the water quality at the Gold Bug Adit has remained similar to pre 1979, some minor increases in TDS and sulfate have occurred and pHs have been reduced on occasion. See Section 3.2.5 for clarified text.

92. COMMENT: The inadequate characterization of the ground-water flow system prevents assessment of the extent to which surface and ground water contamination resulting from current mining activities will have long-term adverse effects on surface and ground water flowing from the Zortman and Landusky mines. Information in the Draft EIS shows that the most extensive contamination of surface and ground water occurs in watersheds that drain to the south, away from the Fort Belknap Reservation. However, movement of contaminated ground-water in the direction of the Reservation may be more significant that indicated in the Draft EIS. The Draft EIS notes on page 3-6 that the direction of ground-water flow is strongly controlled by fracture orientation. The Draft EIS states that major controls on the geologic structure of the area are steeply-dipping, north-northwest trending fractures. North-northwest fractures, which appear to control the shape of the Zortman mine, would tend to allow ground-water to migrate preferentially in the direction of the Reservation. (267)

RESPONSE: Please see Section 3.2.4 for expanded discussion on structural control of groundwater flow.

93. COMMENT: The Draft EIS is confusing with respect to directions of ground-water flow at the Landusky Mine. It cites Water Management Consultants (1995--which is not listed in the reference Section) as indicating that northeast trending shear zones are the principal feature controlling ground water flow in that area (p. 3-46). However, it mentions a high water level elevation measured in 95LH-010 (which I can't locate on the Exhibit 2 map) may indicate that water in the Surprise Shear Zone is draining toward the northwest towards Peoples Creek. It also notes that Spring L-5 in King Creek may be the result of a discharge from a perched water table in the Narrows Fault Zone. The geologic map of the Little Rocky Mountains prepared by Knechtel (1959) shows a number of northwest-trending faults in the vicinity of King Creek which could serve a preferential flow paths for contaminated ground-water toward the Fort Belknap Reservation. (267)

RESPONSE: The northeast trending shears do appear to have a significant effect on the flow of groundwater at the Landusky mine. However, some flow also appears to be controlled by other features. See Section

3.2.4 for expanded discussion of geologic structures and their effect on groundwater flow. Exhibits have been revised to show more key monitoring locations. Overall, groundwater flow beneath the pit areas appear to be preferentially directed to the south due to the influence of the Gold Bug and August adits.

94. COMMENT: The existing ground-water monitoring network to the north of the two mines is so sparse that, undetected contaminant plumes may be moving in the direction of the Reservation. The Draft EIS states that no ground water data are currently available from South Bighorn Creek (3-97). The topography in the map in Exhibit 2 indicates that Swift Gulch which lies immediately to the north of the Landusky Mine has a northwest trend typical of fracture trends in the area, which intersects the northeast trending fracture zones where active mining is occurring. There would appear to be a logical preferential flow path of ground water toward South Bighorn Creek and failure to install ground-water monitoring wells in this are is a serious oversight. (4, 267, 320, 338, LO-37, HA-53, GF-15)

RESPONSE: Additional monitoring is necessary in South Bighorn Creek and other northern and southern drainages; please see Sections 2.7.3.1 and 2.11.3.1 of the EIS for the agency proposed monitoring program.

95. COMMENT: Spring Z-6 which feeds Lodgepole Creek north of the Zortman Mine was the only ground-water monitoring point north of the Zortman Mine from 1979 until 1995 when two wells were installed. This spring lies across the Lodgepole Creek valley from the mine and would not be expected to be affected by the mine. The quality of water in this spring could be affected by proposed Limestone Quarry LS-1, so monitoring of this spring should continue. (267)

RESPONSE: Monitoring would continue at this location under any alternative. The Preferred Alternative has been changed and mining of limestone at LS-1 would not occur.

96. COMMENT: Surface water monitoring stations in Beaver Creek north of the Zortman Mine do appear to provide representative baseline surface water quality data. Installation of a bedrock monitoring well would help provide baseline ground-water quality data. (267)

RESPONSE: Groundwater data from Beaver Creek would be useful baseline groundwater data at least for portions of the Little Rocky Mountains not receiving recharge from a mineralized area. Should any activity be proposed in this area, a baseline well would be installed.

97. COMMENT: The Draft EIS states that recent sampling of 3 springs and 2 ground water wells on the Fort Belknap Reservation showed no indications of influence by ARD and concluded that the continued good quality of the spring discharges is likely due to the high neutralizing capacity and dilution within the limestone upgradient. There is no justification for this conclusion without a better understanding of the groundwater flow system. As with the Zortman well Z-8A discussed below, unless the direction and speed of ground-water flow is better known, contamination may show up tomorrow, or many years in the future long after the Zortman and Landusky Mines have been shut down. The Madison aquifer in other parts of the Fort Belknap Reservation is of marginal quality as a drinking water source for humans. The high quality of springs and wells associated with the Madison aquifer northeast of the Landusky mine is all the more reason to be concerned about evidence cited above that contamination is moving in that direction. (267)

RESPONSE: See Sections 4.2.3 through 4.2.9 for additional discussion of the potential impacts to the Fort Belknap Indian Reservation and other groundwater users. The potential for contamination to affect these springs is low.

98. COMMENT: The Draft EIS also understates the potential for adverse impacts from current contamination on the ground-water wells used by the towns of Landusky and Zortman. Data in the Draft EIS indicate that the contaminant plume from the Landusky Mine reached well TP-1, one of the town of Landusky's water supply wells, relatively recently (with a maximum of 508 mg/l sulfate in fall of 1993). Yet the Draft EIS says nothing about the need for assessing the vulnerability of the town's other three water supply wells or requiring ZMI to take measures to prevent further degradation of the town's ground water. (267)

RESPONSE: Maximum sulfate concentrations at TP-1 have been recorded during August of 1995 at 657 mg/l indicating that the alluvial aquifer below the town of Landusky has been impacted by ARD. The water from these wells is suitable for domestic use, although bottled drinking water has been made available to the residents of Landusky by ZMI. Under the Water Quality Improvement Plan, the existing surface water segregation and mine drainage capture systems would be augmented by a much larger capture pond and two additional seepage capture systems. All captured water would be pumped to the Landusky water treatment plant to be constructed in Montana Gulch. These actions would significantly improve downgradient water quality by capturing poor quality seepage bypassing the current capture system. A contingency drinking water well for the town of Landusky exists to the south, although yields are limited and that well is not presently in operation (Russell 1995).

99. COMMENT: The Draft EIS states that ARD contamination or other mining related effects at Zortman community well Z-8A are unlikely because it is located in a tributary that has no mining related facilities and is separated from the impacted limestone at ZL-142 by a "considerable" distance. There is no justification for such a statement without a better understanding of the line ground-water data from the area ground-water flow system. As noted earlier, other base would indicate that a concentration of 209 mg/l sulfate may well indicate influence from ARD. Even if it has not yet been influenced, unless it can be demonstrated that the zone of influence of the pumping well does not intersect the contaminant plume from the Zortman Mine, the failure to find indications of contamination since 1982 is no assurance that it won't show up in the foreseeable future. (267)

RESPONSE: A sulfate concentration of 209 mg/l within a limestone well does not suggest current contamination from mining related activities. However it is acknowledged that if the cone of depression around the well intersects a plume of contaminated groundwater in the Ruby Gulch drainage, then the potential for degradation of the water supply well does exist. Water supply well Z-8A is monitored frequently and any water quality degradation should be quickly recognized.

100. COMMENT: The Draft EIS says nothing about the need for long-term monitoring of surface and ground water after mining is completed. (267, 211, 320)

RESPONSE: Monitoring is required to continue at least five years after final mine closure at all monitoring sites (see Section 2.3.8.1). Post-closure monitoring is covered by the reclamation bond.

101. COMMENT: In general, the discussions for geochemistry, groundwater, and surface water appear to be overly simplistic, even for a document written for public consumption. For example, the discussion of impacts to ground and surface water assumes that ARD and/or system leakage has affected water chemistry conditions. The rational for deciding whether groundwater or surface water resources have been impacted is based on apparent changes in sulfate, pH, cyanide (total), TDS or EC. It is assumed that there is no potential for naturally high levels of sulfate, metals, TDS or EC, or low levels of pH. At least some of the elevated or depressed conditions may be the result of natural processes, yet no discussion of the possible occurrence of natural ARD is presented. (342)

RESPONSE: The rationale for deciding whether groundwater or surface water resources have been impacted is based on changes in indicator parameters listed above over time, i.e trend analysis over time rather than apparent changes. However, the potential for naturally depressed pH's, and elevated sulfates and metals does exists, and a brief discussion of these processes has been incorporated into the EIS. Also, drilling of a monitoring well can result in oxidation of surrounding bedrock resulting in changes in water quality over time. See the sidebar in Section 3.2.2.1.

102. COMMENT: Many of the graphs presented (e.g., Figure 3.2-11) show that there is a strong seasonal trend to the data. This, however, is not discussed in the accompanying text. (342)

RESPONSE: Seasonal trends are discussed in the EIS where they are apparent as the discussion may explain observed fluctuations in concentrations.

103. COMMENT: Section 3.2.3, 3.2.4, and 3.2.5. The Surface Water, Groundwater, and Water Quality sections contain several discussions that are inconsistent with ZMI data including:

- variations in the locations of sampling stations (i.e. which drainage a particular surface water station or groundwater monitoring well is located)
- periods of record for surface and groundwater samples
- sites used to characterize specific drainages
- geologic units in which wells are completed (e.g. in Table 3.2-26, ZL-131 is listed as metamorphic, while our records show that this well is completed in syenite porphyry). (342)

RESPONSE: Where specific errors have been identified, changes have been made (see Table 3.2-26) in the EIS.

104. COMMENT: Section 3.2.3 - <u>Surface Water</u>, page 3-43, column 1, paragraph 2. For clarity, this paragraph might want to point out that in the Zortman Mining area, Alder Gulch, Ruby Gulch (which was not included in the discussion), and Goslin Gulch are tributary to Ruby Creek. Pony Gulch, Alder Spur and Carter Gulch are tributary to Alder Gulch. This gives the reader a general idea of the order of the creeks. Also note that the Goslin Flat area comprises the drainage and adjacent ground, including uplands. Goslin Gulch refers to the drainage specifically. (342)

RESPONSE: Please see Section 3.2.3 - Surface Water for text clarifying the order of the creeks.

105. COMMENT: Section 3.2.3 - Surface Water, page 3-43, column 1, paragraph 5. Why was the period of record chosen for Z-1 and Z-15 1989-1992? Both stations have a longer period of record. (342)

RESPONSE: This comparatively short duration of time was reported to show the large variation in flow in Ruby Gulch due to large runoff events.

106. COMMENT: Section 3.2.3 - Surface Water, page 3-43, column 2, paragraph 1, line 16. The "significant" rainfall years listed in this paragraph are not consistent with ZMI data, which indicate that 1985 and 1987 were high rainfall years. (342)

RESPONSE: The text is referring to significant rainfall events rather than high rainfall years; see Section 3.2.3 for clarification of text.

107. COMMENT: Section 3.2.3, page 3-44, column 1, paragraph 1 - Lodgepole Creek. This paragraph may want to incorporate the following information:

- At the confluence of Lodgepole Creek and Glory Hole Creek, there is a spring area that provides perennial flow to Lodgepole Creek.
- Glory Hole Creek contains waste rock and open mine pits in the very upper end. (342)

RESPONSE: See Section 3.2.3 for text discussing the mine disturbances in Glory Hole Creek and the perennial spring at the confluence of Glory Hole Creek and Lodgepole Creek.

108. COMMENT: Section 3.2.3.2 - Streams and Tributaries - Landusky, page 3-44. The discussion of Landusky streams and tributaries may want to include the following information:

- King Creek and South Bighorn Creek are tributaries to Little Peoples Creek
- Swift Gulch is tributary to South Bighorn Creek
- Rock Creek has low flow in its upper segment, but becomes intermittent east of the Mill Gulch confluence where it enters the wider valley near the community of Landusky. (342)

RESPONSE: These items have been added to the discussion of streams and tributaries at Landusky; please see Section 3.2.3 of the EIS.

109. COMMENT: The groundwater discussion in Section 3.2.4 seems overly simplistic. There is no discussion of hydraulic properties (e.g., transmissivity, hydraulic conductivity, storativity, groundwater flow rates, flow controls, recharge, discharge) in this section. Also, the discussion on regional versus mine site groundwater occurrences is confusing. It seems as though the term Little Rocky Mountains is used when "mine site" might be more appropriate. The mine encompasses only a small part of the Little Rocky Mountains, and the terms are not synonymous. It would be useful to subdivide this section. Suggested subheadings include: regional hydrogeology (to include a discussion of the Madison aquifer); groundwater occurrences (include descriptions for both Zortman and Landusky); hydraulic properties of hydrostratigraphic units; groundwater movement (include descriptions for both Zortman and Landusky). (342)

RESPONSE: The level of detail provided in the discussion of the groundwater in the Little Rocky Mountains reflects the amount of technical data available at the time the Draft EIS was prepared, and the level of information presentation required by NEPA and MEPA regulations for public disclosure. Please see Section 3.2.4 for some an expanded discussion of groundwater conditions.

110. COMMENT: It is stated in paragraph 3 of page 3-45 of the Draft EIS that "Monitoring wells located within the Little Rocky Mountains are predominantly located near to or at the base of the valleys." This statement follows a sentence discussing ZMI monitoring wells. Is this statement referring to the wells at and adjacent to the mine site? Are there many other monitoring wells in the Little Rocky Mountains? The term "valley" suggests something on a grander scale than most of the drainage bottoms and valleys at the mine sites. (342)

RESPONSE: This statement refers to the wells at and adjacent to the mine site being predominantly located near or at the base of the drainages.

111. COMMENT: Section 3.2.4 - Groundwater, page 3-46, column 1, paragraph 1, line 3. "The third component of groundwater flow is." Are the southeasterly flow and possible northern flow, the first and second components of flow? (342)

RESPONSE: "The third" component of flow does not reflect any order of significance or magnitude. Please see Section 3.2.4 of the EIS where this flow is referred to as "another" component of flow.

112. COMMENT: Section 3.2.4, page 3-46, column 1, paragraph 4. Does this paragraph infer that a significant proportion of the flow from Goslin Gulch is intercepted by the limestone units? The previous page states that there is over 200 feet of low permeability Thermopolis Shale between the Goslin Gulch alluvium and the Madison. Some discussion of the amount of time required for water from Goslin to penetrate the alluvium and 200 feet of shale in order to provide recharge to the Madison may be appropriate. (342)

RESPONSE: The decrease in volume or absence of water observed in the streams and alluvium at downstream locations does suggest that a significant portion of the flow is currently intercepted by the limestone units where they are exposed in the streambed or directly underly the alluvium. Quantification of flow times through the shales at Goslin Flats is not considered necessary. See Section 3.2.4 for clarification of the text.

113. COMMENT: Section 3.2.4, page 3-46, column 1, paragraph 5. This paragraph states that most of the springs along the flanks of the Little Rocky Mountains are fed through precipitation and infiltration into exposed limestones as evidenced by the quick reaction of spring flow to the precipitation events in the mountains (Feltis, 1983). This may be true, but it leaves out the point that the baseflow in many of the springs along the flanks of the Little Rocky Mountains is due to discharge from the regional Madison aquifer. Page 3-101 describes the response in Big Warm Spring after a significant snowstorm in 1974. While discharge from the spring did increase significantly, this increase was short-lived and both water quantity and quality returned to baseflow conditions. (342)

RESPONSE: It is unclear if baseflow to the springs around the periphery of the Little Rocky Mountains is due to regional discharge from the exposed limestones or due to recharge to the limestones at higher elevations within the Little Rocky Mountains. See Section 3.2.4 for clarification of text.

114. COMMENT: Section 3.2.4, page 3-46, column 2, second bullet. This key point states that "The Madison Group limestones exposed within the Little Rocky Mountains have received relatively minor amounts of recharge by water impacted by mining activities. This recharge is facilitated by downward vertical gradients in the rocks exposed in the streambeds." There is indeed evidence supporting that downward vertical gradients exist within the lower portions of the mine site drainage and that the Madison aquifer may receive some recharge from mine site waters which flow over outcropping or subcropping Madison Limestone in drainages. However, the amount of recharge and the quantity of recharge by "impacted" waters is currently under investigation. No evidence of mining-related impacts have been observed in any springs sampled around the periphery of the Little Rocky Mountains. Additionally, evidence of impacts to the Madison within the mine site are speculative since well logs are lacking or of poor quality. Areas identified as "limestone" may be limestone alluvium or carbonate units within the metamorphics." (342)

RESPONSE: Relative to the regional recharge the Madison limestone receives, the impacted recharge within the Little Rocky Mountains is "relatively minor." However, as data is not available to adequately quantify this recharge, the EIS now states "have received recharge by waters impacted by mining activities" with no reference to the amount of recharge.

115. COMMENT: Section 3.2.5, page 3-46. The water chemistry discussion assumes that waters at the site are either natural and pristine or have been directly impacted by recent mining. In order to support these two conditions, the authors rely on tenuous arguments. For example, the authors argue that elevated sulfate, TDS, and other constituent concentrations at Z-1 coincide with the excavation of the 85/86 pads, suggesting that disturbance of the pad areas caused ARD, which then affected the water chemistry at Z-1. If this impact was the result of surface water runoff, constituent concentrations should reflect both seasonal changes and effects of liner installation. If the excavation of the 85/86 pads affected groundwater, which in turn affected the water chemistry at Z-1, it appears that the transit time is extremely brief. Since the groundwater discussion does not present any hydraulic conductivity/transmissivity information, it is difficult to determine if this transit time is reasonable. (342)

RESPONSE: The water quality discussion recognizes impacts based on water quality trends; degradation of water quality over time is attributed to mining facilities or mining related activities. Water quality degradation does roughly coincide with the construction of the 85/86 pad. After further consideration of the available data, however, it is thought that the water quality degradation is more likely due to exposing acid generating rock during deepening of the pit areas. Some seasonal response is recognized at Z-1, with higher TDS concentrations and lower pH during spring sampling events when flow are generally higher. No response to liner installation at the 85/86 leach pad is expected as the majority of the flow is baseflow through the underdrains, recharged by the pit areas and undisturbed catchment area upstream rather than infiltration through the liner.

116. COMMENT: The authors suggest on page 3-50 that pre-disturbance water chemistry conditions can be defined by either: 1) pre-disturbance water chemistry samples (generally one sample per drainage); and 2) water chemistry conditions in adjacent undisturbed stream or groundwater systems. The result of this approach leads to the conclusion that "baseline" water chemistry conditions at the Zortman site are represented by water chemistry conditions in Beaver Creek or other unimpacted drainages in the Little Rocky Mountains. Since a variety of factors, including geology, influence the water chemistry in individual drainages, a regional baseline characterization is usually inadequate. It should be made clear that the regional conditions are not necessarily representative of individual drainages. (342)

RESPONSE: The number of pre-1979 samples available for a particular drainage has been included in the text (see Sections 3.2.5.1 and 3.2.5.2). Discussions of water quality conditions in adjacent drainages potentially being representative of baseline have only been made where geologic conditions are thought to be similar. Beaver Creek has only been referred to as potentially being representative of baseline conditions in nonmineralized drainages of the Little Rocky Mountains.

117. COMMENT: It should be noted that as part of the Compliance Plan, appropriate water quality standards and criteria for drainages in the Zortman and Landusky area are being evaluated as part of the Work Plan Supporting Permit Development for the Zortman and Landusky Mine Site Drainages. Based on results of this process, background water quality will be defined. Commentor suggests adopting the baseline water quality criteria from the Water Quality Improvement Plan, when completed. (342)

RESPONSE: All available pre-1979 data is extremely important to the EIS process as impacts are analyzed relative to pre-1979 or pre-disturbance conditions, not existing conditions.

118. COMMENT: The fall 1992 date for capture installation is in error on page 3-60. The Alder Spur capture was installed in July of 1992. (342)

RESPONSE: See Section 3.2.5.1 for correction to text.

119. COMMENT: Paragraph 3 on page 3-60 of the Draft EIS references Table 3.2-15 which presents summary data for Lodgepole Creek sites Z-28, Z-29 and Z-7, but then only discusses Z-5 in the text (which is not included in the table). (342)

RESPONSE: Only Z-5 was discussed as the other stations showed no discernible impact. Please see Section 3.2.5.1 and Table 3.2-15 for addition of Z-5 data and further discussion of the other surface water monitoring stations in Lodgepole Creek.

120. COMMENT: The Draft EIS Section 3.2.5.1 (page 3-60) infers increased nitrates in the headwaters of Lodgepole Creek may be to blasting activities at the Zortman pits from 1989 to 1993. Mining was discontinued at Zortman in 1989, making it unlikely that blasting was the source for increased nitrates. (342)

RESPONSE: Residual nitrates may still exist on the rock surfaces. It is likely that the nitrates detected in the water quality samples are derived from blasting activities at the Zortman pits.

121. COMMENT: Why hasn't the early sampling history (pre-1990) been included in Table 3.2-15? The period of record for Z-7 is 1978 to present. (342)

RESPONSE: Pre-1990 data was and is included in the table. See Table 3.2.15 for edit to column heading.

122. COMMENT: With reference to the Draft EIS Section 3.2.5.1 (Alder Gulch), the summary (page 3-64) fails to note that seepage is being captured. (342)

RESPONSE: Please see Section 3.2.5.1 for edited text, discussing where impacted waters are currently being captured.

123. COMMENT: Impacts in Lodgepole Creek have been negligible, and restricted to Glory Hole Creek immediately adjacent to the mine. (342)

RESPONSE: Based on the significant amount of time between sampling events at Z-5, the comment that the impacts have been "short-lived" has been removed from the EIS. However, see Lodgepole Creek summary bullet in the Final EIS where text states that surface water impacts are minimal and restricted to Glory Hole Creek.

124. COMMENT: There is an adit located on the east arm of Rock Creek above L-29, which contradicts the statement that "this tributary does not receive drainage from any mining-related activities." (342)

RESPONSE: See Section 3.2.5.1 for corrected text, reflecting that this tributary does not receive drainage from any recent mining related activities but does contain an historic adit.

125. COMMENT: Monitoring station L-17 is not located immediately below the 83 leach pad. However, this station is located below the 85/86 pad. (342)

RESPONSE: See Section 3.2.5.1 for edited text reflecting the correct location of monitoring station L-17.

126. COMMENT: "Adversely" impacted groundwater is not demonstrated in the preceding text for Alder Spur land application (page 3-86 of the Draft EIS). (342)

RESPONSE: See Section 3.2.5.2 for discussion of groundwater contamination from cyanide at Alder Gulch and Alder Spur.

127. COMMENT: Paragraph 3 on page 3-97 of the Draft EIS states that "ZL-139 is impacted by mining activity through fractured bedrock flow or poor well completion." It could be argued that data for this well may reflect tailings impacts. (342)

RESPONSE: It is true that drainage through historic tailings could have contributed to at least some of the water the degradation of groundwater quality; however, the elevated nitrates are more likely derived from recent mining activities.

128. COMMENT: Section 3.2.7 is extremely confusing. Subheadings might be useful to separate regional versus local interactions. Based on a review of Sections 3.2.4 and 3.2.7 of the Draft EIS, and ZMI data, the following points can be made regarding regional and local conditions:

Regionally:

- the Little Rocky Mountains are a minor component of recharge to the Madison aquifer; (and while not documented, the mine site area is probably a minor component of the total recharge of the Little Rocky Mountains)
- the regional aquifer accounts for the baseflow in the springs located along the flanks of the Little Rocky Mountains, although localized precipitation events may temporarily affect the discharge and water chemistry of these springs;
- the flanks of the Little Rocky Mountains generally represent a discharge area for the regional Madison aquifer.

Locally:

- potentiometric surface interpretations, vertical hydraulic gradients, and streamflow data suggest that the upper reaches of Ruby Gulch and Alder Gulch are receiving groundwater from the bedrock system seasonally;
- data indicate that the vertical hydraulic gradient in the lower portions of the Alder Gulch are downward and that water may flow from the alluvium to the bedrock in the lower reaches of the drainage.
- potentiometric and streamflow data show little groundwater recharge to surface water in the upper reaches of the Landusky mine drainages.
- groundwater recharge to surface water in Landusky occurs primarily through flow from underground workings to Montana Gulch.
- much of the groundwater that seeps into streams within the mine permit boundary reinfiltrates along the lower reaches of Rock Creek and Montana Gulch near Landusky.

Some type of quantification of the recharge might also be useful to give the reader a reference. How much of the mine site infiltration contributes to the local recharge? What percentage of the total recharge to the regional aquifer does this constitute? (342)

RESPONSE: The structure of this section has not been altered. As far as quantifying the amount of recharge to the regional aquifer, inadequate hydraulic conductivity and hydraulic head data are available to make a quantitative calculation. The relative amounts of recharge are consistent with the comment.

129. COMMENT: A statement on page 3-101 of the Draft EIS infers that the only reason that springs and groundwater on the Reservation are of good quality is because the high neutralization capacity and dilution of the upgradient limestones. Alternative explanations could include: 1) lack of contaminant load, and 2) strong anisotropic flow in the limestones (i.e. southern margin waters do not mix with northern margin waters). (342)

RESPONSE: The Draft EIS stated that the continued good quality of the spring discharges is likely due to the high neutralizing capacity and dilution within the limestone upgradient. However, it is agreed that the good quality water may be the result of a lack of any contamination in the limestones on the northern side of the Little Rocky Mountains. See Section 3.2.6 for edited text.

130. COMMENT: The discussion of ARD impacts on page 3-101 of the Draft EIS appears contradictory in this section. For instance, column 1, paragraph 4 - the last two sentences state the following with respect to the spring and groundwater sampling on the Reservation: "Analytical results show the springs and groundwater to be of a general calcium bicarbonate type with no indications of ARD. The continued good quality of the spring discharges is likely due to the high neutralizing capacity and dilution within the limestones upgradient." Couldn't another explanation be that the spring discharges and groundwater within the Reservation have not been impacted by mining-related activities? The last sentence of the fourth bulleted item in column 2 indicates that "the water quality of the peripheral springs is unimpacted by mining related processes." (342)

RESPONSE: No existing impacts have been identified to water resources within the Reservation boundaries.

131. COMMENT: The sentence on page 3-102 of the Draft EIS "as a result of the impacts to the alluvial groundwater the town of Zortman now has community well, Z-8A, installed by ZMI." This may infer that the alluvial aquifer is unusable, which is not true. The current water quality at the collection gallery, Z-8, is reported as "good" elsewhere in the Draft EIS. For background, Zortman has a well because it was necessary to replace a water collection gallery (Z-8) after a 1982/83 series of cyanide incidents. This private water supply had not been built according to permit, and the replacement system provided a more dependable and safer supply of water from a properly permitted facility. (342)

RESPONSE: Please see Section 3.2.7.2 for clarification of the need for an alternative water supply for the community of Zortman.

132. COMMENT: The summary of water quality findings on page 3-110 of the Draft EIS states that streams flowing from the Little Rocky Mountains "have defined beds and support aquatic communities." This broad statement is inconsistent with the more specific information included in Section 3.5.2 Fisheries. That section states that few drainages in the Little Rocky Mountains support fisheries, and that "macroinvertebrate populations in the project area are relatively insubstantial." The summary finding should be revised to more accurately reflect the data contained in the Draft EIS. (342)

RESPONSE: Please see Section 3.2.9 for revised text. Text now states that due to the drainages current intermittent nature, fisheries or significant macroinvertebrate populations are not typically supported.

133. COMMENT: Table 3.2-32 notes that the "removal of historic tailings during 1993 has reduced the TSS concentration of surface water." It should probably be noted that seasonal precipitation differences may also have some impact. (342)

RESPONSE: Although seasonal precipitation difference would be expected to have an influence on suspended solids content, since removal of the historic tailings began in 1993 station L-6 has had low suspended solids contents in all samples.

134. COMMENT: Section 4.2.1.2 provides information on the effectiveness of capping at a variety of mine sites, mainly in Canada and Australia. The conclusion from this discussion is that " the Zortman/Landusky facilities may respond quite differently to capping than either the Australian or Canadian examples." It might be appropriate for the BLM and DEQ to review data regarding the effectiveness of covers on sanitary landfills in similar climates to Zortman and Landusky (within the United States). While ARD is not necessarily a problem at landfills, the effectiveness of covers like those proposed in the Draft EIS, with respect to leachate development, may be useful in determining the typical amount of infiltration through the covers. Greg Richardson's March 17, 1995 Engineering Peer Review for the Draft EIS for Zortman and Landusky Mines included numerous water balance cover references (pages 9-12). (342)

RESPONSE: Available literature has been reviewed; however the physical conditions at the Zortman and Landusky mines (slope and climate) suggest that modeling of infiltration is still required. See also new Appendix G for the infiltration modeling assumptions.

135. COMMENT: Section 4.2.1.2, page 4-26, column 1, paragraph 2. This section and, specifically, this paragraph, is generalized and not specific to either the Zortman or Landusky Mines. The first sentence states that mining activity and acid rock drainage can result in high sediment loads which can smother bottom-dwelling aquatic organisms and destroy their habitat. It should be noted that some streams in the Little Rocky Mountains (South Bighorn Creek, for instance) have naturally high bed loads. (342)

RESPONSE: This section is meant to be a generalized discussion of water quality issues at mine sites. The water quality of specific drainages is discussed in Section 3.2.

136. COMMENT: Do the values for Montana Gulch included in Table 4.2-2(b) include Gold Bug Adit? If the table does not include discharge from Gold Bug adit, this should be added. Gold Bug adit water will be treated. (342)

RESPONSE: These tables do include Gold Bug Adit drainage.

137. COMMENT: The pit-related reduction of flow analysis in King Creek is in no way comparable to the reduction of flow analysis in Lodgepole Creek because of the difference in stream order. The Little People's Creek drainage is the appropriate comparison for Lodgepole Creek. (342)

RESPONSE: No direct comparison between these drainages is intended. The downstream limits of the drainages have been selected at points which the reader will recognize, so as to be able to visualize the magnitude of the impact.

138. COMMENT: The discussion of the flow impact to individual drainages appears to conflict in some discussions. Section 4.2.3.2 states that "redistribution of flow to Ruby Gulch (due to routing Landusky capture water to the Zortman water treatment plant) would result in continued low flow or intermittent flow conditions in many drainages that could otherwise provide supplies for wildlife and habitat for fish or macroinvertebrate populations." Section 4.2.4.2 goes on to state that "as the majority of the streams in the Little Rocky Mountains are not perennial in their upper reaches, the impact of diverting acid rock drainage seepage to the Zortman water treatment plant would be minimal." Commentor suggests reassessing the impact and be consistent. Please note that the Water Quality Improvement Plan will require a water treatment plant at Landusky. (342)

RESPONSE: The majority of the steams in the Little Rocky Mountains are not perennial, but some are such as Montana Gulch. See Section 4.2.3.2. for revised text. It is now understood that a water treatment plant will be constructed at the Landusky Mine and capture water would not be transferred to the Zortman Mine for treatment.

139. COMMENT: Is there documentation indicating that the hydraulic conductivity of the 6-inch compacted clay layer in the Alternative 2 reclamation cover would be reduced to 6.4 x 10^{-3} cm/sec for the 6-inch layer? Why are the agencies assuming that the 3-inch compacted clay layer (reclamation cover C for Alternative 4) and 6-inch compacted clay layer will have the same hydraulic conductivity? (342)

RESPONSE: Please see Appendix G for a discussion of HELP modeling inputs and assumptions.

140. COMMENT: The Draft EIS text on page 4-43 states that the "estimated concentrations for facility drainage above the capture systems exceed both aquatic life and human health criteria" and that "these concentrations represent a significant detrimental impact on a local scale." It should be noted that, in most cases, the capture structure is located at the toe of the fill and the drainage area above the capture has been filled. The total capture structure disturbance is estimated at 0.48 acre, therefore, the "local scale" impacts are very small. (342)

RESPONSE: The significance of the impact is not referring to areas of disturbance of the capture system but rather the water quality degradation which results in it no longer being useful for wildlife drinking water, etc. The relatively small area this covers is acknowledged.

141. COMMENT: Is there any documentation for the hydraulic conductivity values presented on page 4-46 for the compacted clay layers presented in this section? (342)

RESPONSE: See Appendix G for a discussion of the HELP modeling inputs and assumptions.

142. COMMENT: Is there documentation indicating that the hydraulic conductivity of the 3-inch compacted clay layer in the Alternative 4 reclamation cover C would be reduced to 6.4 x 10^{-3} cm/sec? This value seems high even for a thin layer. Commentor suggests documenting the value used in the HELP model. (342)

RESPONSE: The HELP modeling and RCRA landfill guidance were used to select an appropriate K for the 3 inch layer of clay. Please see Appendix G in the Final EIS for a discussion of the HELP modeling inputs and assumptions.

143. COMMENT: The Draft EIS predicts a significant long-term impact to Goslin Gulch/Ruby Creek due to a build up of fines from salvaging of soil in the footprint of Goslin Flat leach pad. It should be noted that ZMI plans to employ BMPs to reduce the sediment load to Goslin Gulch and Ruby Creek. Also, there is no potential fish habitat in Goslin Flat or Ruby Creek. (342)

RESPONSE: Although BMPs would be used to control any runoff, some short-term elevated concentrations are expected to result from extreme precipitation events. This impact is not considered significant due to the relatively poor quality of the receiving waters and the lack of any fishery or significant macroinvertebrate population.

144. COMMENT: Section 4.2.9 does not include any reference to the hydraulic conductivity values used in the HELP model for the water balance reclamation covers. Is there any experience at other mine sites or sanitary landfills that might provide guidance for appropriate hydraulic conductivity values? Hydraulic conductivity values should be included and values chosen documented. (342)

RESPONSE: Hydraulic conductivity values are drawn from the HELP model guidance, see Appendix G for a discussion of HELP model inputs and assumptions.

145. COMMENT: The Montana DEQ policy to achieve 48 inches over acid producing materials based on OSM guidelines for coal mines does not apply to the use of a water balance or barrier type reclamation cover. The criteria soil cover should be based on is site specific covers that will prevent infiltration into potentially acid generating material. The infiltration criteria should be 5% or less of precipitation. (342)

RESPONSE: The Montana DEQ policy currently remains to achieve 48 inches over acid producing materials and to minimize infiltration through the reclaimed facilities.

146. COMMENT: The Draft EIS is premature and must be withdrawn until adequate data is collected. The Draft EIS assessment of groundwater impacts is based upon insufficient geologic and hydrologic data. Plans and criteria for how, whether and when the existing mine operations will come into compliance with environmental laws are not yet developed. The Draft EIS should address the strategy for long-term monitoring of surface and ground water and particularly compliance monitoring. BLM should require compliance with the Federal Clean Water Act and Montana Water Act in the Draft EIS prior to or as a condition of expansion. (330, 331, 332, 344)

RESPONSE: Work must be performed by ZMI to attain and monitor interim compliance at the Zortman and Landusky mine sites with the effluent guidelines for ore mining and dressing BAT (Best Available Technology Economically Achievable, 40 CFR 440) water quality standards and final compliance with Montana Pollution Discharge Elimination System (MPDES) water quality effluent limits, and the Clean Water Act, in accordance with a specific schedule. Plans for coming into compliance with water quality standards are described in Appendix A.

147. COMMENT: There is an especially notable lack of monitoring wells to the north of the site, one of the major possible routes for groundwater flow (only three such wells are shown on Exhibits 1 and 2 of the Draft EIS). (344)

RESPONSE: The lack of groundwater monitoring wells is acknowledged in the EIS Section 3.2.5.2 Groundwater Quality and suggested locations for additional monitoring wells proposed in Chapter 2.0 under Alternatives 3 and 7.

148. COMMENT: A more thorough evaluation of the groundwater flow and quality in the vicinity of the Little Rocky Mountains is now underway. This evaluation is needed to fully assess the impacts of both current operations and the proposed mine expansion. (344)

RESPONSE: Existing information is adequate for the purposes of assessing impacts, developing mitigation and alternatives, and making a reasoned choice among alternatives.

149. COMMENT: Even if information was available with which to characterize the potentiometric surface it would not be possible to develop an accurate determination of groundwater drainage divides, flow direction, and potential contaminant flow routes, because the aquifer in the Little Rocky Mountains is a fracture controlled aquifer. (344)

RESPONSE: Some level of uncertainty is always involved when contouring potentiometric surfaces and the influence of structures does compound this uncertainty. The EIS states that the location of the groundwater divide could be subject to some debate due to the lack of monitoring wells from which to contour the potentiometric surface. See Section 3.2.4. Potentiometric Surface and Figures 3.2-9 and 3.2-10 where generalized potentiometric maps are shown for the Zortman and Landusky mine areas. The mitigation of impacts to groundwater beneath the pit areas does not depend upon the groundwater divide but upon placement of enhanced reclamation covers and runon diversions to minimize seepage to groundwater.

150. COMMENT: Evaluation of a fracture-controlled aquifer requires detailed structural and hydrologic analysis to determine groundwater flow directions and velocities. The Draft EIS does not disclose that such an analysis is necessary to develop an accurate description of the impacts on groundwater of the proposed expansion, and there is certainly no evidence in the Draft EIS that such analysis has been performed. (344)

RESPONSE: The Preliminary Assessment of Groundwater Conditions For The Expanded August Pit by Water Management Consultants and the Hydrologic Study of the OK and Independent Open Pits by Hydro-Geo Consultants are referenced and discussed in Section 3.2.4 of the Final EIS. Existing and potential impacts can be assessed based on existing information.

151. COMMENT: Although the Draft EIS admits that impacts to groundwater are foreseeable and significant (Draft EIS at 4-62 to 4-70), the Draft EIS fails to disclose or discuss what those impacts will be. (344)

RESPONSE: All available information on the hydrogeology of the Little Rocky Mountains has been reviewed and incorporated into the EIS. The EIS discusses where groundwater has been and may potentially be impacted. See Sections 3.2.5.2 and 4.2.3 through 4.2.9 for an expanded discussion of impacts to groundwater.

152. COMMENT: The Draft EIS admits that as surface water goes downhill at the site it goes into groundwater, but claims that the amount of such infiltration is "minimal." Draft EIS at 3-45 to 3-46. The Draft EIS offers no basis for this summary dismissal of impacts. (344)

RESPONSE: The comment "relatively minor" is comparing the amount of recharge in the Little Rocky Mountain to the regional recharge of the Madison Limestones. See Section 3.2.4 for text which now states that an unquantified amount of recharge occurs.

153. COMMENT: The Draft EIS also claims that a "significant" percentage of this unquantified groundwater drainage is intercepted by limestones and neutralized. Draft EIS at 3-86. Again, the Draft EIS offers no basis for this conclusion. (344)

RESPONSE: This statement is based on the field observation of little or no flow in the streams downgradient of where limestones are exposed or directly underlie the alluvium and water quality monitoring within the limestones showing neutral pH, low metal concentrations but elevated concentrations of sulfate (typical of neutralized ARD).

154. COMMENT: The Draft EIS makes no attempt to quantify the extent to which this remarkably convenient natural phenomenon "neutralizes" the toxicity of ARD from the mine. The Draft EIS also completely fails to address what happens to the metals that precipitate when ARD encounters limestones. (344)

RESPONSE: Adequate data are not available to quantify the amount of water that is neutralized by the limestone with any confidence. Metals such as aluminum, iron, and manganese, etc., with precipitate out of solution, some will settle out and deposit on the fracture surface and/or karst feature surface (forming an iron stain type deposit), others will become colloidal and travel further before finally settling out onto the rock surfaces. The neutralizing effects of limestone on acidic water is a widespread natural process extensively documented in standard geologic or geochemical literature.

155. COMMENT: The Draft EIS fails to assess whether and when the facility will be in compliance with Water Quality Laws. In addition to omitting information on groundwater impacts the Draft EIS completely fails to discuss how compliance with the CWA and Montana water quality laws will even be achieved or measured. (344)

RESPONSE: Appendix A describes how compliance with the water quality laws would be achieved under the various alternatives.

156. COMMENT: The Draft EIS fails to account for the BLM's trust obligation to the Tribes. Impacts to water quality to the north are not adequately discussed, especially in light of the Tribes reserved water rights. The Draft EIS admits that the mine diverts water from the Reservation. Specifically, 0.6% of the Lodgepole drainage area that would normally flow to the north onto the Fort Belknap Reservation is currently diverted to the south into the Zortman mine pit, a diversion that the Draft EIS characterizes as "negligible." (344)

RESPONSE: Although any alteration to a drainage area is of importance, the EIS must assess the significance of an impact with respect to beneficial use. As Lodgepole Creek is ephemeral in its upper reaches and only approximately 0.6% of the drainage area upstream of the Reservation boundary has been diverted, the impact has been characterized as negligible with respect to water quantity, and minimal with respect to water quality.

157. COMMENT: Flow has been diverted from King Creek, in an unquantified amount characterized as "negligible." (344)

RESPONSE: The diversion of 13 percent of the King Creek area is characterized as "significant" with respect to that drainage; please see Section 4.2.3.4.

158. COMMENT: The preferred alternative would nearly triple the diversion from the Lodgepole drainage, so that approximately 1.5% of the surface runoff in the drainage would be diverted into the expanded Zortman mine pit and would then flow into the Ruby Gulch drainage. Draft EIS at 4-54. Although the Draft EIS claims that the impact of these diversions would be "minimal," the Draft EIS provides no explanation for this conclusion. (344)

RESPONSE: As mentioned, any alteration to a drainage is of importance. However, the percentage of recharge that will be diverted is minimal and therefor impacts to water resources are considered to be minimal. From a cultural point of view such a diversion may be perceived as significant.

159. COMMENT: At the Landusky Mine, the preferred alternative would "re-establish the approximate pre-mining King Creek catchment area" (Draft EIS at 4-55); but a capture trench is also planned for King Creek that would carry water to Montana Gulch for treatment, again diverting an unspecified amount of water towards the south. (344)

RESPONSE: The "preferred alternative" (Alternative 7) no longer includes diversion of runoff from the Landusky pit complex to King Creek. The capture trench would be installed as a contingency. If the runoff water is of poor quality then that water would be pumped to the Landusky treatment plant and discharged to Montana Gulch. This would not be a significant volume of water as King Creek is typically dry at the capture trench location.

160. COMMENT: The Landusky pit expansion would also affect groundwater flows to the north. The pit is expected to act as a groundwater sink, causing the surrounding groundwater to flow into the pit then south, through the August adit to Montana Gulch. (344)

RESPONSE: Groundwater flow in the upper reaches of the northern drainages may decrease as a result of deepening the pit (at least prior to backfilling). See Section 4.2 for expanded groundwater impacts discussion. Note that the Landusky pit would become deeper but would not expand.

161. COMMENT: The Draft EIS fails to reveal that the preferred alternative violates BLM's duty to avoid unnecessary and undue degradation under FLPMA. The Draft EIS claims that "surface water usually represents "worst-case" conditions when compared to adjacent groundwater, particularly bedrock which is much less likely to be impacted than alluvial groundwater. The Draft EIS provides no basis for this hypothesis, which is, in fact incorrect. Such a theory may be true in the short term, for contamination that occurs at the surface, but does not hold true for long-term groundwater quality because contaminants generally linger in groundwater after surface water is clean, or travel long distances to areas where surface waters were never contaminated. (344)

RESPONSE: The statement that surface water quality usually represents "worst-case" conditions when compared to adjacent groundwater, is too generic and has been removed from the EIS. The intent of this statement was to point out that seepage at the base of mine waste units is generally more degraded than adjacent groundwater and therefore represents "worst-case" impacts that would be expected to occur. Surface water quality is discussed predominantly in the impact analysis as it provides resolution between alternatives from which to recognize which reclamation alternatives are most protective to water resources. As a result of the higher level of uncertainty associated with groundwater flow and quality, the discussion is more qualitative. Please see Section 4.2 for an expanded discussion of groundwater impacts.

162. COMMENT: The Draft EIS fails to account for groundwater impacts of water-saturated fill in the expanded pits. The Draft EIS's assessment of where contaminated water from the pits will flow is wrong. At both mine sites the Draft EIS assumes that all groundwater that enters the pits (and is then contaminated from contact with waste rock) will be siphoned towards the south via underground passages into the surface drainages. Id. The Draft EIS assumes that all of this ARD contaminated water from the pits will emerge at just one outfall for the Landusky mine and one for the Zortman mine, and therefore proposes to capture and treat ARD contaminated water only at these two points. Obviously, if these assumptions are wrong contaminated mine drainage will escape capture and treatment and will spread to further contaminate ground and surface waters. (344)

RESPONSE: The EIS states that there is the potential for groundwater from the backfilled pits at Zortman and Landusky to discharge to the north either to the surface water and alluvium or to recharge the bedrock on the northern flank of the mountains (see Section 4.2). However the majority of the groundwater discharge is expected to be along the preferential flow paths identified to the south. If groundwater monitoring shows any discharge of impacted groundwaters to the north or elsewhere, corrective actions would be taken. This includes water capture and treatment as necessary. Mitigation has been added to the preferred alternative that restricts the acid generating potential of waste rock that is backfilled in the Zortman pits below the water table.

163. COMMENT: There is some support in the Draft EIS for an assumption that much of the drainage from the August pit will emerge at a single outfall. There is no basis for assuming, however, that all of the contaminated groundwater from the August Pit will emerge at this pitfall. In fact there is every basis for assuming that at least some of this contaminated groundwater will percolate downward through fractures. Similar assumption made by the Draft EIS for the Zortman pit is virtually groundless. It is based solely on the presence of an ARD-impacted seep in Ruby Gulch that may be currently draining polluted waters from the pit area. The mine cannot base its proposal on the unsupported and incorrect theory that the groundwater. (344)

RESPONSE: See Sections 3.2.4 and 4.2.3 through 4.2.9 for an expanded discussion of groundwater conditions at the Zortman and Landusky mines and anticipated groundwater flow conditions. Project flow directions from the Zortman pit complex are based upon locations of underground mine workings, fractures, faults, contouring of the potentiometric surface in the pit area and other hydrogeologic investigations, as well as observations of acidic seepage in Ruby Gulch.

164. COMMENT: ARD will certainly flow downward and outward from the high water levels in the pit area into the surrounding sedimentary rocks, including flows to the north. The Draft EIS dismisses this flow of contaminants without any quantitative basis, stating only that it could possibly take thousands of years for the pollutants to reach recharge zones to surface waters. Both of these alternative flow routes (to the north and down) will introduce contaminated waters into areas which have <u>no</u> monitoring or containment facilities. The Draft EIS fails to disclose and consider these impacts in assessing the various alternatives presented. (344)

RESPONSE: The near vertical flow path discussed in the text refers to flow down through the core of the intrusive rocks, where it is likely that hydraulic conductivities would be low as would be the potential for karst-like features in the limestone. See Section 4.2 for expanded discussion of groundwater impacts between alternatives. Additional groundwater monitoring to the north of the mine operations has been added to the preferred alternative in Section 2.11.3.1.

165. COMMENT: The Draft EIS fails fully to address the potential impacts of the proposed mine expansion on the Local Madison aquifer. The Draft EIS states that "some recharge to the Madison Group occurs from precipitation on the flanks of the Little Rocky Mountains and by infiltration from streams, (but) the principal regional source of recharge for the Madison Group (sic) the vast outcrops of the Big Snowy and Little Belt Mountains further to the south (Feltis 1983)." Although this statement is generally true it ignores the local importance of recharge from the Little Rocky Mountains in the immediate surroundings of the mountains, including the Fort Belknap Reservation. The Draft EIS discusses the existence but not the significance of data from the same study showing that an individual large precipitation event in the Little Rocky Mountains in 1974 led to a 50% increase in flow rate of the Big Warm Spring and also led to a change in water quality at the spring. (344)

RESPONSE: The response of springs following an individual precipitation event or snow melt does show that groundwater velocities in the limestones can be rapid. Springs located in drainages receiving recharge from the vicinity of mining operations do have the potential to discharge poor quality water. It is unlikely that recharge in the vicinity of the mining activities would impact the volume or quality of the discharge at the Big Warm Spring due to the presence of significant topography between the mine and the spring. Communication between these two points across a topographic divide would require flow along a major structural feature or karstic feature. No such structure is apparent from the surface topography and karst communication over that distance is considered unlikely. The Water Quality Improvement Plan will result in capture systems in the headwaters of impacted drainages significantly improving the water quality of downgradient recharge to the groundwater system.

166. COMMENT: The Draft EIS does fail to address how absorption of precipitation will affect the <u>quantity of water flow from the area,</u> particularly to the north, in King's Creek, Lodgepole Creek, and their tributaries. The tribes possess water rights to the flows in those creeks, and current operations at the mine have already illegally decreased those flows. It appears that the proposed "water balance" cover will further reduce those flows, thereby violating both the Tribes water rights and the BLM's trust obligations to help protect the Tribes rights. (344)

RESPONSE: Although the available flow data from Little Peoples Creek, Lodgepole Creek and Little Warm Creek do not document any discernible loss of surface water flow to the north of the Little Rocky Mountains (see Figure 3.2-26, Section 3.2.7.1), it is considered likely that such a reduction has occurred due to the diversion of drainage area that has occurred. The proposed water balance covers would reduce infiltration and runoff by enhancing evapotranspiration. However, as under Alternative 3 or 7 the open pits would be constructed to free drain to the south, use of the water budget covers rather than barrier type covers proposed under Alternative 4, 5 and 6 would make no difference to surface water flow volumes to the north and would serve to protect the overall water quality in these drainages.

167. COMMENT: Reclamation issues and impacts are, in general, inadequately addressed. There is a significant concern for the possibility of impacted waters to migrate from the pit backfill towards the northern tributaries. Present water levels suggest this possibility and Pegasus/ZMI has provided no plan for capture and treatment of acidic and elevated metal drainage from the backfill should this occur. The potential for ARD beneath the mine pits to enter the surface water to the north of the mine has not been assessed. Although the Draft EIS states that portions of the 85/86 leach pad and dike would be detoxified prior to use as backfill material in the pit floor, no level of detoxification is discussed. Once again, the Draft EIS fails to address to address possible groundwater contamination as a result of the use of this type of backfill materials, especially given the history of subsurface and groundwater contamination from past and present mining activities. (344)

RESPONSE: The preferred alternative (Section 2.11.3.1) includes an enhanced groundwater monitoring network to detect any such groundwater contamination. Should contamination be detected, ZMI would have to install mitigation measures to intercept or recover any such discharge. The preferred alternative has been changed in the EIS to leave the majority of the existing 85/86 pad spent ore on the leach pad. Off-loaded material would be placed on a separate lined surface to allow selective water management of leachate. Detoxification criteria for leach pads is 0.22 mg/l WAD cyanide. This is described in both the Draft and Final EIS.

168. COMMENT: The prediction of "low negative" water quality impacts (Draft EIS at ES-14, ES-18) under the preferred alternative is not supported by the Draft EIS. There is a significant potential for long-term contamination of both groundwater and surface water as a result of the proposed mine expansion. Additional water monitoring and analysis are needed to adequately predict the result of increased mining activity on the groundwater quality in the region. Furthermore, additional mitigation measures are necessary to ensure the protection of water quality. (344)

RESPONSE: The preferred alternative in the Final EIS is now ranked as low negative to neutral. The EIS has acknowledged the potential for further contamination of surface water and groundwater; however, the potential for impact to occur would be reduced by the implementation of agency-developed mitigation measures. Additional water monitoring is described in Section 2.11.3.1.

169. COMMENT: The Tribes were unable to locate in the Draft EIS any discussion of the potential environmental impacts of future overflow of capture ponds during high rainfall events. The absence of such a discussion is all the more remarkable such overflows have had devastating consequences when they occurred in the past. Such consequences should be the central focus of the Draft EIS, yet they are completely ignored. This violates NEPA's mandate that an EIS address all foreseeable impacts from a proposal. 40 C.F.R. § 1502.16. (344)

RESPONSE: See Section 4.2.3 of the EIS for a discussion of the potential for, and impacts associated with, any overflow of the capture ponds. Capture ponds would be upgraded and sized for runoff from the design events described in Appendix A.

170. COMMENT: ZMI should selectively handle any non-oxide waste rock and place it either in a waste rock repository or into the pit that has been fully mined out. With this recommendation, the occurring enhanced reclamation cap and the short-term water treatment would ensure the protection of any water resources in the surrounding area. (210)

RESPONSE: Alternatives 4 through 7 include selective handling of both oxide and non-oxide waste rock.

171. COMMENT: The Draft EIS clearly states that there has been little or no impact to surface and ground water located on the Fort Belknap Indian Reservation from the Zortman and Landusky mines. Specifically, the BLM, BIA, Council of Energy Resource Tribes, USGS, Agency of Toxic Substances and Disease Registry and the EPA have investigated the health threat from mining to King Creek and Little Peoples Creek and concluded there is no risk to the people of the Fort Belknap Indian Reservation. To date, no documented evidence has been presented in the Draft EIS or any other documents that I am aware of showing water quality impacts to the reservation. (204)

RESPONSE: No evidence of water quality impacts on the reservation due to modern day mining activity has been identified during preparation of the EIS. It is stated in the EIS that groundwater monitoring data on the northern side of the mountains is lacking and the lack of documented evidence does not rule out the possibility that some unidentified groundwater contamination may be occurring. Mitigation is proposed in the EIS under the preferred alternative (see Section 2.11.3.1) to place more monitoring wells on the northern side of the mountains to identify any potential impacts.

172. COMMENT: Comprehensive groundwater studies completed in the past indicate that groundwater recharge from the pits areas, flow southwesterly along southwest-northeast trending structures toward Ruby Gulch at the Zortman mine. There is no evidence that ground water has been impacted to the north that I know of. Another point to make is that surface mining of both the Landusky and Zortman mines has not encountered groundwater to my knowledge, hence groundwater flow paths have not been altered due to surface mining. (185)

RESPONSE: The significant volume of water discharging at the head of Ruby Gulch and the orientation of the major structures suggests that the majority of recharge to the Zortman Pit complex flow southeasterly along northwest-southeast oriented structures. Despite the fact that the open pit operations at Zortman and Landusky have not yet intercepted groundwater, altering the surface topography during open pitting changes surface water drainage divides and has an associated effect on groundwater drainage divides and flow paths.

173. COMMENT: Another issue of concern that has been expressed is what has the mine taken away with regards to surface flow from King Creek. Approximately 2,000 linear feet of drainage has been removed from Kings Creel along with roughly 89 acres of water shed surface area. This amount of removed water shed has a very minute impact to overall surface flow when considering the vast amount of surface area that feeds into King Creek. In contrast Zortman Mining has restored over 1000 linear feet of drainage below current mine disturbances by removing historic mine tails and revegetating the drainage. (185)

RESPONSE: The 89 acres of King Creek drainage area that has diverted flow back into the pit complex represents approximately 13 percent of the catchment above the King Creek, South Bighorn Creek confluence. This is considered to be a significant impact to that northern drainage.

174. COMMENT: The proposed quarry appears to be located at the headwaters of "Lodgepole Creek" and/or "Beaver Creek." Any additional activities related to mining at the headwaters of either one or both of these creeks will impact the drainages with silt, alteration of run-off, and probable exposure of additional "Acid Rock Drainage" ore bodies which will have an additional direct effect on the water quality and quantities of either or both "Lodgepole" and/or "Beaver Creeks" in addition to contributing drainages to both creeks. (48, 181, 186, 353)

RESPONSE: Both the Zortman LS-1 and Landusky King Creek quarries are no longer included under Alternatives 3 or 7, and would now only be used if other NAG material was not obtainable. The two quarries are still included under Alternatives 4, 5, and 6. See Section 4.2.6 Reclamation Materials for an expanded discussion of impacts associated with the development of the limestone quarries. Mining at the limestone quarries would not result in additional ARD. This material is sough specifically for its ability to mitigate ARD impacts.

175. COMMENT: The concerns and problems associated with "Acid Rock Drainage" involves not only ARD but the other heavy minerals released through exposure of sulphide ore to the elements but those that are released through the use of cyanide during the "leaching" process currently in use and the expanded use proposed. The impact of ARD and heavy metals associated with unresolved and unanswered health related issues are not sufficiently addressed through this process. (48, 181, 186)

RESPONSE: All available health risk assessments associated with the mines and affected environment have been reviewed and disclosed as part of the Draft and Final EIS. There is no data indicating that the mining has created, or would create, a significant health risk to the Fort Belknap community.

176. COMMENT: Section 3.2.3, Surface Water, first sentence states, "Drainages in the Upper Little Rocky Mountains are typically....ephemeral...within their upper reaches, becoming...intermittent...once reaching the flanks of the mountains." Big Warm Creek is classified as a permanent stream and flows at 30 to 40 cfs continuously. Little Warm Creek is also a permanent stream and flows continuously , although at a lesser amount than Big Warm Creek. These streams should be included. (17)

RESPONSE: The hydrology of the Big Warm and Little Warm creeks was not discussed in the introduction to Section 3.2.3, as the first sentence in Section 3.2.3 should read "Drainages in the immediate vicinity of the Zortman/Landusky mining operations" rather than "Drainages in the Upper Little Rocky Mountains." Please see Section 3.2.3 for edited text.

177. COMMENT: Page 3-43, third paragraph, states - "Tributaries draining the northeastern side of the Zortman Mining operation flowing toward the Milk river are Lodgepole and Beaver Creek." Again, neither Big Warm nor Little Warm Creeks are mentioned. Both flow into the Milk river. Little Warm Creek is listed on Fig 3.2-26. (17)

RESPONSE: Neither the Big Warm nor Little Warm creeks are considered to drain the Zortman or Landusky mine areas and therefore are not discussed in this portion of the text.

178. COMMENT: On page 3-45 of the Draft EIS, it is stated "Some of the groundwater draining into the bedrock may also drain north, although no geochemical evidence (ARD contamination) of such flow is observed north of the pit complex." This statement is not backed up by the following: Table 3.2-15, Lodgepole Creek Surface water-quality shows that the pH has been reduced and the Sulfates have increased in Kings/Swift Gulch surface water. Table 3.2.25, Lodgepole Creek Groundwater Data shows that pH has decreased, and sulfates have increased from 5 to as much as 158. Also cadmium, lead, and zinc are present. Table 3.2-29, King Creek Groundwater Quality Summary shows that sulfates have increased from 134 to as much as 640. Cadmium and zinc are also present. The statement should be rewritten to include this data. (17)

RESPONSE: The last paragraph on page 3-45 is discussing the Zortman Mine only, and is stressing that the majority of discharge from the pit complex appears to daylight at the head of Ruby Gulch. The data from stations Z-28, Z-29 and Z-7 making up the summary statistics on Table 3.2-15 show no indication of decreasing pH or increasing sulfate content and these are surface water monitoring stations. It is unclear if the recently available groundwater quality data at ZL-210 and ZL-209 represents any impact from mining activity or if it represents baseline groundwater conditions. If the latter, effects are minimal. Please see Section 3.2.5.2 for revised text reflecting the uncertainty of any impact to the groundwater system to the north of the Zortman mine and a discussion of the impacts to groundwater in the King Creek drainage.

179. COMMENT: Page 3-47, 1st column, last paragraph, states " An increase in sulfate concentration in surface or groundwater can signify the existence of acid rock drainage contamination."

By definition, the Draft EIS does not recognize ARD until the pH is 6.0 or lower. However, this does not mean that contamination has not occurred, or is not now taking place. From the information presented in the tables and text it appears that contamination has occurred in the past, is occurring at present, and will undoubtedly continue into the future. This should be stated in the EIS. (17)

RESPONSE: Sulfate, TDS, SC, pH, and metal concentrations are all used as indicators in order to establish the presence of ARD. Impacts to surface water and groundwater that have occurred in the past, are occurring at present and will continue to occur are discussed in great detail in Sections 3.2 and 4.2 of the EIS. Enhanced reclamation and capture and treatment measures are expected to significantly reduce the magnitude of impacts experienced in the past and potential impacts in the future.

180. COMMENT: Page 3-46, sixth paragraph, states - "In summary key points concerning groundwater flow...are:...The Madison Group limestones...have received relatively minor amounts of recharge by waters impacted by mining activities." The tables referred to in item 10, above refute this statement. Contamination of groundwater has occurred and is still occurring at present. Also, according to Section 3.1.4.1, second paragraph, "the major controls...are steeply dipping north-northwest trending fractures....Faults, joints, and fractures can also play an important role for groundwater transport....particularly in controlling the direction of flow." Section 3.2.4, 5th paragraph, last sentence states - "numerous historical mine adits and shafts have intersected water-bearing zones and highly fractured mineralized rock. The direction and rate of groundwater flow in the bedrock is also affected by faults, hydrothermal alteration, geologic contacts, and variabilities in porosity." These statements back-up the fact that groundwater is being contaminated by mining activities at present. From the data presented in the tables it would seem logical that the contamination will increase with additional mining. It should also be pointed out that the Big Warm and Little Warm Creeks both emanate from the Madison Group. No baseline or present data are available for these streams. Both should be monitored. (17)

RESPONSE: The summarizing comment that the Madison Group limestones have received relatively minor amounts of recharge by waters impacted be mining activities has been removed from the EIS. This now reads, "The Madison Group receives recharge from waters impacted by mining activities. On a regional scale this represents only a small percentage of recharge to the aquifers and available water quality data around the periphery of the mountains currently shows no impact to the water quality of the limestones. With installation of the proposed capture systems, recharge to the limestones by poor quality water would be significantly reduced." Some baseline water quality does exist for the Big and Little Warm Creeks (Feltis 1983).

181. COMMENT: Table 3.2-32, Lodgepole Creek, states - "Neutral pHs, low TDS and sulfate, no cyanide detections, e.g.Z-27" According to Table 3.2-15, the pH in Z-28, Z-29 and Z-7 has decreased. Sulfates have increased as much as five times. Cadmium, lead, and zinc are present in Z-28 and Z-29. The statement should be changed to reflect these conditions. (17)

RESPONSE: The data from stations Z-28, Z-29 and Z-7 making up the summary statistics on Table 3.2-15 show no indication of decreasing pH or increasing sulfate content at these surface water monitoring stations. It is currently unclear if the newly available groundwater quality data at Z-6, ZL-210 and ZL-209 represents any impact from mining activity or if it represents baseline groundwater conditions. Please see Section 3.2.5.2 for revised text reflecting the uncertainty of any impact to the groundwater system to the north of the Zortman mine and a discussion of the impacts to groundwater in the King Creek drainage.

182. COMMENT: Table 3.2-32, King Creek, states - "Neutral pH but mod levels of TDS and Sulfate." According to Table 3.2-20, TDS and Sulfates have increased significantly . Also cadmium, lead, and zinc are present in L5, L6, and L-19. (17)

RESPONSE: TDS and sulfate have increased at station L-5 since 1979, however water quality indicators have remained relatively constant at station L-6.

183. COMMENT: Does this Table 4.2-1 apply to surface water, groundwater or both? (17)

RESPONSE: Table 4.2.1 refers to surface water only. See Table 4.2.1 for edited title "Existing and Estimated Short-Term Post Reclamation Downstream Surface Water Quality."

184. COMMENT: The "existing conditions" do not agree with any of the tables in Section 3.2. An example is Table 4.2-1 for Lodgepole Creek which shows the following: pH 8.4, TDS 189, Sulfate 17. Table 3.2-15 shows the pH 7.8, TDS 195, and sulfate 24. Also Table 3.2-25, Z-6 shows pH 7.7-8.7, TDS 200-292, Sulfate 11-26, zinc, lead, and arsenic present. Zl-210 shows pH 7.4-7.8, TDS 252-389, Sulfate 82-158. ZL-209 shows pH 7.8, TDS 259, Sulfate 80.

Another example is Table 4.2-1 for King Creek which shows the following: L6 -pH 7.9,TDS 328, Sulfate 114, zinc 0.01, lead 0.01, arsenic 0.005. Table 3.2-20, L5 shows pH 6.9, TDS as high as 1930, Sulfate as high as 1070, zinc 0.02-0.25, Lead 0.02, Arsenic 0.02. L6 shows pH 7.2-8.1, TDS as high as 735, Sulfate as high as 0.06, Lead as high as 0.02. (17)

RESPONSE: The data used to represent existing conditions on Table 4.2-1 of the Draft EIS was not from the summary statistics tables provided in Section 3.2. These data are the latest 1994 water quality data that was available for each stream at the time of preparation of the Draft EIS. This data was used so to represent most recent water quality conditions after the implementation of capture and capture and treatment in the southern drainages. Please note that the most recent 1995 data has been used for existing conditions in Table 4.2-1 of the Final EIS.

185. COMMENT: Page 3-47, second paragraph, last sentence states - "As part of this EIS , all available monitoring data has been compiled and reviewed in groundwater and surface water quality." In other words the tables in Section 3.2 show "existing conditions." (17)

RESPONSE: The tables in Section 3.2 summarize the available water quality data by showing the minimum, maximum and mean (summary statistics).

186. COMMENT: Is the "existing conditions" data in Table 4.2-1 new data? If not, it should have been included in Section 3.2. From the data presented in the Tables in Section 3.2, water quality (both surface and groundwater) has degraded since 1979, and appear to continue to degrade at present. Table 4.2-1 predicts that water quality will improve. This is incongruous, since the water quality has been degrading for more than fifteen years. To expect it to improve seem very far fetched. These predictions need to be re-examined. (17)

RESPONSE: The data presented as existing conditions in Table 4.2-1 are 1994 data that are included in the summary statistics shown on the tables in Section 3.2. Table 4.2-1 gives estimated surface water quality in the future, as capture and treat systems will be included in all impacted drainages under any of the alternatives, downstream surface water quality is expected to improve.

187. COMMENT: Big Warm, Little Warm and Beaver Creeks need to be included in Table 4.2-1. (17, HA-53)

RESPONSE: Table 4.2-1 is restricted to drainages that currently receive drainage from mining operations or mining related facilities. The Big Warm and Little Warm Creeks do not receive drainage from mining facilities. Beaver Creek has not been included in Table 4.2-1 as potential impacts associated with the development of the LS-1 quarry under Alternatives 4, 5, and 6 would be restricted to short-term increases in suspended solids concentrations. Suspended solids concentrations are not included in Table 4.2-1.

188. COMMENT: Table 4.2-1 gives "estimated short-term post reclamation downstream water quality." The downstream water quality (both surface and groundwater) should also be estimated for the period during mining, and long-term after reclamation, and included in an additional table. (17)

RESPONSE: The estimated future water quality presented in Table 4.2-1 is applicable in the short and long-term. It is not possible to make estimates of groundwater quality due to the poorly understood influences of geology on groundwater quality (neutralization, attenuation) and the extreme spatial variations in groundwater quality.

189. COMMENT: Page 4-57, fourth paragraph, second sentence states - "Water quality is expected to remain similar to that observed in King Creek and Peoples Creek today." According to tables in Sections 3.2-20, 3.2-21, 3.2-29, and 4.2-1, it is unclear as to what the water quality is today. The tables in Section 3.2 show the water quality to have been degraded since 1979. Also, it would seem to be difficult to predict future water quality on Peoples Creek since no data has been presented in the Draft EIS. (17)

RESPONSE: Paragraph 4 should read "water quality is expected to remain similar to that observed in King Creek and Swift Gulch."

190. COMMENT: Section 4.2.9.1, last sentence, states - "Cumulative impacts resulting from Alternative 7 are rated low negative as implementation of Alternative 7 would establish a slightly negative trend away from baseline conditions." This statement is not borne out by the data presented in the Tables in Section 3.2. (17)

RESPONSE: Cumulative impact ratings are made with regard to past, present, future, and reasonably foreseeable impacts to water quality. In the Draft EIS, Alternative 7 had a low negative cumulative impact ranking as it was expected to maintain a slightly negative trend in water quality. Please note that Alternative 7 has been revised and is given a cumulative impact ranking of low negative to neutral in the Final EIS.

191. COMMENT: Section 4.2.10.3, second paragraph, states - "The following...are also pertinent. Accurate predictions of water quality...are not attainable. Predictions of relative water quality are most realistic." If this is the case, it is interesting that the "relative water quality" is predicted to improve for the future. From all the information presented water quality has been degrading since 1979. (17)

RESPONSE: Water quality in general has been degrading since 1979. However with the application of the enhanced reclamation covers and the capture and treatment facilities under the Water Quality Improvement Plan, the volumes of impacted waters draining from facilities and the pits is expected to reduce, and downstream water quality will improve due to the treatment. Therefore, water quality will improve and compliance with the water quality standards would be achieved.

192. COMMENT: The next sentence states - "The water quality of all southern drainages has been impacted to some degree by recent mining activity." The tables in Section 3.2 show that water quality in the northern drainages has also been impacted. The word "northern" needs to be included in the sentence. (17)

RESPONSE: The text now reads "The surface water quality of all major drainages surrounding the mining operations have been impacted to some degree by recent mining activity."

193. COMMENT: Page 4-70, sixth sentence, states - "regional aquifers such as the Madison Limestone would not be degraded beyond the perimeter of the Little Rocky Mountains by any of the Alternatives analyzed." The question immediately arises of how much degradation will take place within the perimeter of the Little Rocky Mountains? Does the statement apply also to Big Warm and Little Warm Creeks? Many people, in and around the mountains, get their water from the Madison Group which, from the data presented, is presently contaminated and degradation may increase. (17)

RESPONSE: No impact is expected to the Big Warm and Little Warm Creeks and impacts to the limestone where it outcrops or subcrops in the stream bottoms are expected to be localized and reduced due to the capture and treatment upstream improving downstream water quality.

194. COMMENT: Page 4-70, last sentence, states -"To make the monitoring of water quality impacts more quantitative,...accurate flow measurements...are needed," It would seem that this should have been taking place since 1979. Are accurate flow proposed prior to any proposed new mining? (17)

RESPONSE: Accurate water flow measurements have been typically biannual in the past with flow estimates occurring more frequently. More accurate measurements have been made in recent years and this will be included under any future monitoring program.

195. COMMENT: None of the information presented in the seetion on Environmental Consequences gives any predictions on water quality of streams and groundwater during the proposed mining period or long term future. These predictions should be ineluded in the EIS. (17)

RESPONSE: The surfaee water quality estimates on Table 4.2-1 are applicable for the short and long-term including during the proposed mining period. Long-term estimates for water quality draining from waste rock and spent ore pads are given on Figures 4.2-1 and 4.2-2 for each alternative.

196. COMMENT: There is insufficient data available to determine or predict the mine's impact on groundwater and flow regime in the Little Rocky Mountains onto the Fort Belknap Reservation, (specifically to the Madison aquifer), contrary to 40 CFR 1502.22 (a) of NEPA regulations. The Draft EIS should disclose additional data/information that supports the contention of no detrimental impacts to groundwater flowing onto the reservation (i.e potentiometric data, hydraulic charaeteristics of different geologic materials in the Zortman/Landusky mine areas, etc.). There are four known Madison springs in the vicinity of the Little Rocky Mountains; three flow onto the reservation. (353)

RESPONSE: See Section 3.2.4 for full disclosure of available hydrogeologic information and an expanded discussion of groundwater flow. Data is adequate to meet the requirements of 40 CFR 1502.

197. COMMENT: The Draft EIS needs to examine the potential for acid rock drainage, generated beneath mine pits, heap leach facilities, and waste rock dumps to enter surface and ground water to the north of the mines, specifieally Lodgepole, Beaver, and King Creeks located on the Fort Belknap Indian Reservation. The potential for acid mine drainage occurring in the reservation ground water has not been determined or addressed in the Draft EIS (i.e., Madison Limestone aquifer). (353)

RESPONSE: See Section 4.2 for expanded discussion of potential impacts to groundwater resources surrounding the Little Rocky Mountains. Impacts to groundwater on the Fort Belknap Indian Reservation are not likely to occur.

198. COMMENT: According to the Draft EIS, King Creek water quality is monitored primarily by one well 1/4 mile from the mine site. Another monitoring site is installed, but in such a location that water flows rarely reach the site. The adequacy of the data received from one monitoring site should be addressed. (351)

RESPONSE: See Section 2.11.3.1 for agency proposed monitoring program, including additional groundwater monitoring in King Creek.

199. COMMENT: The Draft EIS states that water quality will be temporarily impacted in King Creek upon removal of the rock fill. The Draft EIS also states that settling ponds will be installed below the pits to address water quality eoncerns. King Creek is the primary drainage from the mine site running north to the Fort Belknap Indian Reservation. How temporary the contamination will be, and the adequacy of these measures to protect water quality should be addressed. (351)

RESPONSE: Capture systems have the ability to remove the majority of fines if construction is earried out during periods of minimal rainfall. However some significant rainfall events will oceur while vegetation is getting established on the pit floor and other disturbed areas. During such events it is expected that elevated levels of suspended solids would enter the creek either from the reclaimed surfaces or from the capture system it self. These potential runoff events should be restricted to a matter of days and are estimated to be similar in scale to past impacts from runoff events prior to removal of historic tailing in upper King Creek.

200. COMMENT: On page 2-232, the Draft EIS mentions the water needed for the expansion will come from two supply wells ZL-102 and ZL-163 at 190 gpm, but can't loeate these wells on the map or if they double as monitoring wells. How do they get the water rights that were reserved to the Tribe under the Grinnell agreement or treaty signed by the 5fourth Congress, October 9th 1895. (352)

RESPONSE: Water rights were approved by DNRC; please see Exhibit 2 for the locations of ZL-102 and ZL-163. (Please see comments and responses in Section 6.15 regarding treaty rights.)

201. COMMENT: The amount of new water that will be drained from the aquifers feeding the surrounding communities and the Fort Belknap Indian Reservation is not identified in the Draft EIS. (352)

RESPONSE: Quantitative estimates of groundwater flow are unable to be made given the available information. However the amount of undisturbed drainage area within the Little Rocky Mountains suggest that no reduction in ground water volume will occur in the wells on the Fort Belknap Indian Reservation.

202. COMMENT: I believe there is not enough data to accurately judge the mine's impact on groundwater, specifically to the Madison aquifer. There are four known Madison springs in the vicinity of the Little Rocky Mountains, three on the north (on the Fort Belknap Indian Reservation). The Draft EIS needs to examine the potential for acid rock drainage generated beneath mine pits, to enter surface water to the north of the mines, specifically Lodgepole, Beaver, and King Creeks located on the Fort Belknap Indian Reservation. (203, 330, 331, 332)

RESPONSE: Please see Section 3.2.4 of the EIS for an expanded discussion of the existing hydrogeologic conditions underlying the Zortman and Landusky pits and Sections 4.2.6 through 4.2.9 for an expanded discussion on the movement and discharge of groundwater beneath the expanded pit complexes to enter surface water to the north and south of the mines.

203. COMMENT: We also note that the flowing spring in Sec. 6, T. 24N., R.24E. appears visually contaminated by producing a rust colored fluid. (360)

RESPONSE: A rusty colored fluid usually means that iron has been precipitated out of the fluid as its pH is increased. The processes can occur naturally or due to neutralization of acid mine drainage. To assess what the cause of this discoloration, water quality samples and information on the geology in the vicinity of the spring is needed.

204. COMMENT: EPA does not believe that there is enough data to accurately judge the mine's impact on groundwater, specifically to the Madison aquifer. There are four known springs in the vicinity of the Little Rocky Mountains, three on the north. (203)

RESPONSE: The EIS reviews all available hydrogeologic and water quality data and identifies deficiencies or gaps in the data. Where the lack of data or understanding makes definitive statements about impacts unreasonable, the potential impact is still identified, discussed, and taken into consideration in the alternative ranking process. The data is adequate for purposes of impact assessment, mitigation development, and making a reasoned choice among alternatives.

205. COMMENT: The Draft EIS lacks reliable data to determine in what direction and how fast the groundwater flows (page 3-45). This deficiency arises because much of the groundwater data comes from monitoring wells located in the valleys (page 3-45). To accurately determine groundwater flows, data must also be obtained from high places. Without this additional information, it is difficult to determine how effective pit reclamation measures will be and where contaminated water will go. (361)

RESPONSE: The potentiometric surface parallels surface topography except where structural geology, historic mine workings or geology are the controlling features (see Figure 3.2-9 and 3.2-10). Please see Section 3.2.4 of the EIS for an expanded discussion of the existing hydrogeologic conditions underlying the Zortman and Landusky pits and Sections 4.2.6 through 4.2.9 for an expanded discussion on the movement and discharge of groundwater beneath the expanded pit complexes to enter surface water to the north and south of the mines.

206. COMMENT: The inadequacies of the present water monitoring system upon which this Draft EIS was based are made clear in the Science Applications International Corporation (SAIC) report prepared for the EPA's Water Management Division in April 1994. This report states in part: "In the review...of the data, it became clear that these basic monitoring plan elements were either lacking or were insufficient to provide useable data for an accurate, statistical analysis." More detailed recommendations are presented in this report. Further, the EPA also does not believe there is enough data to accurately judge the mine's impact on groundwater. (361)

RESPONSE: Please see Sections 3.2.5.1 and 3.2.5.2 of the EIS for discussion of the adequacy of water quality monitoring data at the Zortman and Landusky mine sites. Improvements required to the existing water quality monitoring program, including many identified by SAIC are incorporated into the preferred alternative monitoring program presented in Section 2.11.3.1.

207. COMMENT: The introduction does not mention the fact that some of the water that is getting into the waste dumps and pads may be, or is, coming from springs and seeps underneath. Capping of the waste piles will not stop the creation of ARD and leakage exposed to these underground waters. (361)

RESPONSE: Please see Section 4.2.1. Infiltration Modeling of the EIS for a discussion of the origin of waters discharging at the toe of waste rock dump and leach pad facilities. This base flow volume is accounted for in the prediction of discharge volumes potentially requiring treatment.

208. COMMENT: If water quality objectives are not met for a leach pad within 10 years, or dewatering is necessary prior to 10 years, under the Company Proposed Action (Alternative 4), ZMI proposes to dump the contaminated water onto the land application disposal area (LAD) (page 2-149). There is inadequate discussion of what the environmental consequences of disposing of this contaminated water directly onto the land will be. Data from already existing LAD areas shows that soil, vegetation, and groundwater have been adversely impacted. (361)

RESPONSE: Please see Sections 4.2, 4.4, 4.5, and 4.14 for discussion of impacts associated with land application.

209. COMMENT: The Draft EIS makes no attempt to quantify the amount of diversion there will be after the expansion and reclamation, and therefore what the impact will be on the tribes' water rights as a result of the proposed expansion. (361)

RESPONSE: The acreages that would be diverted from draining to the north under each alternative are presented in Sections 4.2.3 through 4.2.9 and the significance of these diversions is also discussed.

210. COMMENT: At the present time, there is a detailed study being done by Zortman Mining, Inc. of the seeps and springs around the mountains. It would be helpful if this information were better referenced, or incorporated in the Draft EIS. Similarly, the Draft EIS relies on HELP modeling and an ARD-potential analysis which is insufficiently referenced or documented. (361)

RESPONSE: All applicable reports and data have been incorporated and referenced in the EIS. A more detailed review of the HELP modeling including references is included in Appendix G of the EIS.

211. COMMENT: The SAIC report, an important document prepared in April of 1994 for the EPA, indicated that there was ARD and/or precursors of ARD in water tests as early as 1986. That document should have been mentioned in the Draft EIS and made available to the public, at least upon request. (361)

RESPONSE: The fact there was ARD and/or precursors of ARD in water tests earlier than 1986 is clearly illustrated by the water quality graphics and text in the Draft EIS. The same data used by SAIC to prepare their report was used by the EIS team to prepare the Draft EIS. The SAIC report was not labeled as "Final" at the time the Draft EIS was published and could not be cited as a finished product. Evidently, the report is readily available from EPA and requests for copies should be directed to that agency.

212. COMMENT: Samples have been collected from Mission Canyon (C133), Community Well - Lodgepole (C143), and Beaver Creek (C135). (51, 206)

RESPONSE: The lead concentration recorded at the Community Well at Lodgepole was 18.7 μg/l exceeding the MCL of 15 μg/l. From the data available, it is unclear if this is representative of the groundwater quality or derived from the water supply system (pipes and pumps). The source of the lead in the sample warrants further investigation. The EIS cannot include water quality data collected during the comment period as the procedures carried out during sampling cannot be validated, and the impartiality of the persons collecting the samples is unknown. Water samples collected by the EPA at Lodgepole's low income housing do not have any indication of lead contamination.

213. COMMENT: Enclosed you will find additional water sample results that were paid for by TEAM "Families for Montana." I would like to have them included in the Final EIS for the Zortman Mining, Inc. extension project as supporting evidence for non-degradation of the surrounding waters. This should be included with the data that was submitted at the public hearing held in Malta on Wednesday, September 20, 1995. (57, MA-12)

RESPONSE: Samples were collected from Peoples Creek (B), Rock Bridge (D), Kings Creek (F), Hays High School (H), and where Big Warm crosses the Highway (J). Both samples show the waters to be of good general quality with few detectable metal concentrations, although sulfate, Total Dissolved Solids (TDS), and Specific Conductance concentrations are moderately elevated in sample (J). The EIS cannot include water quality data collected during the comment period as the procedures carried out during sampling cannot be validated and the impartiality of the persons collecting the samples is unknown.

214. COMMENT: What is being done now and in the future to protect our water resources? What will happen to our drinking water? (LO-13)

RESPONSE: Section 2.5.1.7 of the EIS provides a description of the actions currently undertaken by ZMI to prevent contamination of water resources. Equivalent sections are included in each of the remaining six alternatives which describe additional efforts that would be implemented for protection of water resources. Section 4.2 of the EIS presents the adverse and beneficial impacts to water resources for implementation of each of the seven alternatives.

215. COMMENT: If the tailing is removed from Ruby Gulch, what would happen to the town of Zortman during spring runoff and heavy rain events? The tailing acts as a sink for the rainfall and runoff. Would there be floods and potential for washouts of roads and buildings? (207, LO-51)

RESPONSE: The mitigation to remove tailing from Ruby Gulch would not include that portion in the town of Zortman, but concentrate on tailing within the upstream Ruby drainage. The concerns expressed are genuine, as water in the drainage is typically within the tailing on top of bedrock. Removal of the tailing would cause storm runoff to collect in the stream channel and flow as surface water in the drainage. The tailing removal program would incorporate engineering controls at the base of Ruby Gulch, near where Ruby Creek enters the town, to maintain the surface water flow within the stream channel.

216. COMMENT: The EIS is totally deficient in that it does not inform the average person about the problems at the mines with acid drainage, or what acid rock drainage is. The true extent of the acid drainage problem is not disclosed. (3, LO-33)

RESPONSE: The EIS has disclosed all available data concerning acid drainage at the mines, and exhaustive detail is presented concerning the geochemical reactions contributing to acid drainage, water resources affected by ARD, and potential mitigation measures. Please see Section 3.2.2 for an analysis of ARD at the mines, and subsequent sections in Section 3.2 for a presentation of water quality.

217. COMMENT: I would like documentation of all of the heavy metals that cyanide carries with it to the water; this has not been presented in the EIS. (LO-41)

RESPONSE: A complete discussion of water resources geochemistry, including cyanide and metal-cyanide complexes, is found in Section 3.2.2.

218. COMMENT: Nobody has ever tested Rock Creek water quality when the streams are running full. (HA-20)

RESPONSE: Station L-1 has been used as a water quality monitoring post on Rock Creek for a number of years. Table 3.2-17 presents a summary of the data collected at this station over approximately 15 years. While the data do not isolate samples collected during storm events or high runoff, the range of values for many analytes suggests a variety of flow regimes have been sampled. Reported flows at L-1 between 1979 and 1986 during routine sampling events range from 0 to 2,400 gallons per minute. Figure 3.2-16 illustrates spring vs. fall water quality trends on Rock Creek.

219. COMMENT: The Draft EIS addresses concerns about water quality impacts to the Reservation by documenting that water drainage from the mines will flow south, and not north onto the Reservation. (GF-22)

RESPONSE: The Draft and Final EIS present information and conclusions that most water from the mines would flow south. However, there is the potential for groundwater flow to the north, particularly through fractures in the bedrock. In addition, some surface water could flow north if not captured and diverted to collection systems prior to discharge in southern drainages.

220. COMMENT: Monitoring wells may be checked once or twice a month, but what happens on a daily basis? There are always spills at the mines, and this stuff ends up going into the groundwater. (GF-56)

RESPONSE: The frequency of water quality sampling from monitoring wells varies, depending on the well sampled and the analytes to be checked. However, none of the wells are routinely monitored on a daily basis unless cyanide is detected in them. The surface water sites downgradient of the heap leach pads are monitored daily for cyanide because spills typically impact surface water more rapidly than groundwater. Spills of hazardous substances or other materials are to be cleaned up and reported to the agencies according to approved spill contingency plan procedures. If spills have released potentially hazardous substances, a focused monitoring program would be instituted to determine if water resources have been affected, and to what extent.

221. COMMENT: It will take even less time for contaminated groundwater to show up in springs on the Reservation than it does for water falling on the Little Belt Mountains to come out at Giant Springs, about 38 miles away. (GF-34)

RESPONSE: The time required for groundwater to travel from a recharge area in the Little Rocky Mountains to springs on the north side of the mountains is dependent on distance, but also on other factors. These include the permeability of the rock the water travels through and the hydrostatic pressure or gradient causing the movement. Travel time in heavily fractured, open fracture bedrock can be very fast; groundwater can move even faster in karst terrain (such as limestones with a lot of caves). However, groundwater flow in fractured bedrock can also be slow if the fractures have been sealed with minerals precipitating out of solution. Also see response to earlier comments about the relatively rapid response of some springs on the perimeter of the Little Rocky Mountains to large precipitation events.

222. COMMENT: The effects on groundwater quality from the alternative actions are not adequately disclosed, and no rationale or data is presented. In addition, the effects of land application disposal of rinse water are not discussed. (273)

RESPONSE: Potential impacts to groundwater quality are presented in Section 4.2, including effects resulting from disposal of rinse water using land application. Section 4.4 also evaluates impacts of land application disposal of rinse water.

223. COMMENT: We have a well in the town of Zortman that supplies water to the town and Camp Creek water uses. This is some of the best water in the State. Does that say anything about our water quality? (136)

RESPONSE: The water supply well referred to in the comment is deeper and farther downgradient from the mine than other shallow wells closer to the mines which have degraded water quality.

224. COMMENT: The Draft EIS clearly states and supports with water quality data that there is no impact to water on the Reservation. (163)

RESPONSE: The Draft EIS and Final EIS disclose little impact to water north of the mines. While no impact has been detected to water resources on the Reservation, it is possible that undetected impacts have occurred.

225. COMMENT: A big concern is how the weather has been accounted for in the design for new facilities. Large storms have in the past caused flooding and contamination downstream of the mines. (201)

RESPONSE: Problems have occurred in the past because water management structures have failed or been overtopped due to large precipitation events. Water management structures would be designed to accommodate flow from the 6.33-inch, 24-hour storm event which has a calculated frequency of once every 100 years.

226. COMMENT: As an alternative to releasing surface water into King's Creek to restore flow, why not tap into groundwater under artisan pressures at Mission Peak to develop springs? (36)

RESPONSE: Development of springs from groundwater off Mission Peak could work but would not be as reliable diverting surface water flow back into King Creek.

227. COMMENT: What does the scientific data reveal about impacts to groundwater resources, particularly groundwater connected to spring water consumed by residents of the Fort Belknap Reservation? (363)

RESPONSE: Please see Sections 3.2 and 4.2 for an assessment of existing water quality, and potential impacts to groundwater resources, including water north of the mines on the Fort Belknap Indian Reservation.

228. COMMENT: The Landusky Mine has contaminated water resources in the Rock Creek drainage, possibly for many generations, and now supplies bottled water to residents. (253)

RESPONSE: Degradation of the Landusky water supply is described in Sections 4.2.2.2 and 3.2.5.

229. COMMENT: If the mines are allowed to expand, will the groundwater be safe to drink? What type and how much pollution will the expansion cause? And how much has been caused already? (52)

RESPONSE: Sections 3.2.5 and 4.2.2 provide information on the existing groundwater quality, and degradation of groundwater resources caused by mining activities. Sections 4.2.6 through 4.2.9 present an analysis of the potential impacts to groundwater quality resulting from the four mine expansion alternatives.

230. COMMENT: There is apparently inadequate data to judge the impact on groundwater, contrary to 40 CFR 1502.22(a) which requires that where "incomplete information relevant to reasonably foreseeable significant impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement. There is a critical lack of monitoring wells (only 3) on the north side of the Little Rockies near Indian communities compared to the more numerous wells on the south side. Basic baseline data must be collected for an extended period before any expansion of mining is contemplated. A complete understanding of the structural geology of the area is necessary to analyze and predict groundwater flow and the distribution of acid-generating waste rock. (320, 343, 344, 353)

RESPONSE: Section 3.2.5.2 of the Draft EIS evaluates the baseline groundwater quality data for the drainages north of the mine. There is no data missing essential to making a reasoned choice among alternatives. Section 4.2.9 of the Draft EIS acknowledges the potential for seepage of acid rock drainage from the pits to the northern drainages. The existing monitoring network would be augmented with additional wells to detect when and if such seepage occurs and thereby prevent contamination by identifying and directing any necessary mitigation. The reclamation plans for the mine pits in the Preferred Alternative have been developed to route runoff away from northern drainages and limit seepage to underlying groundwater.

231. COMMENT: "They say the water is clean and they have all of these documents and all of these things that prove supposedly that the water is clean and that the water does not contaminate the people. I've seen animals born with no skin, animals born with a nose on their head, these are documented and filmed before meetings like this. I'd like to know where those are and where those comments are." (LO-41)

RESPONSE: No documented evidence linking mine-generated contamination to birth defects in animals has been presented to either DEQ or BLM.

232. COMMENT: The Tribes were unable to locate in the Draft EIS any discussion of the potential environmental impacts of future overflow of capture ponds during high rainfall events. The ARD capture ponds will be designed to capture and treat runoff from a 10-year 24-hour rainfall event, or seepage from a 100-year storm event, "wherever the terrain accommodates such a facility." Draft EIS at A-3. Yet nowhere does the Draft EIS address what the environmental impacts will be when these rainfall and storm events occur and ARD-tainted water overflows from the ponds. The absence of such a discussion is all the more remarkable such overflows have had devastating consequences when they occurred in the past. Such consequences <u>should</u> be a central focus of the Draft EIS, yet they are completely ignored. This violates NEPA's mandate that an EIS address all foreseeable impacts from a proposal. 40 C.F.R. § 1502.16. (344)

RESPONSE: The Water Quality Improvement Plan (Appendix A), which is applicable to any of the alternatives, has been modified to mitigate the effects of a storm event that may exceed the capacity of a particular containment system. Modifications include upsizing capture systems for some drainages. Due to the low frequency of such system upsets (i.e., once every 100 years), the low value aquatic ecosystems, and the presence of back-up treatment systems, the overall impact from potential capture pond overflows is not significant.

233. COMMENT: "When the first mine was here, all the miners say, well, this contamination in your water comes from the old tailings pond, which a lot of it does, but I think when they processed their gold, they used mercury in them days, not cyanide. So that, that' another thing I'd like to have answered." (HA-20)

RESPONSE: It is likely that mercury as well as cyanide were used to process gold in the historic milling operations. Mercury has been sporadically detected in water samples taken in Ruby Gulch. These random occurrences of mercury contamination are believed to be related to the historic tailing deposited within the Ruby Gulch drainage by the historic milling operation. Cyanide was used during historic mining/milling in both Ruby Gulch and King Creek. A Montana DHES inspection report from 1933 documents that tailing discharging to King Creek from the Little Ben mine contained about 17 ppm cyanide. Cyanide levels today in King Creek are below detection.

234. COMMENT: Why are the water discharge standards and treatment methods not available for public comment? (348)

RESPONSE: Interim water discharge standards are Best Available Technology (BAT) economically achievable contained in 40 CFR 440 for ore mining. Final effluent limits will be established in the final MPDES permit so as to meet water quality standards at the point of compliance. Water capture and treatment methods are described in the Draft and Final EIS and in Appendix A.

235. COMMENT: In the Draft EIS on page A-1, Appendix A, 1.2, "The work to be performed by ZMI to attain interim compliance at Zortman and Landusky mines is to fall within three categories. These categories will require generation of additional data, some of which only can be obtained, apparently, via additional field investigations. The data described in the discussions that follow, identify data that is integral to completing a baseline description for the Zortman and Landusky projects. This data will need to be obtained and become a part of the NEPA/404 processes. Complete evaluation of alternatives cannot be accomplished until such data becomes available." (346)

RESPONSE: For the various drainages in the Little Rocky Mountains, baseline water quality data, or data representative of baseline is already presented in the Draft EIS (Chapter 3). The additional data collection is part of the development of an MPDES Permit. The data collected would be used to refine the Draft EIS baseline numbers for a specific stream reach with greater precision in order to set an upper contaminant limit on discharge of effluent. This limit would provide for the Montana water quality standards to be met at the point of compliance. The data is not critical to the assessment of impacts, development of mitigation, or the choice among the alternatives presented in the EIS. It is simply part of the process to ensure that water quality standards are meet regardless of which alternative is selected.

236. COMMENT: The Draft EIS is premature, it was written prior to the setting of effluent limits will help the public understand more fully the impacts of the proposed expansion. No quantitative limits on the mine's effluent are listed. This is because none have been developed. The setting of effluent limits that will help the public understand more fully the impacts of the proposed expansion. The effluent limits will likely set maximum discharge limits on cyanide, ARD, and metals. Until these limits are set, the public and decision makers are unable to understand the extent of adverse impacts to water resources. (344)

RESPONSE: The Draft EIS goes on at some length to predict ultimate seepage quantities and attempts to bracket the contaminant levels that could be present in discharges from both existing and expanded mine facilities under each alternative. Based on the Draft EIS analysis, the ultimate conclusion regarding future compliance is that by using selective waste handling; enhanced reclamation covers; segregation of storm water vs. mine drainage; capture sumps, trenches and wells; and water treatment plants at both mines; that compliance with the Montana water quality laws will be achieved. Therefore, exact effluent limits do not need to be known in order to *predict* whether the approach to be used at the mines is likely to achieve compliance with the water quality standards.

237. COMMENT: On Page 2-240 of the Draft EIS, Water Capture and Treatment; This agency [BIA] is protesting against ZMI and your [BLM] office because a Water Capture and Treatment plan is not available for our review and comment. (348)

RESPONSE: Water capture and treatment plans are described in the Draft EIS in Section 2.8.1.7. Plans for water treatment are also described in the Permit Application submitted by ZMI. Copies of the application are available for viewing at the BLM offices in Malta or Lewistown, and at the DEQ office in Helena. A copy of the application was initially provided to the tribal government at the Fort Belknap Agency. Drainage plans for the Zortman Mine are shown in Figure 2.8-10 of the Draft EIS. A site drainage plan map specific to Alternative 7 has been added to the EIS on Figure 2.11-3 and in Appendix A.

238. COMMENT: Implementation of the water quality improvement plan and the Compliance Plan are separate documents. The main difference in the plans is that the Water Quality Improvement Plan involves construction of capture facilities while the Compliance Plan requires removal of facilities. If the plan meets the objective of preventing unnecessary and undue degradation of federal lands, the Compliance Plan will supersede the Water Quality Improvement Plan presented in this document. The agencies should adopt the Compliance Plan in the Draft EIS provided that it meets Draft EIS objectives. (342)

RESPONSE: The Water Quality Improvement Plan (Appendix A) is the agencies approach for remediation of water quality issues. No direct conflicts are anticipated with requirements of a Compliance Plan under development by ZMI. Should the two plans overlap, the more protective measures would be required to prevent unnecessary or undue degradation.

239. COMMENT: Even if the Draft EIS were to explain what standards for compliance will be proposed, reviewers of the Draft EIS would not know whether those standards are likely to be achieved, because the compliance plan summarized in Appendix A defers decisions on how to achieve compliance to some future date. (344)

RESPONSE: The approach for improving water quality and achieving compliance with the standards is described in Section 3.0 of Appendix A in the Draft EIS. Figure A illustrates how the water quality improvement systems would function. Figures A-1 through A-7 provide drainage specific plans for the water quality improvement constructions. Updated plans have been added to Appendix A in the EIS. The EIS conclusion regarding compliance is that by using selective waste handling; enhanced reclamation covers; segregation of storm water vs. mine drainage; capture sumps, trenches and wells; and water treatment plants at both mines; that compliance with Montana water quality laws will be achieved.

240. COMMENT: Although the Draft EIS admits that this contamination "may be transmitted from the groundwater system to surface water at some lower elevation" (id.), the Draft EIS does not disclose where or when impacts to groundwater and then to surface water will occur. This violates NEPA's full-disclosure requirement. (344)

RESPONSE: Section 3.2 of the EIS identifies existing water quality impacts while Section 4.2 assesses potential impacts associated with alternative implementation. All major drainages within the vicinity of the Zortman and Landusky mines have been impacted to some degree by acid rock drainage and/or releases of process chemicals (see Section 3.2.5.2 and 4.2.2.2).

241. COMMENT: The hydrology related to the stope mining should be discussed. (346)

RESPONSE: Historic mining was underground, but ZMI has conducted no underground mining, nor is there underground mining anticipated in proposed actions. Section 4.2.2 describes impacts to water resources from past mining activities and effects of underground workings on groundwater.

242. COMMENT: The proposal makes no provisions to ensure the perpetual function of the engineered drain proposed to be constructed into the existing August Adit. (344)

RESPONSE: The company proposed action includes draining the Landusky pit complex through the existing August Adit. The agency modification (see Alternatives 3, 5, 6, and 7) involves backfilling the pit to a free-draining condition. This would eliminate the need to ensure perpetual function of the engineered drain.

243. COMMENT: All the meetings that I attended, the pro-mining side stated that all drainage of contamination would drain south. They were right, it did go south. Is the land to the south expendable? (253)

RESPONSE: Surface water flows for the Zortman and Landusky mines are addressed in the "Water Resources" section of Chapter 3.0. Most of the facilities associated with the mines are located in drainages that flow south. Measures needed to protect water quality on all lands are included in the EIS alternatives.

244. COMMENT: Who determines what is the Best Available Technology (BAT) standards for the mine waters and who monitors to ensure compliance with the BAT standards? (348)

RESPONSE: The effluent limitations, or standards, attainable by the application of the best available technology economically achievable (BAT) are identified under 40 CFR § 440.103. ZMI would be responsible for monitoring water quality. The DEQ has the responsibility for ensuring compliance with effluent limitations.

245. COMMENT: Now, I understand this acid rock drainage showed up in approximately 1991. Now, where was everyone? Shouldn't this have been started to be corrected at that time? (LO-49)

RESPONSE: In the summer of 1992, based on ongoing field inspections and a review of water quality monitoring data (1985-1992), the agencies noted that ZMI's approved operating and reclamation plans were not adequate to address acid rock drainage (ARD). Interim remediation measures began at that time. During the next 18 months, remediation plans were developed specifically addressing ARD control. In March 1994, the agencies issued a decision on corrective measures to address ARD at the Landusky Mine requiring some short-term remediation but withholding approval of final long-term reclamation and closure designs until completion of this EIS. This EIS addresses modified reclamation plans at the Zortman and Landusky mines to control ARD. Further information on ARD is discussed in the section on "Other Documentation and the Acid Rock Drainage Issue" in Chapter 1.0 of the EIS.

246. COMMENT: All of the Water Treatment and Handling sections and Reclamation/Post-Reclamation Water Handling and Treatment sections need to be reviewed for consistency. The company proposed design event is the 6-inch, 24-hour storm, not the 100-year, 24-hour storm as often indicated. If the agencies consider the 100-year, 24-event to be 6-inches, this should be stated. Also since the Compliance Plan and the final MPDES will supersede all of the methods proposed, that should be made clear up front in all sections.

It should be noted that during litigation negotiations, there has not been an agreement to design capture facilities to specifically collect seepage from a 6-inch, 24-hour storm event. This is due to the difficulty in reliably producing the seepage volume calculation. Additionally, using this event may result in the design of large, new disturbances that have been unacceptable to the same agencies in the past.

ZMI will construct capture facilities to capture impacted seepage and admixed stormwaters. The sizing of these facilities will vary and depend in part upon the nature of the impacts which are predicted from the seepage source, the feasibility of capture system construction, and the expected schedule for operations and reclamation in a given area. Where it is practical and desirable to do so, these facilities will be designed for containment of the 6-inch, 24-hour storm event. (342)

RESPONSE: Water management sections have been reviewed and edited for consistency. The agencies would require water capture and control systems to handle a 6.33-inch, 24-hour event where terrain allows. In situations (if any) where terrain does not allow the capture and control systems to meet the 6.33-inch, 24-hour event, the minimum design allowed would be for a 10-year, 24-hour event. Clarification to the Company Proposed Action is noted. Based on review of meteorological data, the 6.33-inch, 24-hour storm event is considered to be the 100-year event frequently referred to in the EIS.

247. COMMENT: It is argued that mining to date has affected surface and groundwater resources. While this may be true, this discussion is not relevant to the proposed action, especially in light of the fact that some of this activity pre-dated ZMI. Any discussion of impacts to ground and surface water should be presented in the characterization of the Affected Environment and not under the impacts analysis. (342)

RESPONSE: An important component of this NEPA/MEPA analysis is to determine impacts that have occurred during the approximately 16 years of large scale, open-pit mining in the Little Rocky Mountains. The relevance of this analysis is to establish impacts still occurring that may be mitigated by enhanced reclamation activities. In addition, the baseline analysis for this mining operation is pre-1979; all resources have recognized that some mining has occurred in this area for over 100 years, but the disturbance and impact from those historic mining operations is minor compared to current operations. The baseline environmental conditions for this or other projects are not subject to change, even as environmental resources or conditions degrade.

248. COMMENT: The removal of facilities and backfilling of some pit areas under some alternatives is not consistent with the Water Quality Improvement Plan as it is currently described. How will the approved changes to the reclamation plan be reconciled with the Water Quality Improvement Plan? (342)

RESPONSE: The Water Quality Improvement Plan in Appendix A has been updated to provide a consistent approach under the various EIS alternatives. New figures have been added to show what water management facilities would be constructed under the pit backfilling, facility removal, and expanded mining alternatives.

249. COMMENT: In the Draft EIS, page 2-46, estimates of the percent of seepage, drainage, and runoff collected and treated should be provided. Is it the intent to develop systems that collect and treat all such waters? Also, what is the total character and ultimate fate of the sludge pumped to the containment trench? Does disposal in this manner present any potential problems? (346)

RESPONSE: Information concerning the water management cycle at the two mines is presented in Section 3.2 and assessed for impacts in Section 4.2. The intent is to capture and treat all waters emanating from the mine or mine facilities which, if discharged directly to the environment, could degrade water quality and affect aquatic habitat. Section 3.14 describes the hazardous materials and potentially hazardous wastes generated at the mine, including sludge from the treatment plant. Section 4.14 discusses potential environmental concerns associated with this method of sludge disposal.

250. COMMENT: In the Draft EIS, page 2-50, what assurances are there that solutions remaining after detoxification will not produce ARD after the 0.22 mg/l levels are met? What holding pond would receive solutions remaining after detoxification? What volumes of materials are expected to be applied to a LAD? How long would such activities occur? Who would be responsible to monitoring heaps after 0.22 mg/l levels are met? (346)

RESPONSE: There are no assurances that the solutions remaining after detoxification will not produce ARD. That is one reason solutions are pumped to a holding pond, near the water treatment plant, for retention and possibly treatment prior to land application. It is not known what volumes of metals would be applied during land application. This could not be predicted until post-detoxification water quality is determined on samples from the holding ponds. However, potential attenuation capacity of the area has been predicted, so that loads should not exceed the ability of soils to retain metals. Land application would continue until attenuation capacity is reached, at which time a new LAD area would be needed, or all solution has been disposed. ZMI would be responsible for all mine monitoring programs and be required to submit all data collected to the agencies for review.

251. COMMENT: In the Draft EIS on page 2-53, was the pre-rinse conducted during 1994 on the 84 pad effective, or is ARD still being generated? If so, in what quantities? What will be the ultimate fate of the 200,000 tons of acid producing material removed from the buttress of the 85/86 pad? (346)

RESPONSE: The pre-rinse and rinsing conducted on leach pads is not for the purpose of reducing or eliminating ARD, but to reduce cyanide concentrations. It is not known what quantities of ARD would be generated at the 84 pad. Water quality in Alder Spur is presently impacted by ARD with monitoring station Z-14 having pHs of 4.1, SC of 2,090 μmhos/cm, and sulfate of 3,480 mg/l (fall 1993). ARD contamination can be traced to the dike/foundation construction for the 83 leach pad complex. The material removed from the 85/86 pad buttress would be used as pit backfill under Alternative 3.

252. COMMENT: In the Draft EIS page 2-61, the first bullet states that the underdrains exit from beneath the leach pad liner below the retaining dike in Sullivan Creek. Is Sullivan Creek being tested? If so, what are the results regarding ARD or other pollutants? (346)

RESPONSE: Water quality information for all drainages being monitored at the Zortman and Landusky mines is contained in Section 3.2 of the Final EIS. Except for three baseline samples taken in 1988 (see amendment to application), water quality data for Sullivan Creek is limited to after 1991 when the Sullivan Park heap leach pad was constructed. Monitoring station L-28, located at the toe of the leach pad, receives water directly from the leach pad underdrain and appears to have become intensely affected by ARD, as illustrated by increases in sulfate, TDS and SC concentrations. Monitoring station L-27, located a few hundred feet further down Sullivan Creek, has demonstrated a similar, though less severe, decline of water quality. The ARD effects seen in Sullivan Creek are thought to be derived from acid generating material used in the construction of the Sullivan Park leach pad dike or due to oxidation of acid generating bedrock exposed during construction of the pad.

253. COMMENT: It is not clear that additional groundwater monitoring would be required for mine expansion alternatives. A monitoring program based on existing wells would be inadequate. More wells are needed, and some wells may need replacement. BLM should establish monitoring stations on those drainages where there is no data available. (337, 348, 352, LO-38)

RESPONSE: Please see Section 2.7.3.1 for modifications to the groundwater monitoring program. This includes additional monitoring wells north and south of the Zortman pit complex, north/northwest of the Landusky pit complex, and surface monitoring stations near Lodgepole Creek, Montana Gulch, South Bighorn Creek, and Swift Gulch.

254. COMMENT: The Draft EIS proposes on page 2-68 that water from Gold Bug Adit is to be used for road dust suppression. There are no provisions for treating this water, which may result in groundwater contamination. (344)

RESPONSE: Virtually all water used for dust suppression is lost to evaporation. Therefore, the risk of groundwater contamination is negligible.

255. COMMENT: Page 2-239 of the Draft EIS says that heap leach pads will be detoxified with cyanide free water until safe, but it doesn't say how long this will take or how much water will be drained for this use from aquifers serving the Fort Belknap Indian Reservation and surrounding communities. (352)

RESPONSE: It is not known how long leach pad rinsing would be required to meet the rinse water quality criteria. Please see Section 2.8.1.6 for information on water supplies for the mines. ZMI has groundwater appropriations of 450 gallons per minute from DNRC for mine operations. The impacts of this groundwater withdrawal are estimated to be insignificant in Section 4.2.5, even if an additional groundwater source is needed for mining.

256. COMMENT: Full discussion of various mitigation measures and their potential effectiveness is required not only by NEPA, but also by FLPMA, which requires the Secretary of the Interior to "take any action necessary to prevent unnecessary and undue degradation of the [public] lands." 43 U.S.C. § 1732(b). The BLM's regulations provide that "[f]ailure to comply with applicable environmental protection statutes and regulations thereunder will constitute unnecessary or undue degradation." 43 C.F.R. § 3809.0-5(k)(4) (emphasis added). Thus, the BLM must take "any action necessary" to prevent violations of environmental protection laws. In order to satisfy this duty in terms of the proposed expansion, the BLM must prohibit expansion until necessary CWA permits have been issued. The BLM must also identify and analyze in the DEIS mitigation measures that will ensure that the mine will come into compliance with the Clean Water Act and other laws. (340, 342, 344, 346, HA-30)

RESPONSE: The EIS includes measures to ensure that ZMI achieves and maintains compliance with water quality laws for existing and expanded mining operations. These measures are described under the respective alternatives in Chapter 2.0 and Appendix A.

6.6 SOIL AND RECLAMATION

1. **COMMENT:** Is reclamation and regulatory compliance contingent on expansion of mine operations? (258, 320, LO-11)

RESPONSE: Reclamation and regulatory compliance is not contingent on expansion of mine operations. Reclamation can be achieved under either a mine expansion or non-mine expansion scenario. Alternative 7 describes how it would be accomplished in conjunction with expansion and is the preferred alternative. Alternative 3 describes how it would be accomplished without mine expansion.

2. **COMMENT:** How safe, effective, and long-lasting are the proposed reclamation plans; have they been used elsewhere and what were the results? (258, 344, LO-49)

RESPONSE: The safety of the reclaimed facilities in terms of stability is addressed specifically in Section 4.1.2.3 and by alternative in Sections 4.1.3 through 4.1.9. The durability of the covers of Alternatives 3 and 7 or the covers of the other alternatives is a question that cannot be directly answered. Failure, either local or massive, is defined as excessive loss of protective vegetative and/or other sources of cover and accelerated erosion to the extent rills and/or gullies develop as evidence of excessive soil loss. This type of failure is a potential for any reclaimed area. However, the proposed covers, particularly for Alternatives 3 and 7 have been developed with input from reclamation specialists with extensive local and national experience (EPA 1991) and from the review and application of guidance and results published by the EPA for RCRA landfills (Beedlow 1984); the U.S. Nuclear Regulatory Commission (1990) for the final closure of uranium milling wastes; and other published sources (Nyhan, et al. 1990, Fayer, et al. 1992, Anderson, et al. 1993, Waugh, et al. 1994). These areas of reclamation design/planning have yielded an array of publications and results which have been used in the development of covers for Alternatives 3 and 7. The optimization of effectiveness and longevity have been strongly considered in the development of the Alternative 3 and 7 covers, as was the case for the closure and reclamation of landfills and uranium milling wastes.

3. **COMMENT:** Where is sufficient topsoil going to be found? Data concerning the availability of soil and subsoil materials are not presented in a manner allowing evaluation of the alternatives. (258, 347)

RESPONSE: Sources and volumes of suitable cover soil and subsoil materials have been reorganized into more readable tables in Section 3.3.4 of the Final EIS. The soil material volume requirements and availability for each alternative is discussed in the sections on "Soil and Reclamation Effectiveness - Cover Soil Quantity and Thickness" in the environmental consequences section (Section 4.3) of the EIS.

4. **COMMENT:** Impacts from the proposed mining of soil materials at the proposed Ruby Flats waste rock site were not addressed in the Draft EIS. (340, 344)

RESPONSE: The mining of soil materials at the Ruby Flats waste rock repository site described under Alternative 6 has been eliminated from actions for Alternative 7. Section 3.3.4 details the revised sources of soil materials for use in reclamation at the Zortman and Landusky mines complex. Ruby Flats may still be mined for non-acid generating alluvial gravels in other alternatives. Soil would be stockpiled and replaced on the borrow area. Impacts from sedimentation and traffic have been addressed.

5. **COMMENT:** The Draft EIS, Section 2.8.1.4 (page 2-126), states that "since much of the native soil and subsoil under the proposed leach pad area (Goslin) contains calcium carbonate it would be used in construction or reclamation without restriction." Considering Section 2.10.1.4 which states "A relatively shallow bedrock layer under the soil and subsoil in Goslin Flats is the Thermopolis Shale, which probably contains considerable pyrite and sulfur content," a detailed cross section of the geology/soils of Goslin Flats needs to be provided. It should be shown to what depths soils would be removed for construction of a leach pad, define if the Thermopolis Shale will be exposed and describe the potential for ARD formation as a result of soil removal and pad construction. What are the volumes of material expected to be removed from Goslin Flats? Drawings of the filter drains that would be installed beneath the leach pad to prevent the buildup of groundwater should be provided. (346)

RESPONSE: A detailed cross section is not necessary for Goslin Flats. An illustration of the general geologic features of the area is provided in Section 3.1. For additional information, the mine permit application, Volume I, Appendix B contains detailed logs of borings conducted at Goslin Flats.

The Thermopolis Shale should not be exposed by construction of the leach pad. Soil, subsoil, and colluvium are typically 10 feet thick or more in this area. Up to 6 feet of these unconsolidated, surface/near-surface materials would be excavated from the leach pad footprint for use as reclamation material in covers used on facilities at the mine site. Volumes of material required for reclamation, and to be removed from Goslin Flats, are disclosed in Sections 4.1 and 4.3.

6. COMMENT: The Draft EIS contains no mention of the projected survival of vegetation on water balance covers under Alternative 7. (344)

RESPONSE: The potential failure of revegetation in the long-term was described in Section 4.4.9 of the Draft EIS. Under Alternative 7, it is expected that on reclaimed acres total plant cover and productivity would return to pre-mining levels, and achieve 90 percent of cover and productivity relative to adjacent comparable undisturbed acres. The only exceptions would be 1) inaccessible mine pit benches that would not receive a soil/NAG cover and 2) mine pit benches that would receive a soil/NAG cover but could acidify from acidic runoff from mine pit highwalls.

7. COMMENT: Recommendations for modification of the covers and final slopes/bench spacing based on comments of Dr. Richardson from his review of the Draft EIS are: water balance cover - 12-inch capillary break vs. 24-inch; barrier cover - the filter fabric layer and the capillary break layer are dropped from the cover design; and allow construction of slopes as steep as 2:1 with benches placed every 100 vertical feet. (342)

RESPONSE: The water balance cover as now proposed for Alternatives 3 and 7 uses a 12-inch capillary break. The water barrier cover for Alternatives 3 and 7 uses 36 inches of NAG (under 12 inches of topsoil) in place of 24 inches of both subsoil and capillary break material (NAG) and filter fabric (see Figure 2.7-1 in the EIS). The proposed new barrier cover maintains a 48-inch cover over the GCL and potentially acid generating waste rock per DEQ guidelines. The 48-inch cover also enhances the longevity of the GCL layer by providing a more effective protective buffer against freeze and thaw cycles, which over time could reduce the effectiveness of the GCL layer. Based on the evaluation of results of modeling soil loss using the Revised Universal Soil Loss Equation, the vertical spacing of benches has been increased to 100 feet; however, sideslopes of all major facilities would be reclaimed to 3:1 slopes overall to increase the potential for long-term effective reclamation of these facilities and increase facility stability (Section 4.3.1) except heap dikes where it may not be desireable to reduce from 2.5:1 to 3:1 due to effects on adjacent drainages.

8. COMMENT: The Draft EIS states that water balance covers would be used on all disturbances (except haul roads and building facilities). Nowhere is there a discussion of critical sites where the use of this type of cover is ill-advised. (344)

RESPONSE: The Final EIS provides more discussion and consideration of the areas to be reclaimed for which a water balance cover would be most appropriate. Alternatives 3 and 7 would require a water balance cover to be placed on those areas with slopes of 25 percent or greater. Less steep slopes would be covered with a system that includes a low permeability barrier layer which allows for further protection against infiltration of ponded water. Pit benches would be covered with 12 inches of topsoil over 12 more inches of suitable NAG material, as would areas not considered to be acid generating. Please see Sections 2.7.2.1 and 2.11.2.1.

9. COMMENT: ZMI's revegetation program has demonstrated multiple lift soil handling is not necessary for successful revegetation. (342)

RESPONSE: Revegetation can be successful with one-lift soil salvage and replacement. Existing disturbances would still be reclaimed with stockpiled soils which are not segregated. In fact, some subsoils at Goslin Flats would be used to supplement existing topsoil shortages at Zortman. For all new disturbances, two-lift soil salvage and replacement enhances revegetation success and minimizes the loss of 10,000 years of soil development that has occurred in the area.

10. COMMENT: The language in Section 3.3.4, page 3-125, should be revised to indicate that reclamation materials within disturbance areas will be used to the maximum extent possible to reduce the need for processed materials for subsoil and capillary break. (342)

RESPONSE: The text in the Final EIS has been revised to reflect the organization of sources and volumes of reclamation materials.

11. COMMENT: The predicted effectiveness of 25 percent for reclamation covers under Alternative 1 are excessively low. (342)

RESPONSE: The estimation of percentage reclamation success for each alternative has been deleted from the EIS. The percentages were intended to reflect relative revegetation cover between alternatives and not absolute values for overall reclamation success or failure.

12. **COMMENT:** The Draft EIS is premature because of lack of soil impact data on land application areas and land surrounding the Zortman and Landusky mines. (352)

RESPONSE: Testing of soil impacts has been conducted for the proposed LAD area. Results of this test program are contained in ZMI's Permit Application. Soil impact data on land application areas is addressed in Section 4.14 of the EIS. Section 4.14.4 discusses the impacts that occurred during the emergency land application disposal (LAD) at the Zortman Mine that was carried out on Carter Butte, to the south of the 84 leach pad, between October 1986 and June 1987. Locations for the LAD are discussed under each alternative, as well as the impacts of improper LAD that would result in negatively impacted soil and water resources. Section 4.3.3 also projects impacts to soil resulting from land application disposal of spent solutions.

13. **COMMENT:** The Draft EIS notes that slopes would be reclaimed to 3:1, except for leach pad dikes. There is no reason given for why leach pad dike slopes could remain at steeper angles, particularly given the greater risk of failure with increased slope angle. (33, 35, 37, 59, 131, 169, 176, 180, 210, 229, 235, 249, 274, 352, LO-4, LO-30, MA-2, MA-8, MA-13, GF-5)

RESPONSE: Leach pad dike slopes would not be resloped because the act of excavation for resloping could affect the stability of the ore heap. In addition, resloping of pad dikes would extend the facilities even further into drainages and impact additional waters of the U.S.

14. **COMMENT:** Under Alternative 7 (preferred), the document states that the percent effectiveness of the reclamation plan is predicted to be 99 percent; yet the document at no point states where a similar reclamation plan has worked. This 99 percent figure is pure conjecture and leads one to believe that the people involved are groping for answers to justify the mine expansion. The water balance reclamation covers are experimental at best and where are they going to find sufficient topsoil when mountain tops don't contain that much to begin with. (258)

RESPONSE: The 99 percent value was used in error. Under Alternative 7 usage of the water balance covers is expected to result in a revegetation success of greater than 70 percent. This prediction is based on experience at other reclaimed sites, and is the revegetation value used in modeling water infiltration through facilities. Overall reclamation success is required to be 90 percent of adjacent, comparable communities. With the water balance reclamation covers increased moisture retention and availability in the soil material would provide better growth medium and support relatively higher plant cover and productivity.

The soil material volume requirements and availability for Alternative 7 is discussed in the section on "Soil and Reclamation Effectiveness - Cover Soil Quantity and Thickness" in the Environmental Consequences of the EIS. The need for additional soil material could be met with the salvage of subsoil beneath the proposed Goslin Flats leach pad or Ruby Flats.

6.7 VEGETATION

1. COMMENT: In the Draft EIS, page 4-118, under "Impact Rating"; this discussion is brief and quickly concludes with an overall rating of negative low. Suggest elimination of this discussion because it seems to be arbitrary. Significant adverse effects to forested areas, wetlands, and species diversity are involved. (346)

RESPONSE: The overall impact rating is consistent with the methodology discussed in Section 4.4.1 for rating impacts. Impacts would be high for species diversity for all alternatives in areas disturbed and reclaimed. Impacts would be moderate to high for forested habitat. "Overall" ratings have been deleted from Section 4.4. Please see Section 4.4.1 for relevant information on how impacts were assessed for loss of species diversity, removal of forested habitat, and wetlands.

2. COMMENT: Plant more trees wherever they can grow. They help the air and might provide timber in the future. (128)

RESPONSE: Please see Chapter 2.0 for detailed reclamation plans for each alternative, including plans for revegetation. In general, native tree species may be planted in select locations such as pit benches to enhance visual quality. Following mine closure, the site would be managed for wildlife habitat, which is consistent with the BLM's land management goals for this area. Currently, lack of open parks and meadows is a limiting factor for wildlife; therefore, replanting the entire site with trees is not included in the BLM and DEQ mitigated revegetation plans.

3. COMMENT: On page 2-241 of the Draft EIS it says the reclamation revegetation cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location, but it gives allowance for the omission of replanting trees which are plentiful in surrounding environment. (352)

RESPONSE: Reclamation goals for Alternative 7 are to enhance wildlife habitat. While few trees would be replanted, a similar percentage of cover can be achieved with grasses, forbs, and shrubs. This would quickly provide wildlife forage, stabilize slopes and soil, and minimize erosion. In addition, the climate in the Little Rocky Mountains would allow invasion of trees in the area over time. Please see Section 2.11.2.8 for revisions to the text to clarify this statement.

4. COMMENT: Why does the preferred alternative (#7) require that reclamation achieve 90% cover of adjacent, natural communities yet omit trees from the revegetation mix, when trees are a large component of the surrounding environment? The reason for not using trees in revegetation efforts should be explained. (346, 352)

RESPONSE: Prior to mining, most southwest-facing hill slopes were sparsely timbered. These aspects are more suited for meadows. Trees would be used on a limited basis for visual impact mitigation. The use of grasses, forbs, and shrubs for revegetating would provide better forage for wildlife. In addition, tree roots are more likely to puncture liners in the reclamation covers. The 90% criteria is not species dependent and could be achieved without trees.

5. COMMENT: At the entrance or mouth of Baker Canyon on the southeast corner of the Little Rocky Mountains at the foot of Bear Mountain; there used to be a large grove of Quaking Aspen in which deer and elk lived. Now the trees have suddenly all died. Is this related to polluted groundwater. (42)

RESPONSE: Bear Mountain and Baker Canyon are outside of the impact area and no connection is likely between mine activities and dead aspen trees.

6. COMMENT: As you drive from Hays to the D.Y. Junction you can see the trees dying all along what is called Mud Creek. Why are these trees dying? Has anyone taken the time to find out why? Maybe there are bugs or mites, then again maybe it is toxins from the mine. (39)

RESPONSE: This area is outside the impact area; and no connection is likely between mine activities and dead trees along Mud Creek.

7. COMMENT: Right now the Chinese are in Saskatchewan dealing with Native Americans and their plants to better the people in China because they know how important plants are. How important are plants to us? Where do you think insulin, antibiotics came from, the rain forest, we're all getting some good out of it. We would like to help everybody with this plant study. I've got my personal heart surgeon working on a plant that does my heart more good than any nitro can give, this is for all of us. We've got to have a good plant study. (LO-39)

RESPONSE: As discussed in Section 3.4 numerous vegetation inventories have been conducted in the project area. This information has been summarized in Section 3.4.1, and impacts to the various plant communities are discussed in Section 4.4. No plant gathering areas used by Native Americans have been identified that would be disturbed under any of the alternatives. Potential future medicinal uses of plants occurring in the Little Rocky Mountains is reportedly being investigated and documented by representatives of the Fort Belknap tribes.

8. COMMENT: Section 3.4.3.1 of the Draft EIS states that a "formal" riparian study has not been conducted. Riparian areas have been inventoried both during the baseline study inventories and the wetlands inventory. Riparian areas have been adequately delineated. (342)

RESPONSE: Please see revision to Section 3.4.3.1; this statement has been deleted and information is provided on the results of the vegetation surveys, which included riparian areas.

9. COMMENT: The Draft EIS discussion of the past success of revegetation after reclamation reports mixed results and suggests that "[c]ountermeasures to the deterrents to shrub and tree survival <u>could be developed</u> to decrease mortality." Draft EIS at 4-99 (emphasis added). This deferral of analysis to some future date and some other document violates NEPA's mandate that impacts be disclosed in the EIS. 40 C.F.R. § 1502.16. "NEPA clearly requires that consideration of the environmental impacts of proposed projects take place <u>before</u> any [ ] decision is made." <u>LaFlamme v. FERC,</u> 852 F.2d 389, 400 (9th Cir. 1989). The agency practice of approving now and asking questions later is "precisely the type of environmental blind decision-making NEPA was designed to avoid." <u>Conner v. Burford</u>, 836 F.2d 1521, 1531 (9th Cir. 1988). NEPA requires program development "be directed by research results rather than that research programs ... be designed to substantiate programs already decided upon." <u>Save Our Ecosystems v. Clark</u> , 747 F.2d 1240, 1248-49 (9th Cir. 1984). (344)

RESPONSE: The countermeasures to reduce shrub and tree mortality were recommended in the referenced revegetation studies conducted to date and are repeated in the EIS as full disclosure of the information provided in these reports. Current revegetation plans have incorporated these suggested mitigation measures as discussed in the reclamation plan for each alternative. This includes such plans as surface ripping where soils are compacted to improve water and air movement in the root zone, mulching to conserve moisture and reduce competition, restriction of grazing until revegetation is fully established, and planting the seedlings when environmental conditions are optimal for tree and shrub survival.

10. COMMENT: Vegetative cover of "90% of that demonstrated in adjacent, natural communities of similar composition and location" may be very difficult to achieve under the best of conditions. What is the 90% cover based on? The vegetative cover is considered to be a component of the reclamation cover which will be designed to:

- limit surface water infiltration through the final cover to 5 percent or less of annual precipitation, and
- limit soil surface erosion loss to less than 2 tons/acre/year.

Based on past successful reclamation at the Zortman and Landusky mines, vegetative cover requirements should be in the range of 60 percent. (342)

RESPONSE: The 90% cover is what would be considered successful revegetation. This does not mean that 90% cover must be achieved overall; it is 90% of the natural, undisturbed cover of communities with similar species composition, slope, aspect, and elevation. As an example, if natural vegetative cover is 60%, then 90% of 60%, or 54%, cover would be required for successful revegetation.

11. COMMENT: With reference to the Draft EIS Section 2.5.5.3, page 2-86, what are results of [vegetation] studies to date? (346)

RESPONSE: Results of annual operating reports for reclamation are available at the DEQ office in Helena. This information has been used in preparation of Section 4.4, impacts to vegetation. A report detailing results of the test plot studies has not yet been released.

12. COMMENT: The Zortman permit application and Landusky addendum list existing disturbance as 401 acres for Zortman and 814 acres for Landusky totalling 1,215 acres. What does the 1,248 acres listed in the first paragraph on page 4-103 of the Draft EIS include? (342)

RESPONSE: The additional 33 acres is previous disturbance at the Williams and Seaford clay pits and the King Creek quarry.

13. COMMENT: In the Draft EIS, page 2-54, it states that the Carter Butte LAD area will likely not require reclamation measures. What testing has been or will need to be completed to document/determine that Carter Butte LAD will/will not require reclamation? If more testing is needed, when will it be accomplished? (346)

RESPONSE: There is no overall requirement for LAD monitoring. These are developed on a case by case basis for specific LAD events. However, all mitigated alternatives would require a minimum level of analysis of LAD areas to determine operational efficiency, solution testing, collection of pore waters and seeps, etc. This program is outlined in Section 2.7.5.1 of the Draft EIS (Section 2.11.3.1 of the Final EIS). The Carter Butte LAD area involves no surface disturbance and, thus, requires no surface reclamation. The vegetation has reestablished and soil tests do not show plant toxic metal accumulations. Specific test data are available from BLM or DEQ files upon request.

6.8 WETLANDS AND OTHER WATERS OF THE U.S.

1. COMMENT: Please note that the mitigation measures proposed in the individual 404 permit applications for Zortman and Landusky are designed to restore the function of the jurisdictional water post-mining. (342)

RESPONSE: The mitigation plan and its intent are described in Section 4.4.6, which has been revised to reflect ZMI's plan as presented in the 404 permit applications.

2. COMMENT: The Draft EIS should be revised to indicate that the Corps has evaluated the WESTECH memo dated February 17, 1995, and determined that the mining-related disturbance of jurisdictional waters is actually less than reported in this memo. Specifically, the Corps has identified a total of 2.45 acres of jurisdictional waters affected by mining activities, consisting of 2.15 acres at Landusky and 0.3 acres at Zortman (Memorandum for File by Martin Keller, Corps' Regulatory Branch, June 1, 1995. Moreover, the Keller memo clearly indicates that many of the upper draws and erosion zones at both mines "are not considered waters of the United States." (342)

RESPONSE: Since the Draft EIS was issued, several discussions and meetings have been held to determine the extent of both direct and indirect impacts to jurisdictional wetlands. The EIS text has been revised to reflect the acreages provided by ZMI in its comments, plus the following:

- 0.65 acres of direct impacts to Goslin Flats non-wetland waters (two stock ponds), as determined by WESTECH/ZMI (Alternatives 4, 6, and 7).
- 3.0 acres of indirect impacts to Camp Creek wetlands and 0.59 acres of indirect impacts to Ruby Gulch wetlands for Alternative 6, as determined by discussions with OEA Research, Inc.
- 16.0 acres of indirect impacts to non-wetland waters from past disturbances (1979-present), of which 14.6 acres of indirect impacts occurred from 1990-present and is used for mitigation purposes.
- Various acres of indirect impacts to non-wetland waters from proposed actions, as determined by the COE or Woodward-Clyde using the COE methodology:
  <u>Alternatives 4 and 7</u> - 3.96 acres in Ruby Gulch and tributaries, 3.12 acres in Goslin Gulch drainages entering Ruby Gulch, and 0.22 acres in Antoine Spur, a tributary of Carter Gulch, for a total of 7.3 acres.
  <u>Alternative 3</u> - 0.40 acres in Goslin Gulch downstream of the borrow area.
  <u>Alternative 5</u> - 0.40 acres in Alder Gulch.
  <u>Alternative 6</u> - same acreage as described for Alternatives 4 and 7, plus 1.4 acres in Camp Creek.

The text in Section 3.4 indicates that jurisdictional waters include the intermittent and perennial streams (not the ephemeral headwaters), and Section 3.2.9 has been modified to indicate that the upper reaches of many streams are not jurisdictional waters.

3. COMMENT: How does noise indirectly disturb waters of the U.S.? (342)

RESPONSE: Noise can indirectly impact non-wetland waters of the U.S. by affecting the functions and/or values that are affected by noise, e.g., wildlife use.

4. COMMENT: The sentence beginning (line 3) "Corrective measures at the Zortman and Landusky mines, required by the Water Quality Improvement Plan, could have additional...." (342)

RESPONSE: The text in this section has been changed; please see Section 4.4.6.

5. COMMENT: The § 404(b)(1) analysis that exists does not include an adequate analysis of the functional values of the existing wetlands and waters of the United States. In order to assess the ecological importance of the loss associated with the proposed destruction of wetlands and other waters at this site, it is critical to have a good understanding of the existing functions of the wetlands. The importance of employing a comprehensive, interdisciplinary approach in analyzing the function and value of wetlands has been recognized by Corps officials in the development of the HGM model. That model provided a mechanism for analyzing hydrology, geology, and morphology and their interconnections with the affected wetlands. We suggest that such a comprehensive analysis of the functional value of wetlands and waters be employed at this site. (362)

RESPONSE: Section 3.4 includes Table 3.4-2 and new Table 3.4-3, that summarize information about functions and values of both wetlands and non-wetland waters of the U.S. This information is used in the 404(b)(1) analysis presented in Appendix B and in the impact assessment presented in Section 4.4. The methods used to assess wetland functions and values was one approved by the COE. Although it is not the HGM model, it is one widely used and accepted for wetland functional assessment and it employs a comprehensive, interdisciplinary approach.

6. COMMENT: The Corps should not grant a permit allowing the mine to fill or pollute waters in connection with the proposed expansion because in so doing, they would be allowing the mine to violate other federal laws. This is contrary to what the law allows. 33 C.F.R. 325.2(b). If the Corps were to allow the mine to fill the wetland area, they would be in violation of: 1) The Historic Preservation Act (Goslin Flats is just to the west of a stone circle site, additionally, the entire Little Rocky Mountain Range is a candidate for the National Register as a traditional cultural property); 2) Federal Land Management and Policy Act; The Endangered Species Act (Goslin Flats will destroy an important water and insect source used by bald eagles, and potentially the black footed ferret, the piping plover and the peregrine falcon (if planted within the area); The Fish and Wildlife Coordination Act (since it has already been admitted that the loss of the wetlands and subsequent construction of Goslin Flats will be a substantial disturbance to the bats which inhabit Azure Cave, allowing this habitat destruction may also violate this law). (351)

RESPONSE: Information is provided in Section 4.12 regarding historic and other cultural resources and in Sections 3.5 and 4.5, regarding presence of and effects on endangered species and other wildlife. None of the information gathered for the EIS and presented in these sections indicates that the proposed action would violate the federal laws listed. There are impacts to certain resources covered by the laws, and these impacts are addressed and recognized in the appropriate sections. For example, adverse impacts to bats at Azure Cave due to loss of ponds/wetlands are discussed, but these are not considered to be high or significant impacts, based on the data collected and contacts made with experts in the field.

7. COMMENT: Even assuming that Pegasus/ZMI can create an artificial wetlands, accurately placing habitat and preserving indigenous species, these "mitigation" wetlands will be destroyed once the mine uses Land Application Disposal (LAD) at Goslin Flats. As shown on the map for Alternative 7, the proposed LAD area completely encompasses the site of the replacement wetlands. According to the Draft EIS, this LAD area will be used during closure activities, and the water applied will contain metals and cyanide. Draft EIS at 2-139. Although a 200-foot buffer is proposed on either side of drainages (Draft EIS, Fig. 2.8-1), there is no indication that the Draft EIS considered the consequences of land application on the wetlands, and no discussion as to how the wetlands will be restored once again following the application of mine wastes. (340, 344)

RESPONSE: The boundary of the LAD area in Goslin Flats has been changed to avoid the wetland mitigation site. The LAD would be located downgradient from the site, and adequate buffers (200 feet) would be provided around any wetland areas, as well as drainages, that may be located in the LAD area. Figures indicating the location of the LAD area have been revised.

8. COMMENTS: The Corps must conduct a public interest review prior to granting a permit to fill a wetland area. A permit may not be granted if it would be contrary to the public interest. 33 C.F.R. § 320.4(a). Some of the aspects considered important for public interest include conservation, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, recreation, water supply and conservation, and water quality. 33 C.F.R. § 320.4(a). These problems demonstrate that granting a 404 permit is not in the public interest. (340, 351)

RESPONSE: The aspects that affect the determination of public interest listed in the comment are addressed in the various resource sections of the EIS and in The Purpose and Need description provided in Chapter 1.0. Based on the EIS Purpose and Need and resource analyses, the project meets the public interest review requirement. Additional information can be found in Appendix B, which is the Section 404(b)(1) draft evaluation.

9. COMMENT: Was this [Seaford clay pit] area investigated for the presence of wetlands? A map is needed showing the location of this pit. (346)

RESPONSES: The Seaford clay pit is in a location with no apparent wetland characteristics and is currently adjacent to an area under cultivation as a wheat field. The clay pit location is shown on Figure 2.5-2 in the Final EIS.

10. COMMENT: Discussion needs to be added that addresses wetlands and waters of the U.S. that <u>were</u> affected. Such discussion may need to be extrapolated. What needs to be specifically discussed is what <u>were</u> the functions and values of the streams that have been affected. Were the affected streams intact wetland/stream systems with few perturbations? (345)

RESPONSE: Please see revised text in Section 3.4.3.3. A discussion that addresses wetlands and waters of the U.S. that were affected has been added, and Table 3.4-3 summarizes both past and existing functions and values of the drainages. Any information that was available about stream conditions/impacts from past years that could help characterize the streams' condition prior to mining has been provided in the table. Generally, there is very limited data on stream conditions prior to the onset of mining in the area.

11. COMMENT: This table [Table 3.4-2] only addresses the wetlands in each of the affected drainage areas. The waters of the U.S. in each of the affected drainage areas also need to be addressed. The physical dispersal (export) of potential food sources from waters of the U.S., including wetlands should not be overlooked. Such export is probably due mainly to flushing during severe storm events. Major export can occur during just one or a few storms. Seasonal or annual pulses of exporting energy may be quite important for long-term productivity and food availability in receiving streams. Is there a relationship between exported organic material and downstream fishery production? Is that relationship significant? Either this table or another table needs to address wetlands and waters of the U.S. that were affected. (346)

RESPONSE: Please see Table 3.4-3, which has been added to address non-wetland waters. The contribution of the limited macroinvertebrate biota/energy found in the project area streams to downstream fishing production is not considered significant. Stream biota is extremely limited in the project area, where most of the stream reaches are ephemeral or intermittent, and it is unlikely that periodic export of this material is a major factor in the support of downstream fisheries.

12. COMMENT: Any loss in waters of the U.S., including wetlands, which have substantial value based on functions; or any change which reduces the value from substantial to marginal. (346)

RESPONSE: Since this comment was received, several discussions and meetings have been held with the COE and other agencies to discuss the wording of the significance criteria for wetlands and non-wetland waters. Agreement was reached on the revised criteria as presented in Section 4.4.1 - #6 of the Final EIS. These criteria are now based on the functions and values presented in Tables 3.4-2 and 3.4-3. For example, the criteria now state that high impacts are losses or changes to waters with "high" or "moderate" value that are not minimal or would not result in losses of high value functions.

13. COMMENT: Impacts to waters of the U.S., including wetlands are determined to be either significant or insignificant. (346)

RESPONSE: The "high" impact rating is considered a significant impact; the "medium" or "low" ratings are considered insignificant. The text at the beginning of Section 4.4.1 has been revised to clarify this.

14. COMMENT: Section 4.4 should be entitled - Waters of the U.S., Including Wetlands. Consideration should be given to moving this section to Wildlife and Aquatics. This section determined that 4.14 acres of non-wetland waters of the U.S. were directly impacted from 1977 to present. Such information is needed for cumulative impact analysis. The direct effect from 1990 to present must also be determined. Because of uncertainty relating to the authority of a Federal Agency to require mitigation which addresses impacts more than 5 years preceding notification of a violation, the Omaha District does not intend at this time to require mitigation for any impact prior to 1990. This section makes reference to Appendix B, but the referenced appendix does not address the non-wetland waters of the U.S. that were directly impacted during 1977 to present. Indirect impacts to non-wetland waters of the U.S. since 1990 have now been determined. Zortman mining has indirectly impacted 3.04 acres, and Landusky mining has indirectly impacted 11.56 acres for a total indirect impact of 14.6 acres. This section needs to discuss the significance of the loss or change in non-wetland waters of the U.S. Add a statement to the last paragraph that informs the reader that the COE may require additional mitigation. Also, the last paragraph should quantify the gain expected by the restored waters of the U.S. (346)

RESPONSE: The text has been revised to include discussions of both wetlands and non-wetland waters of the U.S. Although much of the information pertains to aquatic issues, it was decided to leave the organization as is and reference or re-state information from other sections of the EIS in Section 4.4. Section 4.4 now includes information about both indirect and direct impacts to both wetlands and non-wetland waters, which has been used to revise Appendix B material, and the discussions about Residual Water Quality Impacts in the "Wildlife and Aquatics" section. Where possible, additional, quantitative information has been provided regarding gain or positive impacts expected from mitigation, including changes to Table 4.2-1 that provide information on estimated post reclamation downstream water quality. A new appendix (Appendix F) has been added to the Final EIS which describes the aquatic ecosystem mitigation plan for all past, present, and proposed direct and indirect impacts. The plan was developed in consultation with the COE.

15. COMMENT: Delete the seventh bullet [under summary of impacts, page 4-97 of the Draft EIS]. Replace the statement that impacts to wetlands are rated neutral with a statement that no vegetated wetlands are believed to have been impacted. (346)

RESPONSE: The text in this section has been changed, and this bullet has been deleted. Past impacts to wetlands are now discussed within the narrative.

16. COMMENT: This section refers the reader to Appendix B for more details. This appendix identifies wetland site #9 as the mitigation site. The map in this appendix is missing wetland site #9. (346)

RESPONSE: The map in Appendix B has been revised to show wetland site #9.

17. COMMENT: We do not agree with the statement in this section that states wetland functions and values would not substantially change by Alternative 4 activities. Two stockwater ponds which are probably used by Azure Cave bats for watering would be destroyed. The direct impacts discussion also needs to address the direct effects on the functions and values of the waters of the U.S. (346)

RESPONSE: The text in Section 4.4.6 has been revised, and Table 4.4-5 has been added to describe indirect impacts to the functions and values of wetland and waters of the U.S. The impacts related to the disturbance of the stockwater ponds are addressed in the Table 4.4-5 and are described in detail in new text added to Section 4.5.6.1 - Special Status Species. The direct impacts discussion and acreage now includes the loss of 0.65 acre in Goslin Flats, which is the stockpond acreage. Mitigation is specifically proposed for this impact (creation of a new pond in that area).

18. COMMENT: Impacts to wetlands should be rated significant and adverse because of the loss of watering habitat for bats. A rating of the impacts to waters of the U.S. needs to be made. (346)

RESPONSE: Impacts to non-wetland waters are now specifically addressed and include an assessment of the loss of water source for the bats; however, the impact is not considered to be significant because there are other water sources in the area and mitigation is required (creation of a new pond in upper Goslin Gulch). See revised text in Section 4.5.6 and response to several related comments under "Wildlife and Aquatics" for more detail.

19. COMMENT: The significance of the impacts on waters of the U.S. needs to be discussed. Appendix B states that there will be a loss of open water provided by ponds in Goslin Flats. How important is this open water to stock watering? Appendix B states that minor to major changes would occur to the wildlife diversity/abundance function and value of Ruby Tributary A. What is meant by this "range" of change? Is Ruby Tributary A of substantial value because of the wildlife diversity/abundance function? If so, would its value be reduced to marginal? The reader is unable to get a good understanding of Ruby Tributary A -- is it an intact wetland/stream system with few perturbations? Please note that Appendix B needs to address both wetlands and waters of the U.S. Also, what will be the indirect effect of soil runoff from roads, placement of soils during reclamation, and any other earth moving activity on downstream waters of the U.S, including wetlands? (346)

RESPONSE: Section 4.4.6 has been revised to include a discussion of both direct and indirect impacts. Appendix B has also been revised to address this comment. The indirect impacts analysis now provided in Table 4.4-5 includes discussion of soil runoff/erosion on downstream waters (sedimentation effects). The existing value of Ruby Tributary A is now addressed in Table 3.4-3 under "Ruby Gulch Above the Town of Zortman," and its current use/condition is discussed in the mitigation plan provided in Appendix F.

20. COMMENT: A map of the study area should be provided. (346)

RESPONSE: Maps of the project areas for each of the alternatives are provided in Chapter 2.0 and in Exhibits 1 and 2. Figure 3.4-2 also depicts the project area, the wetlands, and the major drainages.

21. COMMENT: This section makes reference to Appendix B for a summary of potential changes in the wetland functions and values as a result of Alternative 7 actions. Appendix B does not address potential changes that would occur as a result of development in Alder Spur and Alder Gulch. (346)

RESPONSE: Appendix B has been revised to include discussion of direct and indirect impacts to non-wetland waters.

22. COMMENT: Consideration should be given to mitigation in King Creek for the Goslin Flats ponds. Consultation with the Native Americans of the Fort Belknap Indian Reservation will be necessary. (346)

RESPONSE: King Creek is not included as a potential mitigation site because the mitigation is proposed in a location as close as possible to the relevant impacts (i.e., Ruby Gulch/Goslin Flats area). See Appendix F in the Final EIS for a discussion of the mitigation plan.

23. COMMENT: The significance of the impacts on waters of the U.S. needs to be discussed, as well as mitigation. Referring the reader to the impact discussion for alternative 4 is not adequate. Alternative 4 involves the Carter Gulch waste rock repository, while Alternative 7 involves placement of waste rock on existing mine facilities. Again, the indirect effect of soil runoff from roads, placement of soils during reclamation, and any other earth moving activity on downstream waters of the U.S, including wetlands must be addressed. Impacts from corrective measures required by the Water Quality Compliance Plan need to be addressed. (346)

RESPONSE: The text has been revised to include a discussion of impacts to both wetland and waters of the U.S., and Table 4.4-5 has been added to address indirect impacts on water quality such as soil runoff and impacts of corrective measures provided by the Water Quality Improvement Plan. Table 4.2-1 includes specific information on predicted effects on downstream water quality.

24. COMMENT: In discussing impacts to wetlands functions and values (Appendix B), the Draft EIS fails to explain what mitigation measures will be undertaken to offset adverse impacts to wetlands and waters of the United States from fill and removal activities. Instead, the Draft EIS admits that "ZMI has not formally presented a mitigation plan to compensate for past and proposed impact to waters of the U.S." Draft EIS, App. B at 11. Aside from any CWA issues, this violates NEPA's requirement that an EIS must discuss "[m]eans to mitigate adverse environmental impacts" of the proposed action. 40 C.F.R. § 1502.16(h). NEPA requires that "mitigation be discussed in sufficient detail to ensure that environmental consequences have been fairly evaluated." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 352, 109 S. Ct. 1835, 1847 (1989) (explaining that while NEPA does not have a substantive requirement that a complete mitigation plan be actually formulated and adopted, it does require that mitigation be discussed sufficiently in order to ensure an informed decision of the environmental consequences). In Oregon Natural Resources v. Marsh, the Ninth Circuit held that mitigation measures could not be properly analyzed by merely deferring to an incomplete plan. 832 F.2d 1489, 1493-94 (9th Cir. 1987), rev'd on other grds, 490 U.S. 260, 109 S. Ct. 1851 (1989). See also LaFlamme v. FERC, 852 F.2d 389, 401 (9th Cir. 1989) (EA inadequate for failing to explain or discuss how proposed mitigation measures lessen the project's impact on recreational and visual resources). This discussion must "analyze[] the mitigation measures in detail" an "explain[] how effective the measures would be." Northwest Indian Cemetery Protective Ass'n v. Peterson, 795 F.2d 688, 697 (9th Cir. 1986), rev'd on other grounds sub nom Lyng v. Northwest Indian Cemetery Protective Ass'n, 485 U.S. 439 (1988). "A mere listing of mitigation measures is insufficient to qualify as the reasoned discussion required by NEPA." Id. Here, of course, the Draft EIS does not even purpose a mitigation plan, much less discuss the effectiveness of possible mitigation measures. "[O]mission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA." Robertson, 490 U.S. at 352, 109 S. Ct. at 1847. Potential mitigation measures for the expansion proposal must therefore be fully disclosed and discussed not at some future date but now, in the Draft EIS. (340, 342, 344, 346, HA-30)

RESPONSE: An aquatic ecosystem mitigation plan specific to Alternative 7 has been developed in consultation with the COE and ZMI; it is included as Appendix F to the Final EIS. The plan includes 1.5:1 (acreage) mitigation for past direct and indirect impacts to wetland and non-wetland waters, and 1:1 mitigation for proposed impacts. Along with acreage requirements, a primary focus is on replacement of existing functions and values. The mitigation acreage consists of 16 acres of water quality improvements developed under the Water Quality Improvement Plan, 2.6 acres for restoration of Ruby Gulch, 2.69 acres for several wetland creation projects, and 19.59 acres of off-site reservoir project development.

25. COMMENT: The EPA has recently questioned whether it is really possible to "create" viable wetlands. See National Wildlife Federation, "A Net Loss for America's Wetlands: A NWF Critique of the White House Wetlands Policy," Dec. 7, 1993, at 8 (quoting EPA as stating that "[r]estoration or creation of a wetland that 'totally duplicates' a naturally-occurring ecosystem is impossible"). Most such mitigation efforts appear to have failed, a critically important point that is not discussed in the Draft EIS. (344)

RESPONSE: The ability to estimate the success of a created wetland is difficult unless clear goals have been specified. Creation of wetlands which exactly duplicate the naturally occurring wetlands which are destroyed by construction is impossible. However, functions and values can be restored or created and certain wetland functions can be enhanced in particular contexts (1990 Wetland Creation and Restoration). The proposed mitigation wetlands would incorporate the latest research and technology. While the mitigation wetlands may not have the exact species composition of the wetlands which are replaced, they would provide similar functions and values as the original wetland areas and would be required to meet specific success criteria. A long-term monitoring program would be used to assess wetland hydrology, soil stability, and vegetation establishment and to evaluate the overall success of the mitigation. Appendix F provides details on success criteria and monitoring.

26. COMMENT: The alternatives analysis fails to consider alternatives that do not impact wetlands or waters of the United States. As a non-water dependent project, such alternatives are presumed to exist; however, the Draft EIS does not address this issue. (340, 346, 351, 363)

RESPONSE: Section 2.2 of the EIS describes the development of alternatives. Effects on water quality and wetlands were considered in the environmental evaluation of alternatives, but these considerations were balanced against other environmental and engineering feasibility criteria. Although non-wetland/waters sites were considered for locations of various facilities, they were not included because they failed to meet engineering criteria or other physical requirements, as described in Section 2.2 for specific facilities.

Regarding the use of off-site locational alternatives, alternative project locations are not "reasonable" when the proposed action is the development of a precious mineral deposit, for several reasons.

First, the location of gold deposits is geologically fixed. Valuable gold deposits are a rare discovery and the proposed project has been designed for development of these particular deposits, with their specific characteristics. An alternate site location for this particular proposal is not physically possible and could not practically achieve the objective of this project, which is to extract gold from these specific ore deposits. This is a key factor to consider in evaluating alternatives to development of mineral properties since, by definition, no other project could achieve the objective of developing the economically minable ore deposits in the Zortman and Landusky mines. Courts have long recognized that the Corps' alternative analysis should take the applicant's objectives into account:

> Under these [404(b)] Guidelines, therefore, not only is it permissible for the Corps to consider the applicant's objective; the Corps has a duty to take into account the objectives of the applicant's project. Indeed, it would be bizarre if the Corps were to ignore the purpose for which the applicant seeks a permit and to substitute a purpose it deems more suitable.

Louisiana Wildlife Federation v York, 761 F. 2d 1044, 1048 (5th Cir. 1985) (footnotes omitted); see also Sylvester v Army Corps of Engineers, 882 F. 2d 407, 409 (9th Cir. 1989) (upholding Corps' rejection of off-site alternatives which did not meet the applicant's basic purpose and need).

Second, an evaluation of alternate mining project locations to develop alternate ore bodies is not feasible because locations for mining of valuable and rare mineral deposits are not selected from an array of sites, but are individually discovered after an extensive and expensive exploration program. Gold has intrinsic value, in part because it is rare and difficult to find. When a valuable deposit is discovered, it is developed, rather than held for future use or compared with other deposits.

Finally, even if information on discovered alternate ore bodies were available, there are legal and policy reasons that would make it unreasonable to require comparative environmental analysis.

27. COMMENT: Regulations require the applicant to take appropriate and practicable steps to minimize the potential adverse impacts on the aquatic ecosystem. 40 C.F.R. § 230.10(d), and 33 C.F.R. § 320.4(r). The mitigation measures included in the preferred alternative call for the construction of a new wetland area 500-2,000 feet away from the Goslin Flats heap-leach pad. The Draft EIS admits that the disturbances created by the operation of the heap-leach pad will likely reduce the functional capacity of the newly created wetland. Therefore, it will not fully replace the existing natural wetland. This reduction in functional capacity is contrary to what the law requires. In reviewing the Memorandum of Agreement on Mitigation (Feb. 6, 1990) entered into between the EPA and the Corps, the goal is "no net loss" of the wetland's functional values. Since the agencies have already determined that functional value will be lost, the extension permit should not be granted. (340, 351)

RESPONSE: Although the Ruby Tributary A mitigation wetland location is 500-2,000 feet away from the heap leach pad, there is intervening topography along much of this distance that is expected to attenuate noise, lighting, and other disturbances. Therefore, it is not expected that these disturbances would reduce the functional capacity of the mitigation wetland to the extent that a net loss of primary wetland functions would occur. Table 3.4-2 gives a rating of existing wetland functions for the Goslin Flats wetlands, which are rated "low" in overall function and value. The mitigation wetlands would provide a similar level of support in these functional areas, and in addition, another water source is proposed to replace the open water source for Azure Cave bats. Also, the check dams proposed for the mitigation wetland may enhance some of the existing functions, such as floodflow alterations and aquatic diversity.

28. COMMENT: Section 3.4.3.3 states that "the total linear feet or acreage of non-wetland waters of the U.S. within the study area has not been calculated." This is irrelevant with respect to direct and indirect impacts. (342)

RESPONSE: Please see revised text in Section 3.4.3.3.

29. COMMENT: The next-to-the-last paragraph on page 3-133 should be revised by deleting the first two sentences and replacing them with the following: "Proposed activities at the Landusky Mine will result in the disturbance of 0.03 acres of wetlands and 0.08 acres of non-wetland waters of the U.S.; approximately 2.89 acres of non-wetland waters have been previously disturbed. Proposed activities at the Zortman Mine will result in the disturbance of 1.06 acres of wetlands and 4.24 acres of non-wetland waters of the U.S.; approximately 0.84 acres of non-wetland waters have been previously disturbed." (342)

RESPONSE: Please see revised text in Section 4.4 for a description of impacts to wetland and non-wetland waters from proposed activities. Section 3.4.3.3 has been revised to describe past disturbances to wetlands and non-wetland waters (both direct and indirect) and current functions and values.

30. COMMENT: Note that with revisions to the wetlands tables that there would be 0.48 additional acres of disturbance to non-wetland waters of the U.S. (0.040 acre for Zortman and 0.08 acre for Landusky) and 0.03 acre of wetland disturbance (Landusky). (342, 346)

RESPONSE: Please see revised text and tables throughout Section 4.4 that contain revised direct and indirect impact acreages for wetlands and non-wetland waters of the U.S. These acreages were based primarily on information provided by ZMI, plus information provided by OEA Research, Inc. regarding some indirect wetland impacts, and the COE regarding indirect impacts to non-wetland waters.

31. COMMENT: In discussing impacts to wetlands functions and values (Appendix B), the Draft EIS fails to explain what mitigation measures will be undertaken to offset adverse impacts to wetlands and waters of the United States from fill and removal activities. A mere listing of mitigation measures is insufficient to qualify as the reasoned discussion required by NEPA." Id. Here [Appendix B], of course, the Draft EIS does not even purpose a mitigation plan, much less discuss the effectiveness of possible mitigation measures. "[O]mission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA." Robertson, 490 U.S. at 352, 109 S. Ct. at 1847. Potential mitigation measures for the expansion proposal must therefore be fully disclosed and discussed not at some future date but now, in the Draft EIS. (340, 344)

RESPONSE: ZMI has proposed mitigation in its 404 permit application (ZMI, September 1995). A revised and updated mitigation plan has been provided in Section 4.4 and Appendix F of the Final EIS. This plan is used as the basis for the Appendix B evaluation.

32. COMMENT: The Draft EIS fails to include a mitigation plan for past violations of Section 404 of the CWA. The U.S. Army Corps of Engineers has documented 4.1 acres of direct and 14.6 acres of indirect impacts from 1990 to 1995 by past mining operations. Direct and indirect impacts from mining dating back to 1979 need to be disclosed in the Draft EIS and included in the mitigation plan. The Draft EIS Fails Adequately to Disclose and Assess Mitigation Measures for CWA Violations and Destruction of Wetlands. (344, 353)

RESPONSE: An aquatic ecosystem mitigation plan that was developed in consultation with the COE is included in Appendix F to the Final EIS.

33. COMMENT: Appendix B, Page 9 "Section 2.1.3 discusses section 230.10(c) of the 404(b)(1) Guidelines, but fails to specifically discuss sections 230.10(c)(1) through (4). A summary of effects and their significance for each subsection (1) through (4) is needed. Be sure to address all parameters identified in these subsections.

CFR 230.10(c) states: No discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of waters of the U.S. Effects contributing to **significant** degradation considered individually or collectively include: (1) discharge of pollutants on human health or welfare, including...effects on municipal water supplies, plankton, shellfish, wildlife, and special aquatic sites; (2) discharge of pollutants on life stages of aquatic life and other wildlife dependent on aquatic ecosystems... (3) discharge of pollutants on aquatic ecosystem diversity, productivity, and stability...loss of fish and wildlife habitat or loss of capacity of a wetland to assimilate nutrients, purify water, or reduce wave energy; (4) discharge of pollutants on recreational, aesthetic and economic values. This section of the 404(b)(1) evaluation on page 9-10 does little to address these areas in detail. What are the impacts and conclusions for alternative seven, considering each area mentioned in 230.10(c)(1-4)? What are the conclusions considering subparts B through G?" (346)

RESPONSE: Section 2.1.3 of the Final EIS has been expanded and revised to include a discussion of impacts and conclusions for the preferred alternative (Alternative 7) as they pertain to Sections 230.10(c), (1) through (4).

34. COMMENT: Under the preferred alternative, ZMI would obliterate over one acre of wetlands near Ruby Creek for the construction of Goslin Flats leach pad, and cause indirect damage to others along various creeks. As mitigation measure, ZMI is willing to "create" 1.79 acres of wetland downstream from Goslin Flats. This proposal must first comply with Section 404 of the Clean Water Act. (351)

RESPONSE: ZMI has proposed mitigation as described in Section 4.4 and Appendix B of the Final EIS. Specific details of the mitigation plans can be found in ZMI's 404 permit application (ZMI, September 1995). Appendix F contains mitigation required for ZMI to comply with Section 404 of the Clean Water Act.

35. COMMENT: "We [EPA] reviewed the preliminary 404(b)(1) showing in Appendix B. You acknowledge that this showing is not sufficient to satisfy the regulatory review to be conducted by the Corps of Engineers. We [EPA] will need to review the additional information that will be provided to the Corps of Engineers by ZMI in their formal 404 application before we can reach any definitive conclusions." (337)

RESPONSE: The Appendix B in the Final EIS contains a Draft 404(b)(1) Evaluation that was reviewed by the COE. In addition, Appendix F contains the mitigation plan developed in consultation with the COE.

36. COMMENT: The public is entitled to comment on a draft version of the Army Corps of Engineers' 404(b)(1) analysis prior to the release of the Final EIS. That analysis represents the Montana Department of State Lands' and the U.S. Bureau of Land Management's opinion on how the preferred alternative complies with the 404(b)(1) guidelines. If the Corp has concerns about, is providing comment on, or would analyze differently those issues considered in Appendix B, that position should be made available in a supplemental Draft EIS such that the public has a meaningful opportunity to review those considerations and provide comments. (362)

RESPONSE: The Corps of Engineers considers the public comment period and written and verbal comments for the Draft EIS to satisfy the public comment requirements for the Section 404 permit application. In addition, the Corps of Engineers has also reviewed and submitted written comments on the entire Draft EIS, including Appendix B. The Final EIS contains an updated Appendix B titled the "Draft Section 404(b)(1) Evaluation" which has been revised based on additional technical information and applicable public and agency comments. Appendix B is a draft evaluation prepared in response to comments made by the COE on how the preferred alternative complies with the requirements of the Section 404(b)(1) guidelines.

37. COMMENT: "The Water Quality Improvement Plan that will result from the current enforcement discussions will be a key component of the 404 review. We recommend that the Water Quality Improvement Plan presented in the final EIS be as complete and up-to-date as possible to facilitate the 404 review." (337)

RESPONSE: The Water Quality Improvement Plan in the Final EIS has been updated and expanded upon to address existing and expanded mining operation under all alternatives. The plan is also used to mitigate indirect impacts (water quality degradation) to waters of the U.S.

38. COMMENT: The Corps of Engineers may not grant a 404 permit without water quality certification under Section 401 of the Federal Water Pollution Control Act ("FWPCA") from the state. 33 U.S.C. 1341. The certification must state that the applicant is not in violation of various requirements of the Clean Water Act, including, (as relevant here) water quality standards, unless the certification is waived by the state. (340, 348, 351, 361)

RESPONSE: Section 404 permits, issued by the Corps of Engineers, require Section 401 certification which is provided by the DEQ. Any conditions of the Section 401 certification would be conditions of the Section 404 permit, if the Section 404 permit is issued.

39. COMMENT: The Draft EIS does not provide adequate information with which to review the potential contaminants that will be discharged into the waters. A decision by the agencies on whether to grant an expansion permit should not be made until this information is made available to the public and a reasonable determination reached regarding the impact on water quality in the effected areas. (340, 351)

RESPONSE: There is extensive information on the type of materials and potential contaminants contained in the Draft and Final EIS (see Section 3.2 and 4.2). Additional information on the type and quantity of fill materials already placed in existing waters of the U.S. and proposed for placement in both waters of the U.S. and wetlands has recently been submitted by ZMI in their Section 404 permit application (ZMI, September 1995). This information is presented in Table 1-1 in both the Zortman and Landusky mines Section 404 permit applications. Appendix B of the Final EIS has been revised based on this additional technical information.

40. COMMENT: To allow expansion before these past § 404 violations are remedied would compound the BLM's violation of FLPMA. To omit any discussion of the undue degradation represented by these violations violates NEPA's mandate of disclosure. (344)

RESPONSE: The Draft EIS discloses impacts to aquatic resources from past and proposed placement of fill materials in the waters of the U.S. The Final EIS has been revised to include more discussions of the existing (1979 to present) direct and indirect impacts to wetlands and non-wetland waters of the U.S.

41. COMMENT: Page 1-19, U.S. Army Corps of Engineers "Add the following to this section. To date, the Corps has issued a permit for construction of two impoundments in Ruby Gulch that were designed to catch drainage from upper Ruby Gulch to enable treatment of such waters. Before a Corps permit can be issued for a Zortman/Landusky expansion proposal that involves a discharge of dredged of fill material into jurisdictional waters the Corps must determine that the project will be in compliance with the 404(b)(1) Guidelines, that the project will be found to be 'in the public interest', and that 401 water quality certification is obtained. The statement 'Appendix B contains the Section 404(b)(1) evaluation necessary for the agencies preferred alternative' should be modified to read 'Appendix B contains the lead agencies/applicant's effort to display (a showing) how the proposed project will be in compliance with the 404(b)(1) Guidelines." (346)

RESPONSE: Text has been added and modified in the U.S. Army Corps of Engineers section. Appendix B in the Final EIS is a "Draft Evaluation." It was prepared with direction and assistance from the COE.

42. COMMENT: Appendix B - Preliminary 404(b)(1) Showing - The Draft EIS should be amended to clarify that the foundation for its Section 404 compliance evaluation, i.e., the Preliminary 404(b)(1) Showing and the WESTECH and Gallagher memoranda, includes past mining-related disturbance associated with the discharge of dredged or fill material which occurred before Corps' regulation as well as past and future mining-related disturbance which remains outside of Corps' regulation as well as past and future mining-related disturbance which remains outside of Corps' regulation. For example, prior to October 5, 1984 and under certain conditions prior to April 5, 1986, the Corps' did not require permits for the discharge of dredged or fill material into "waters" located above the headwaters. Any discharges of dredged or fill material which occurred before regulation (and are incorporated in the Draft EIS estimates) did not trigger a permitting requirement. In addition, discharges of waste rock into jurisdictional waters have not been and are not governed by Corps' regulation. Waste rock does not constitute "fill material" within the meaning of Section 404 of the Clean Water Act [See, e.g., Friends of Santa Fe v. Lac Minerals, Inc., 1995 U.S. Dist. LEXIS 11313 (1995)]. The Preliminary 404(b)(1) Showing suggests that the only distinction between the amount of acreage affected by Alternative 4 and Alternative 7, is related to the relocation of waste rock from Carter Gulch to the existing Zortman Pad Complex (Volume 2, page B-7). That distinction should not be considered persuasive, from a Section 404 permitting perspective, for selecting Alternative 7. (342)

RESPONSE: Appendix B has been revised to describe in more detail the acreage impacted by previous disturbances compared to proposed impacts from mining Alternatives 4 and 7. Using best available data, the tables and text have been updated to show the acreage of direct and indirect impacts to both wetlands and non-wetland waters of the U.S. The impacted acreage that can be attributed to past mining operations and that would require mitigation is presented in Appendix F.

43. COMMENT: The summary on page 2-1 of the Draft EIS states that the BLM and DEQ decided to integrate the environmental analysis for these mines because of their similarity in operations." Please add to this discussion that ZMI has submitted two separate Department of the Army applications to the Corps and indicated they would like the two mines considered individually. The Corps views both applications as one inseparable project and will review them as one individual permit. (346)

RESPONSE: The Corps of Engineers' decision for permit review as one inseparable project has been added to the Summary of Chapter 2.0.

44. COMMENT: Table 2.3-1 needs to identify indirect impacts to wetlands and waters of the U.S. (346)

RESPONSE: A summary of indirect effects to wetlands and waters of the U.S. has been added to the table.

45. COMMENT: Has the area proposed for road construction to King Creek been surveyed for wetlands/waters of the U.S.? (346)

RESPONSE: Yes, the area has been surveyed for wetlands and waters of the U.S. This information has been disclosed to the Corps of Engineers in the 404(b)(1) permit applications submitted in September, 1995. In addition, see the description of wetlands and waters of the U.S. in Section 3.4 of this Final EIS.

6.9 WILDLIFE AND AQUATICS

1. COMMENT: Zortman Mining Inc. should not be responsible for funding a study on the peregrine falcon. Has this been requested by all the landowners in the area? Why would private landowners in the area wish to have an endangered species introduced, with protection of such species a very real threat to landowners rights under present laws? To force this reintroduction would be a violation of private rights and should not have any bearing with the mine's operations now or later.

Due to the controversy associated with the Endangered Species Act, the Little Rockies CRM Group does not believe that the proposed study would be viable mitigation for habitat loss. We [Little Rockies CRM Group] recommend that the BLM consider ZMI's support of other wildlife habitat enhancement, such as the Prairie Pothole Joint Venture as viable mitigation for loss of habitat. (10, 12, 19, 20, 21, 22, 25, 33, 37, 43, 47, 50, 53, 59, 66, 131, 132, 135, 164, 167, 168, 169, 171, 172, 176, 178, 180, 182, 188, 209, 210, 212, 226, 229, 232 through 238, 241 through 249, 265, 270, 274, 320, 322, 325, 339, 348, 358, LO-4, LO-9, LO-10, LO-15, LO-16, LO-27, LO-32, HA-12, HA-17, HA-26, HA-27, MA-2, MA-8, MA-12, MA-13, MA-15, MA-17, MA-18, LA-1, LA-5, LA-7, LA-8, GF-5, GF-8, GF-10, GF-31, GF-32, GF-35, GF-56)

RESPONSE: The peregrine falcon reintroduction study has been dropped from consideration as a project mitigation. The original intent of the study was to compensate in part for wildlife habitat lost during development of the two mines, while at the same time attempting to meet species establishment goals of the Peregrine Falcon Reintroduction Plan. The pit highwalls could provide suitable habitat for peregrine falcons after mine operations cease. However, the peregrine falcon has been proposed for delisting, and the Peregrine Fund will no longer provide birds for Montana after 1996. Given this situation the study has been dropped and Section 2.11.2.3 of the EIS has been revised to reflect this.

A few commentors had specific concerns about the effect of peregrine reintroduction on game bird population and the black-footed ferret. According to several authorities on the subject, the peregrine falcon feeds almost exclusively on avian prey in flight, not ground-dwelling game birds. Its diet is commonly waterfowl, pigeons, doves, swifts, swallows, robins, flickers, blackbirds, jays, and numerous shorebirds such as killdeer and common snipe (Jonsgard 1990; Waddell and Linner 1991; Enderson et al. 1982). A review of the literature found no recorded accounts of upland game birds in the diet of North American peregrines.

2. COMMENT: I've heard several times mention of the reintroduction of the peregrine falcon. My kind of thinking "reintroduction" may be a key word here. That must mean they were here before. What happened to them? Why aren't they here now? (LO-49)

RESPONSE: The "reintroduction" of the peregrine falcon referred to in the EIS is the reintroduction <u>nationwide</u> of the bird, whose numbers have declined primarily due to past use of DDT. Their presence in/near the Little Rocky Mountains is discussed in Section 3.5.1.1. - Peregrine Falcon.

3. COMMENT: I'm in favor of the reintroduction of the peregrine falcon. Evidently, he lived up there one time, and he can come back anytime he wants, as far as I am concerned. (348, GF-11, GF-39, GF-73)

RESPONSE: Because the peregrine falcon has been proposed for delisting, and the Peregrine Fund will no longer provide birds for Montana after 1996, the study has been dropped from consideration as a project mitigation. The text in Section 2.11.2.3 has been revised to reflect this.

4. COMMENT: Effects of surface water contamination on animals are not discussed. No evaluation of the present aquatic macroinvertebrate community in any stream is discussed. Anticipated effects are not disclosed except in the most general terms. What changes in species composition are expected and how will this effect the productivity of Lodgepole, Beaver and King Creeks? (273)

RESPONSE: Please see Section 3.5.2 for a discussion of the macroinvertebrate populations in the project area. A correction has been made to the text to indicate that the <u>ten</u> streams listed are not <u>perennial</u>. As discussed in Section 3.2.3, the drainages in the project area are typically steep and ephemeral in their upper reaches, and intermittent in their lower reaches. Ruby Creek becomes perennial below the town of Zortman, and Montana Gulch becomes perennial at its confluence with the Gold Bug adit discharge. Anticipated effects to the limited macroinvertebrate populations in these steams are discussed for each alternative under the subheading

Residual Water Quality in Section 4.5.3 - 4.5.9; specific impacts to species composition and productivity are not discussed because of the limited populations and lack of site-specific macroinvertebrate data. The analysis provided does indicate relative impact (positive, negative, and high [significant] to low); some additional text and table changes have been made to clarify the impact levels. Table 4.2-1 estimates post reclamation water quality for Lodgepole Creek and King Creek and indicates no significant change expected, except for a slight increase in nitrate concentrations in King Creek due to rehabilitation of the pit floor for Alternative 5. This analysis indicates that little change in biotic productivity could be anticipated for these creeks, based on water quality parameters. Beaver Creek is not associated with any present day or proposed mining activity (Section 3.2.3); some short-term degradation due to elevated suspended solids may occur from the construction and operation of the LS-1 limestone quarry. These impacts indicate little long term change in biotic productivity.

5. COMMENT: The Draft EIS fails to fully disclose the impacts from mining on wildlife, aquatics, and biological potential of streams flowing from the mining sites (i.e., benthic macroinvertebrates). The Draft EIS lists several endangered species and species of special concern that may potentially be affected by the expansion, but fails to mention whether any macroinvertebrates are among this group. More information should be made available to the public in the Draft EIS on the status of these species, the potential effects upon them, and what mitigation measures would be taken to accommodate them. (353)

RESPONSE: Please see the subheading Residual Water Quality in Sections 4.5.3 through 4.5.9 and associated Table 4.4-5 in Section 4.4 for a discussion of potential impacts to stream macroinvertebrates and fisheries. There are no macroinvertebrates listed as endangered species or species of special concern that may be affected by the proposed actions. No significant impacts would occur to wildlife under the preferred alternative. Measures in the Water Quality Improvement Plan would mitigate current water quality-based effects on stream biota.

6. COMMENT: Effects of surface water contamination on animals are not discussed. No discussion of toxicology is presented. A quick search of the bibliography (Chapter 6.0) reveals that toxicology issues such as sublethal accumulations of heavy metals, and bioaccumulation were not even researched. This is contrary to the requirements of NEPA. You are required to incorporate the most current, available scientific knowledge into your analysis. (273)

RESPONSE: As discussed in Section 3.5.2, fisheries habitat is very limited, and macroinvertebrate populations are relatively insubstantial. These conditions are due not only to the physical and chemical effects of mining activities, but also to the ephemeral and intermittent nature of the streams. The metals found in the water can accumulate in aquatic macroinvertebrates and, at certain levels, may contribute to the lower populations found in the project area, as recognized by the statement in Section 3.5.2 that the conditions are "reflective of natural perturbations and previous mining activities still affecting streams in the area." Where water quality criteria (which are based on toxicity data) are exceeded, some reduction of non-tolerant species could be expected. However, metals such as those found in the ponds and other waters affected by mining do not biomagnify, so that effects at higher trophic levels would not be expected to occur. Also, any other factors besides toxicity related to surface water contamination, such as sedimentation effects, contribute to the lack of macroinvertebrates in the project area streams.

Effects of metals or cyanide on terrestrial animals drinking the surface waters in the area will vary with concentration, water chemistry, and susceptibility of the animal to the chemical. Cyanide at low concentrations is unlikely to affect animals, because at sublethal doses it is rapidly transformed and excreted (Eisler 1991). If metal concentrations do not exceed drinking water standards (based on toxicological data), which are highly protective of human health, it is likely that the water would be safe for terrestrial species. Although there are currently exceedences of some of these standards (Section 3.2.5.1), the Water Quality Improvement Plan was developed to meet water quality standards which are protective of wildlife and aquatic resources.

Please see Section 3.4.6 for toxicology discussion relative to vegetation, including many references to recent site specific research, and other studies conducted by experts in the field of plant phytotoxicity.

7. COMMENT: The dewatering of the (proposed) expanded pits during mining will have effects on water rights and aquatic communities which cannot be predicted with the available data. Groundwater withdrawals needed to dewater the expanded pits (once below the local water table elevations) will capture groundwater which in part discharges to the northern drainages. It is likely that this groundwater will be of poor quality and will require treatment. Although the quantities may be relatively small, the effects of small additional depletions on headwater streams may be significant, and should be assessed as part of a complete evaluation of environmental impacts. The brief evaluation provided does not reflect an adequate understanding of these issues to support a decision to proceed with mine expansion below the water table. (361)

RESPONSE: The dewatering of the pits and the capture and treatment systems would divert flow from several of the headwater drainages in the project area. It is recognized that the drainages would experience low or intermittent flows that could further limit macroinvertebrate populations and possibly recreational use in the areas of the streams that are perennial (see Section 4.2.3-4.2.9, Unavoidable Adverse Impacts, and Tables 4.2-10 and 4.4-5). However, only a few of the creeks have perennial flows; the other headwater drainages that would be affected are intermittent or ephemeral in nature, and therefore the cumulative impacts to the aquatic communities of the area are not significant. The diverted flow would help maintain or create perennial flow in Ruby Creek and Montana Gulch.

8. COMMENT: What is meant by "discharge maintenance" in the last paragraph of Section 3.5.2? What is the importance of the limited macroinvertebrate populations to the food chain in the Little Rocky Mountains. Because they are limited, have they become more important? (346)

RESPONSE: The word "maintenance" has been deleted from the text. The sentence now correctly reads, "fluctuations in runoff and discharge." Ephemeral and intermittent streams such as the drainages in the project area do not maintain sufficient water to support benthic populations throughout the year. Ephemeral streams flow only in response to a rain shower and intermittent streams flow only part of the year, typically during the rainy season or during snow melt. These types of streams do not provide any or only very limited food resources for downstream fish populations. The limited export that would occur during flushing cannot be expected to be a significant factor in supporting downstream fisheries that would need a more permanent, dependable food source to survive and perpetuate.

9. COMMENT: "Why is restoration of aquatic habitat not included as an objective for the current reclamation plan?" (320)

RESPONSE: The current reclamation plan does not specifically include this because it is not a requirement of current permit conditions. Many of the reclamation measures proposed under the various alternatives and especially Alternative 7 serve to either directly or indirectly enhance aquatic habitat through removal of tailings in drainages, prevention of erosion, restoration of contours, revegetation, etc. Specific mitigation for loss of aquatic habitat includes creation of post-reclamation drainageways and implementation of the Water Quality Improvement Plan. Mitigation plans for impacts to the aquatic ecosystem are contained in Appendix F.

10. COMMENT: Discussions on page 3-152 of the Draft EIS should also include other aquatic organisms, reptiles and amphibians. (346)

RESPONSE: Please see Section 3.5.2 for relevant information concerning this issue.

11. COMMENT: It is stated on page 4-50 of the Draft EIS that Montana Gulch could become intermittent, impacting its use as a recreational area and limiting its potential as an aquatic habitat. Table 4.2-10 does not identify these potential effects. (346)

RESPONSE: It is considered unlikely that Montana Gulch would become intermittent under any of the alternatives. This is primarily due to treated water discharging to Montana Gulch from the Montana Gulch treatment plant after being captured from Mill Gulch, Sullivan Creek, Montana Gulch, and possibly King Creek. Therefore, Table 4.2-10 in the Final EIS does not identify this as a potential impact.

12. COMMENT: Impacts to birds and wildlife from mining are not sufficiently disclosed in the Draft EIS nor are measures to protect birds and wildlife from harm adequately considered. This includes netting and other protective cover systems, fencing, cyanide solution detoxification, etc. (320)

RESPONSE: Please see Section 4.5 for relevant information concerning impacts to wildlife and birds from mining. Additional relevant information regarding these issues has been added to address public and agency comments on the Draft EIS including impacts to wildlife from noise, blasting, cyanide solution, and use of protective covers (netting, fencing) and other mitigation. Protective measures for wildlife do include the use of netting, solution pond covers, fencing, and cyanide detoxification.

13. COMMENT: The Draft EIS states that the proposed process solution ponds will be enclosed by netting material to preclude access by birds. Draft EIS at 2-130. However, the discussion focuses only on the construction of the netting support. It does not mention the size of the netting mesh. The Draft EIS contains no discussion of the ability of the mesh to support snow cover and withstand winds-issues, which have plagued installations of bird netting elsewhere in northern climates. The Draft EIS does not discuss alternative wildlife control methods such as chemical repellents and floating barriers. In addition, only process ponds are and will be fenced and netted, while seepage and catchment ponds are uncovered and are of danger to bats and other wildlife. Draft EIS at 4-131. (340, 344)

RESPONSE: Please see Section 4.5.6.1, "Wildlife Mortality," for relevant information concerning this issue including netting mesh size. Additional information on alternative wildlife control methods and ability of control devices to withstand severe weather has been added.

14. COMMENT: As the Draft EIS acknowledges, failing to protect migratory bird species adequately from poisoning from these various types of ponds constitutes a violation of the Migratory Bird Treaty Act. Draft EIS at 4-124. For the BLM to allow such poisoning would violate the plain language of FLPMA's implementing regulations by allowing a violation of environmental law. 43 C.F.R. § 3809.0-5(k)(4). To fail to <u>disclose</u> such impacts also violates NEPA. 40 C.F.R. § 1502.16. (344)

RESPONSE: Please see Section 4.5 for relevant information concerning impacts to wildlife and birds from mining. Measures to protect migratory bird species (and other wildlife) are included in the existing operating plans, in the Company Proposed Action, and in the agency mitigated alternatives. These measures include fencing and netting of process ponds containing toxic solutions, and detoxification of process and mine drainage waters. The BLM is not "allowing" any poisoning of migratory birds.

15. COMMENT: A more detailed discussion is required of the affects the proposed 12,000 foot conveyor system, set off with four-strand fencing, will have on wildlife. (326)

RESPONSE: Please see Section 4.5.6.1, discussion on "Restricted Access" for relevant information concerning this issue. Densities of large ungulates and other wildlife that may be impeded by the conveyor and four-strand fencing are generally low in the area of the proposed conveyor. Thus, very small amounts of bighorn sheep and other wildlife habitat would be fragmented and no wildlife corridors blocked.

16. COMMENT: The Draft EIS admits that "approximately 18,500 acres of crucial year-round Bighorn Sheep habitat is contained in the Little Rocky Mountains. Current mining activities in the Little Rocky Mountains have been estimated to have decreased yearlong crucial habitat for bighorn sheep by 4 percent." Draft EIS at 4-122. <u>Any</u> reduction of bighorn habitat is significant, as the bighorn population "has declined from approximately 1,500,000 in the late nineteenth century to approximately 40,000 at the present, a decline of roughly 97% over a one-hundred-year span." <u>Foundation for North American Wild Sheep v. U.S. Dept. of Agriculture</u>, 681 F.2d 1172, 1182 (9th Cir. 1982). The Draft EIS admits that the two-mile conveyor belt proposed under the preferred alternative will cut directly across a migration route for bighorn sheep, resulting in "restricted wildlife access along Goslin Flats." Draft EIS at 4-132. The belt will not be traversable on land except at two locations. The belt and ore processing facilities will be brightly lit 24 hours a day. Draft EIS at 4-133. "The constant noise and psychological barrier of crossing open areas would likely restrict movement and access of some individual animals." Draft EIS at 4-132. The Draft EIS neglects to discuss the potential for fragmentation of the bighorn habitat. (340, 344)

RESPONSE: Please see Section 4.5.6.1, "Bighorn Sheep," for relevant information regarding this issue which has been added to the Final EIS. A significant impact would not occur from the loss of bighorn sheep habitat associated with the mine expansion. The Draft EIS does not state that "the two-mile conveyor belt proposed under the preferred alternative will cut directly across a migration route for bighorn sheep." The Draft EIS does state that "Construction of the Conveyor from the Zortman Mine to Goslin Flats would result in restricted *wildlife* (emphasis added) access along Goslin Flats." The original intent of this statement is to address impacts of the conveyor to all wildlife in the Goslin Flats area, particularly white-tailed and mule deer.

17. COMMENT: The Draft EIS fails to mention that bighorn sheep "are loyal to their home ranges and return to them in the same season year after year. . . . Sheep have in rare instances immigrated from their accustomed ranges, for reasons largely unknown, but occasionally such a move has coincided with a catastrophic deterioration of the habitat." Geist at 62-3. See also id. at 79 ("[m]ountain sheep are very loyal to their home ranges; their movements between seasonal home ranges are orderly and predictable"); Id. at 99 ("[s]heep maintain their areas of distribution as a living tradition and rarely depart from it"). The Draft EIS also fails to note Geist's finding that:

> If [human disturbance] causes sheep to vacate their accustomed areas and seek refuge on terrain where they would where they would normally be rarely found, then we can expect deleterious effects on the sheep population as a whole. It means the loss of habitat to an animal. If this is wintering habitat, it means a decrease in population size.

Id. at 88. Since the conveyor belt is proposed to disrupt both a home range and a migratory path for the sheep, it is likely to have "deleterious effects" on the sheep. (344)

RESPONSE: Based on information obtained from baseline wildlife studies (WESTECH 1991) and the experience of the BLM wildlife management biologist for the area, the conveyor belt would not disrupt a bighorn sheep home range or migratory path would result in little fragmentation of the habitat. Section 4.5.6.1 "Bighorn Sheep" provides additional information on impacts to bighorn sheep distribution, home range and movements.

18. COMMENT: The Draft EIS does not mention how adverse impacts to bighorn might change depending on the season. Mating season for bighorns is in late November and December. Geist at 184. During these times the sheep are involved in dominance fights, id. at 189, and courtship, both of which can be extremely rigorous. Id. at 214 ("[t]he extensive long chases, the vigorous fights about estrous ewes, and the frequent copulations are only typical of the first week of the rut...Soon the rams begin to look thin and exhausted"). The Draft EIS does not discuss whether any lambing areas will be affected, a potentially catastrophic impact that the Foundation for North American Wild Sheep court held was "crucial information" that must be addressed under NEPA. Id. at 1180-81. (344)

RESPONSE: Seasonal observations mapped by WESTECH (1991) indicate that bighorn winter on the southern fringe of the mountain range in an area bounded by Gold Bug Butte, south to Sugar Loaf Butte, and east to Saddle Butte. Bighorn Sheep of the Little Rocky Mountains do not occupy distinct home ranges during any given season. Please see Section 4.5.6.1 "Bighorn Sheep" for relevant information concerning bighorn sheep seasonal impacts which has been added to the Final EIS.

19. COMMENT: Because upward retreat provides their sole means of defense," bighorn sheep are highly disturbed by roads and other manmade barriers above them. Id. at 1180. Alarmed sheep do not move downhill but rather "move at a stiff, tense walk uphill." Geist at 132-33. Bighorn are particularly likely to retreat uphill when they hear unusual noises. Id. at 260. The only two places at which the proposed conveyor belt will be passable are at Alder and Pony Gulches, where the conveyor will pass overhead. Draft EIS at 4-132. The Draft EIS must discuss whether bighorn can be expected to cross under the conveyor, given their aversion to overhead barriers. (344)

RESPONSE: Bighorn sheep in the Little Rocky Mountains are non-migratory. Seasonal, short-distance (3-4 miles) movements may occur, primarily west of the proposed conveyor route. Densities of large ungulates and other wildlife that may be impeded by a conveyor belt and four-strand fencing are generally low in the area of the proposed conveyor. Specifically, bighorn sheep in the Little Rocky Mountains have acclimated to mining operations and have adopted the existing mine sites as "safe havens" from hunting and poaching. It is estimated that 90+ percent of observations of bighorn sheep occurs west of the proposed conveyor route and little bighorn sheep habitat would be fragmented and few corridors would be blocked (J. Grensten BLM 1995). Section 4.5.6.1, "Bighorn Sheep," provides additional information on disturbance and conveyor impacts to bighorn sheep in the Final EIS.

20. COMMENT: From the wildlife viewpoint, is a 45 degree slope too steep in mine pits? It would seem these sites would be avoided because of the steepness, thus, causing the wildlife to develop a trail that would somewhat be a bottleneck. By using a path similar to a bottleneck situation, they would be easy prey for hunters during the hunting season. (348)

RESPONSE: Most wildlife that inhabits mountainous terrain can easily handle 45 degree slopes. Deer and other large ungulates often prefer steep, exposed slopes for winter foraging. Wildlife would not be expected to develop just one or a few trails on these slopes, but would develop trails in a similar pattern and density as in undisturbed mountainous terrain.

21. COMMENT: The bats in Azure Cave will be adversely affected by planned mine expansion in the vicinity and the degradation of water sources in the area. Specifically the EIS fails to document/analyze the effects of noise from blasting and 24 hour mine operation on sensitive species of bats such as the Big-Eared bat. Consultation with bat biologists reveals that assuming that the bats will tolerate a noise level found in residential areas (page 4-134) may be appropriate for species that are relatively insensitive to noise, however, species vary in their sensitivity to noise disturbance and the Western Big Eared Bat is a sensitive species. Mining in the Pony Gulch area would also provide disturbance from conduction of shock waves from blasting and heavy machinery as well as airborne sounds. There is no analysis of the effects of such conduction/vibration on the bat populations. (338, 361)

RESPONSE: Please see Section 4.13.2.2 discussion on impacts of blasting on the resources of Azure Cave (including bats and speleothems) for relevant information concerning this issue. This section evaluates blasting using Particle Velocity versus Square Root Scale Distance equations. Much of this information has been included in Section 4.5.6.2 "Cumulative Impacts" that addresses impacts from possible mining in Pony Gulch. Further consultation with a bat biologist at Bat Conservation International indicated that airborne noise levels expected from mining activities would not be expected to adversely affect hibernating bats at Azure Cave including the western big-eared bat (Taylor 1995). Additional information from the Draft Habitat Conservation Assessment and Conservation Strategy for the Townsend's Big-Eared Bat has been added to the Final EIS.

22. COMMENT: The assumption that the 2-year duration of the Pony Gulch portion of the project will not permanently effect bat populations is unsupported (page 4-134). There is no information to support this assumption- once disturbed, bat populations may not return to the cave as individuals will be forced into other areas in the 2-year period which may be less suitable habitat and will result in death due to exposure or other causes. The intervening mortality may prevent recolonization of the cave completely or reduce the population to such low levels that they cannot recover due to loss of genetic variation, inbreeding, susceptibility to environmental stochasticity or inability to find suitable mates. No information is given or analyzed regarding the potential for recolonization of the cave either. No assessment is made of dispersal capacity, mortality if the cave is rendered unsuitable, or potential sources of recolonizers (nearest sizable population). (338)

RESPONSE: Analyses of noise and blasting provided in the Draft EIS indicates that neither disturbance would significantly impact bats hibernating in Azure Cave. The bats would not abandon the cave during the hypothetical two years of mining at Pony Gulch. De-colonization and re-colonization is not a foreseeable impact. However, there is a lack of information regarding disturbance impacts to bats in general and breeding, dispersion and summer distribution of Azure Cave bats specifically. Information on the uncertainty of assumptions regarding the long-term impacts of mining in Pony Gulch has been added to Section 4.5.6.2. Any development in the Pony Gulch Area would require a separate Environmental Assessment or Environmental Impact Statement and detailed analysis of impacts to bats could be evaluated at that time.

23. COMMENT: Mining at Pony Gulch will create blasting, processing, and machinery disturbance within 4,000 feet of the cave. According to the Draft EIS at 4-283, approximately 5,000 lbs. of ANFO explosives will be set off with each delay. Approximately 25 delays will be set with each blast, for a total of 125,000 lbs of ANFO per blast. (340, 351, 353)

RESPONSE: Please see Section 4.13.2.2 for relevant information concerning this issue, including a calculation of blasting impacts to Azure Cave. This information has also been added to Section 4.5.6.1.

24. COMMENT: The Goslin Flats cyanide heap-leach pad in the preferred alternative (#7) will be placed over stock ponds currently used as a water and insect source for the bats. ZMI proposes to build another stock pond near the Azure Cave to replace the wetlands that will be destroyed by the leach pad. The Draft EIS does not address whether this new pond will support insects or provide evidence that newly-constructed stock ponds will provide a suitable alternative, and the Draft EIS states that a loss of functional value will occur. Loss of the primary water and insect source, coupled with the level of blasting that will occur within 4,000 feet of Azure Cave, will cause more than minimal effects to the bat population, which has already declined by half since the mine's inception. The Draft EIS should further address this impact. In addition, impacts to wetlands should be rated significant and adverse because of the loss of watering habitat for bats. (340, 351, 353)

RESPONSE: Please see Section 4.5.6.1, "Special Status Species," for relevant information concerning this issue. Most of the bat species known to hibernate at Azure Cave typically glean their prey from vegetation and do not require open water for foraging (although a lack of open water could have an effect on insect populations). Additional consultation with a bat expert from Bat Conservation International indicates that newly constructed water ponds can provide a suitable water source for breeding bats (Taylor 1995). Also, field surveys in 1995 revealed several other water sources in the area; this information has been added to the text. Additional information has been added to specify the proposed location of the replacement stock pond. Bat populations have declined nationwide; there are no data that correlate bat population declines with mining at Zortman-Landusky. For these reasons, the rating of impacts to bats because of the loss of potential watering habitat remain low.

25. COMMENT: The Draft EIS admits that candidate bat species are known to hibernate in Azure Cave, Draft EIS at 4-124, 4-125, and these bats obtain food and water from stock ponds in Goslin Flats, the two open-water bodies closest to Azure Cave. Draft EIS, Appendix B at 17; 4-133. The Draft EIS admits that these food and water sources will be eliminated under the proposed alternative, Draft EIS at 4-133, and that bats must drink up to a third of their weight every night during the breeding season, Draft EIS at 4-127. This loss of open-water bodies could cause bats "to abandon current breeding areas or seek water from other sources such as process and catchment ponds." Draft EIS at 4-133. In addition, the proposed conveyor belt "would impact approximately 10 acres of aspen riparian habitat along the conveyor route that likely supports bats." Draft EIS at 4-133. The Draft EIS admits that local bat populations have been declining, and that cumulative impacts of past and future mining "could produce significant impacts to bats using Azure Cave." Draft EIS at 4-282, 4-283. "The cumulative effects of noise, vibration, and habitat loss, particularly in riparian and mature douglas fir. . . combined with habitat previously lost due to historic and existing mining could adversely impact summer breeding bats by directly removing breeding and foraging habitat or causing bats to avoid the area." Draft EIS at 4-135.

The Draft EIS admits that because bats often die up to a half mile from the poisoning source, "data is lacking" and that "little specific information is known regarding the summer ranges and foraging habitat of the bat species hibernating in Azure Cave." Draft EIS at 4-121, 4-133. In the face of these foreseeable, significant impacts and lack of data, the Draft EIS must discuss the efficacy of netting on bats, not only in the context of preventing bats from drinking contaminated water, but also in regards to preventing the bats from feeding on insects contaminated with mining wastes. (340)

RESPONSE: Most North American bats, except for three species found in the southwestern U. S., feed on flying insects (Cooperrider et al. 1986). Although placing bird netting over a water body will not prevent the escape of flying insects to where bats can feed on them, indirect exposure of bats to contaminants in the process ponds from ingestion of flying insects which spent their aquatic life stage in the ponds is unlikely to pose any threat. This conclusion is based primarily on the biotic potential of the process ponds, the lack of accumulation of cyanide by animals at sublethal exposures, and the lack of biomagnification of metals associated with the process ponds in the food web (Eisler 1988a, 1988b).

Process ponds contain the cyanide "pregnant solution" collected from leach pads. Chemical and physical conditions (i.e., high pH, alkalinity, cyanide, metals, and total dissolved solids) in active process ponds are not conducive for the establishment of aquatic invertebrate populations. Therefore, flying insects are unlikely to originate from the ponds, eliminating this as a potential exposure pathway.

If insects did exist in the process ponds, indirect exposure of bats to cyanide from insects would be unlikely because of how cyanide is metabolized by animals. Cyanide is not accumulated by most animals because at sublethal doses it is rapidly transformed and excreted. There have been no reports of cyanide biomagnification or cycling in animals (Eisler 1991).

Bats are not considered likely to reflect elevated metals levels in aquatic insects from the process ponds. Flying insects consist of types with and without an aquatic life stage such that a bats diet is not likely restricted to only insects from the process ponds. Accumulation of metals during aquatic life stages of flying insects depends on many factors including: (1) the species; (2) duration of exposure; (3) the metal; and (4) water and sediment characteristics such as pH, organic matter content, sediment grain size, water hardness, and metal concentration. However, the amount of total metals concentrations and bioavailability in the flying stage may potentially be reduced or made unavailable from aquatic stages (e.g., potential incorporation into hard body parts). In addition, metals such as those found in the ponds, do not biomagnify, so that increased concentrations would not be expected to occur at higher trophic levels.

For example, in a study of riparian wildlife of two lead mining districts in southeastern Missouri, the investigators found that cadmium, zinc, and lead concentrations in the insectivorous northern rough-winged swallow *(Stelgidopteryx serripennis)*, which, like bats, feeds on flying insects, were not related to heavy metal contamination in the watersheds, despite aquatic macroinvertebrates of the impacted watersheds having elevated metal concentrations (cited in Niethammer et al., 1985). A lack of a relationship was attributed by the authors to the mobility of the bird.

26. COMMENT: The preferred alternative in the Draft EIS, page 2-234, provides for an alternative water source for bats and other wildlife to drink, but it fails to mention they can't read and how will they know which waters were contaminated and which were drinkable. (352)

RESPONSE: Wildlife mortality from exposure to mine-contaminated water has been relatively minor since the mine's inception (Section 4.5.2 of the EIS). Additional precautions and wildlife control methods have been included as part of the preferred alternative, including fencing and covering cyanide solution ponds and contaminated catchment ponds. Therefore, bats and other wildlife should not be able to gain access to ponds that may contain hazardous or toxic solutions. The pond would be located between the leach pad site and the cave. Bats, or other wildlife, would not need to cross the ore processing area to obtain drinking water.

27. COMMENT: Where would alternative water source for bats be located? A map should be provided with the mitigation plan. Details on the source should be provided (size, source of hydrology, permanence, quality, etc.). (346)

RESPONSE: A map is provided in Section 2.0 and on Exhibit 1. Details on the location, water source, etc. have been added to Section 4.5.6.1 "Special Status Species" in the Final EIS. Specific plans are contained in Appendix F.

28. COMMENT: A map of the Azure Cave area should be provided in Section 3.13.1 and a discussion of the management plans in effect in accordance with the Judith-Valley-Phillips RMP should be provided. (346)

RESPONSE: Considering the sensitive nature of resources of Azure Cave, including speleothems and hibernating bats which are most sensitive to human intrusion, a detailed map showing the exact location of the cave has not been included in Section 3.13. The general location of Azure Cave with respect to the existing and proposed mine facilities is shown on Exhibit 1 located in the map pocket in the Executive Summary and Volume 1 of the Draft EIS. The EIS has been revised to reference this map for the location of Azure Cave. Please see Section 3.13.1 in the Final EIS for relevant information concerning Azure Cave, including a discussion of management plans provided in the RMP, which has been added to address comments on the Draft EIS.

29. COMMENT: Section 4.5.9.1 states that impacts to special status species would be the same under Alternatives 4 and 7. Page 4-133 states that by constructing water bodies closer to Azure Cave to replace those that would be removed would result in a low positive impact as bats would be attracted away from mining operations and process ponds. This mitigation is not firmly committed to, yet the discussion concludes that the overall impact rating on special status species is non-significant. This conclusion appears to be in error. (346)

RESPONSE: The replacement of stock ponds has been firmly committed to and details describing the mitigation including location, size, water source and permanence of water are provided in the mitigation plan (Appendix F of the Final EIS). Based on this mitigation and consultation with Bat Conservation International which indicates that loss of drinking water sources for the bat species hibernating at Azure cave can be successfully mitigated (Taylor 1995), the conclusion remains unchanged. In fact, by providing a more consistent source of drinking water and designing the pond to benefit all bats (i.e., Townsend's big-eared bat requires relatively large areas of open water), the result of this mitigation could be very beneficial.

30. COMMENT: Wind drift of chemical/solution applications in the area, as they may impact bats, should be addressed in Section 4.13. (346)

RESPONSE: Wind drift of chemical/solution would not directly impact hibernating bats at Azure Cave. Indirect impacts of wind drift to breeding individuals and populations of bats is addressed in Section 4.5.6.1, "Special Status Species," which has been added to the EIS.

31. COMMENT: The Draft EIS states that the Azure Cave bat population will be minimally impacted by the proposed mine expansions. Azure Cave has been designated an Area of Critical Environmental Concern (ACEC) by the BLM, based on its significant hibernating bat population, and geologic values such as the abundance of speleothems. The Federal Land Policy and Management Act (FLPMA) states that the agencies must give priority to ACEC's in developing or revising land use plans. (340, 351)

RESPONSE: Please see Section 4.13.2.2 discussion on impacts of blasting on the resources of Azure Cave (including bats and speleothems) for relevant information concerning this issue. This section evaluates effects from blasting. Much of this information has been included in Section 4.5.6.2 "Cumulative Impacts" that addresses impacts from possible mining in Pony Gulch. Further consultation with a bat biologist at Bat Conservation International indicated that airborne noise levels expected from mining activities would not be expected to adversely affect hibernating bats at Azure Cave, including the western big-eared bat (Taylor 1995). Additional information from the Draft Habitat Conservation Assessment and Conservation Strategy for the Townsend's Big-Eared Bat has been added to the Final EIS. Also, please see Section 3.13.1 for relevant information concerning this issue, including a discussion on management guidance provided in the RMP.

32. COMMENT: The Draft EIS concludes that no impact to threatened or endangered species will occur, but bases this conclusion on an admitted lack of a comprehensive inventory. Draft EIS at C-2. This lack of information violates NEPA. 40 C.F.R. § 1502.22. This is clearly a significant and foreseeable impact for which full data must be gathered, given that the preferred alternative would disturb an additional 835 acres of wildlife habitat over present levels. Draft EIS at 4-140. The Draft EIS admits "it may be centuries before species diversity is returned to pre-mining levels." Draft EIS at 4-119. (340, 344)

RESPONSE: Please see Section 3.5.1.1, "Special Status Species," for relevant information regarding this issue. Site-specific wildlife studies for all wildlife within the study area, including special status species, have been conducted in the Little Rocky Mountains since 1977 (Scow 1978, 1979, WESTECH 1978, 1985, 1986, 1989, 1991). None of these studies found piping plovers on the project site (WESTECH 1991). The piping plover breeds on wide, sparsely vegetated sand or gravel beaches and islands of large lakes and rivers, a habitat that does not occur within or near the proposed project. Surveys conducted by Montana Fish Wildlife and Parks (Flath, personal communication with R. Beane) and element occurrence searches conducted by the Montana Natural Heritage Program (1992) reveal that the nearest breeding piping plover occur at Fort Bowdoin National Wildlife Refuge, more than 50 miles away. Other occurrences at Nelson Reservoirs and Fort Peck are more than 65 and 100 miles east, respectively.

Appendix C in the Final EIS contains the biological assessment and correspondence from the U.S. Fish and Wildlife Service concurring with the no effect decision for threatened and endangered species.

33. COMMENT: The regulations state that the Corps of Engineers may not issue a permit if the activity will jeopardize the continued existence of species listed as endangered under the Endangered Species Act, or which result in the destruction of critical habitat. 40 C.F.R. 230.10(b)(3). The Draft EIS sets forth several endangered species that may potentially be affected by this activity. The agencies should not grant an expansion permit prior to making more information available to the public on the status of these species and the potential effects upon them from the expanded mining activities. (351)

RESPONSE: Please see Section 3.5.1.1 for detailed discussion of threatened and endangered species, as well as federal candidate and state sensitive species. Please see Section 4.5.3 "Special Status Species" for an evaluation of impacts to these species. There are no known occurrences of, or potential habitat for any threatened or endangered species potentially occurring within the project site, including bald eagle, peregrine falcon, piping plover, or black-footed ferret. Appendix C in the Final EIS contains the biological assessment and correspondence from the U.S. Fish and Wildlife Service concurring with the no effect decision for threatened and endangered species.

34. COMMENT: The Draft EIS admits that there has been no comprehensive inventory of piping plover, a threatened species. Draft EIS at C-2. The Draft EIS admits that piping plover "could be a resident" of the area, and that "[s]ightings and nesting of the piping plover has occurred at Fort Peck and Nelson Reservoirs within the area." Id. Effects on piping plover are clearly significant and foreseeable impacts for which full data must be gathered. The Draft EIS admits that because of impacts to vegetation, "it may be centuries" before species diversity is returned to pre-mining levels. Id. at 4-119. The BLM's failure to gather information relevant to this foreseeable, significant impact violates NEPA. 40 C.F.R. § 1502.22. (344)

RESPONSE: Please see Section 3.5.1.1, "Special Status Species," for relevant information regarding this issue. Site-specific studies for all wildlife within the study area, including special status species, have been conducted in the Little Rocky Mountains since 1977 (Scow 1978, 1979, WESTECH 1978, 1985, 1986, 1989, 1991). None of these studies found piping plovers on the project site (WESTECH 1991). The piping plover breeds on wide, sparsely vegetated sand or gravel beaches and islands of large lakes and rivers, a habitat that does not occur within or near the proposed project. Surveys conducted by Montana Fish Wildlife and Parks (Flath, personal communication with R. Beane) and element occurrence searches conducted by the Montana Natural Heritage Program (1992) reveal that the nearest breeding piping plover occur at Fort Bowdoin National Wildlife Refuge, more than 50 miles away. Other occurrences at Nelson Reservoirs and Fort Peck are more than 65 and 100 miles east, respectively.

35. COMMENT: I like to remember the comment made by one of the truck drivers who hauled lime up to the mines in Landusky. His comment was, "Whoever said that mining and wildlife aren't compatible? I see more wildlife driving through this mine site every trip than I do when I go through the park." (136, LA-4, GF-30, GF-56)

RESPONSE: It is recognized that mining can have adverse impacts on wildlife. However, it is also recognized that mined areas can support a wide variety of wildlife adapted to the conditions present. In addition mitigation can involve land reclamation and water quality improvements that can enhance existing habitat for wildlife species.

36. COMMENT: Section 4.2.1.4 refers the reader to schematic figures in Sections 4.2.5.6 and 4.2.8.6. The two referenced sections do not exist. Table 4.2-1 needs to better address sediment loads. The last paragraph of Section 4.2.1.2 states that mining activity in general and acid rock drainage in particular can result in high sediment loads which can smother bottom-dwelling aquatic organisms and destroy their habitat. Have there been and will there be increases in sediments above naturally occurring concentrations which have or will create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife? (346)

RESPONSE: This section should refer to Figure 4.2-10-1 and 4.2-10-2 rather than Figures 4.2.5.6 and 4.2.8.6. Please see Section 4.2.1.4 for edited text. The monitoring record shows samples when sediment loads clearly exceeded average naturally occurring conditions. Indirect effects to the aquatic ecosystem are discussed in Section 4.4, specifically in Table 4.4-5. Mitigation measures to address past, present, and potential future effects are contained in Appendix F. Long-term significant impacts from sediment loads would not occur.

6.10 AIR QUALITY

1. COMMENT: The Draft EIS fails to disclose impacts from PM_{10} emissions. 40 C.F.R. 50.6. Montana has incorporated the national primary and secondary ambient air standards in a state statute requiring that "[n]o person shall cause or contribute to concentrations of PM_{10} in the ambient air which exceed" either of these standards. Mont. Code 16.8.821(l).

The Draft EIS reveals that under all the expansion alternatives, and most egregiously under the preferred alternative, the proposed expansion will cause massive violations of the federal and state PM_{10} standards in the town of Zortman. Under the preferred alternative, the mine's PM_{10} emissions would reach over three times the allowable 24-hour levels, exceeding the standard by an astounding 322 $\mu g/m^3$. Draft EIS at 4-147 (Table 4.6-2). The preferred alternative would also result in more than twice the annual PM_{10} standard. Id. In fact, both the 24-hour and annual PM_{10} standards would be exceeded under every expansion alternative.

Although the Draft EIS admits that these levels would exceed the federal and state standards, it does not disclose the significant impacts to human health these violations would cause. Even at the town of Landusky, where projected PM_{10} levels would not exceed the legal PM_{10} standards, PM_{10} would be at levels that have caused increased death rates. The EPA is currently considering lowering the allowable standard for PM_{10} based on several recent studies showing that PM_{10} is far more harmful than previously thought. These studies show that a short-term increase in PM_{10} of only 20 to 30 $\mu g/m^3$ associated with a detectable increase in the number of hospital emergency room visits from asthma sufferers. A short-term increase in PM_{10} of 80 $\mu g/m^3$ has been linked to a six percent increase in the death rate.

The claim in the Draft EIS that these increases will be short-term and will disperse after the mine ceases operation does not discharge the BLM's duty to discuss the impacts of PM_{10} emissions, as the so-called "short-term" impacts of these emissions have been proven to cause measurable, long-term harm to human health. Indeed, the fact that the federal and state governments have set separate limits on 24-hour and annual levels of PM_{10} indicates that "short-term" high levels of PM_{10} are clearly of great concern.

The Draft EIS fails to discuss any of the recent PM_{10} studies or EPA's proposal to reduce the PM_{10} standards. The Draft EIS does not disclose the implications for public health of the projected increase in 24-hour PM_{10} levels of between 100 to 400 $\mu g/m^3$. (368)

RESPONSE: Please note that air quality impacts have undergone more rigorous modeling to account for site specific meteorological data, revised reclamation requirements for many alternatives, enhanced dust control measures, and other changes in input assumptions. The most important change concerns the number of reclamation truck trips. A requirement added to the Final EIS limits the number of reclamation truck trips traveling through Zortman and/or Landusky to 150 per day for Alternatives 3, 4, 5, and 6. For Alternative 7, the number of reclamation trips would be reduced to 120 per day. The models for the Draft EIS contained no upper limit, and, therefore, unrealistically inflated daily emissions. Nevertheless, the models suggest some exceedences could still occur; particularly if the Pony Gulch reasonably foreseeable activity were to occur concurrent with Zortman Mine expansion and reclamation.

The comments addressing PM_{10} emissions fail to recognize important factors in the impact analysis. First, the *duration* of particulate emissions is almost completely dependent on the time required for haul trucks to move materials from the borrow source to the area undergoing reclamation or construction (haul trucks represent the greatest source of PM_{10} emissions). In other words, the emissions are not continuous, and in fact would occur for relatively short durations on the days of occurrence. Convoys of about 15 trucks would pass through the towns of Zortman and/or Landusky. It would take each convoy a few minutes to pass through the areas containing human receptors. This would not be a continuous process, as described below.

In conjunction with duration, the *incidence* of haul trucks is necessary to the impact evaluation. Logistical and equipment constraints currently limit ZMI to approximately 155 roundtrips per day, 10 convoys of about 15 trucks per day. Therefore, even if truck convoys were operating every day, they would pass through the towns about once every 40 minutes during normal working hours. Alternative 7 further limits the number of reclamation truck trips through the town of Zortman to no greater than 120.

Impacts to public health are not quantitatively evaluated for increases in particulate emissions. While a risk assessment could be conducted on the chemical-specific elements bound to particulates to quantitatively measure risk to human health, this level of analysis is not necessary to understand the effects of the alternatives given the estimated particulate air emissions. The air quality standards have been developed to account for impacts to human health. Presuming emissions are reduced to the prescribed standards, impacts to human health would be acceptable and additional health risk assessment is not necessary.

2. COMMENT: The Draft EIS fails to disclose violations of air quality standards for lead. The national ambient air quality standard for lead is 1.5 micrograms per cubic meter. 40 C.F.R. 50.12. This standard is echoed in Montana state law, which require that "[n]o person shall cause or contribute to concentrations of lead in the ambient air which exceed" a 90-day average of 1.5 $\mu g/m^3$. Mont. Code 16.8.815(1).

The Draft EIS claims that airborne lead emissions from the Zortman laboratory will cause a maximum concentration of 0.03 $\mu g/m^3$. Draft EIS at 4-145. But recent MSHA monitoring of human exposure at the Zortman-Landusky complex shows much higher airborne concentrations of lead up to 25 $\mu g/m^3$ at the lab, and 1.61 to 5.5 $\mu g/m^3$ at the mine site. MSHA "Personal Exposure Samples, 10/90 - 10/95." Both these measurements exceed the standard of 1.5 $\mu g/m^3$ set by federal and state law, and are 50 to 750 times the lead levels projected in the Draft EIS. Thus, the Draft EIS violates NEPA both by misreporting lead levels and by failing to disclose the ongoing violations of the Clean Air Act and Montana state law. Furthermore, the Draft EIS fails to include any discussion of sources of airborne lead at the mine site, disclosing only the lead levels at the lab. (368)

RESPONSE: Indoor air emissions are not comparable to ambient air emissions which are discussed in the Draft EIS. Monitoring at the Zortman laboratory and Zortman-Landusky complex was conducted by MSHA personnel as <u>indoor air monitoring</u> for an 8-hour work exposure. MSHA uses Threshold Limit Values (TLVs) from the American Conference of Governmental Industrial Hygienists (ACGIH) for enforcement of regulatory compliance (Personal communication, K. Koblis to Ron Renowden, MSHA, Dec. 13, 1995). The TLV for lead is 50 $\mu g/m^3$. Therefore, if we compare the lead concentrations at the lab (25 $\mu g/m^3$) and at the mine site (1.61 to 5.5 $\mu g/m^3$) to the TLV (50 $\mu g/m^3$), lead is below acceptable MSHA guidelines.

3. COMMENT: The Draft EIS fails to disclose impacts from airborne silica. MSHA tests show that respirable silica dust at the mine sites composes about a tenth of the total particulate emissions. This means that the potential increase of PM_{10} from between 100 to 400 $\mu g/m^3$ will result in an increase in silica levels of about 8 to 30, $\mu g/m^3$. Although no federal or state ambient air quality standard exists for silica, this increase is well above the ambient air quality standards for silica in effect in other western states. For example, Nevada's ambient standard for silica is only 2.38 $\mu g/m^3$. The Draft EIS fails to discuss the human health impacts from airborne silica from the proposed expansion. (368)

RESPONSE: It is not appropriate to assume that quartz composes about a tenth of all particulate emissions. Based on the MSHA personnel monitoring data from the Zortman and Landusky mines, only 3 out of 64 samples contained quartz (8.6 to 9.9 percent, respectively). In addition, please note the revised PM_{10} emissions estimated for the Final EIS.

4. COMMENT: The Draft EIS fails to disclose impacts from airborne heavy metals. Tests by the MSHA indicate that the airshed at the mine sites is contaminated with detectable and dangerous levels of airborne fumes of ammonia, cadmium, silver, copper, zinc, and vanadium. But the Draft EIS fails completely to discuss these heavy metal air emissions from the mine. In addition to these fumes, it is likely that a fraction of the huge PM_{10} emissions associated with the mine will contain trace amounts of these and other heavy metals and toxics. For example, the EIS for a similar hard-rock gold mine -- the Battle Mountain Crown Jewel mine in Washington State -- projected high percentages of heavy metals in its airborne particulate. Yet the Pegasus/ZMI expansion Draft EIS fails to mention this component of air pollutants. The EIS must discuss the related human health and environmental impacts of these emissions. (368)

RESPONSE: The MSHA personnel monitor concentrations were compared to TLVs. The concentrations were detected below TLVs and do not pose a threat to workers (MSHA 1995). While a risk assessment could be conducted on the chemical-specific elements bound to particulates to quantitatively measure risk to human health, this level of analysis is not necessary to understand the effects of the alternatives given the estimated particulate air emissions. The air quality standards have been developed to account for impacts to human health. Presuming emissions are reduced to the prescribed standards, impacts to human health would be acceptable and additional health risk assessment is not necessary.

5. COMMENT: The Draft EIS fails to disclose impacts from airborne cyanide. The MSHA's tests demonstrate that airborne cyanide at the mine sites has been detected at double the maximum levels claimed in the Draft EIS. MSHA data (reporting airborne cyanide levels of 2 ppm); Draft EIS at 4-145 (reporting cyanide levels of 1 ppm). This under reporting of airborne cyanide, as well as the failure to discuss the health impacts of this pollutant, violates NEPA. (368)

RESPONSE: The monitoring conducted at the leach pad is at a different location than the MSHA monitoring site. In addition, cyanide emissions from both the personnel monitoring conducted at the leach pads and MSHA monitoring were well below the TLV of 10 ppm. The cyanide data was not "under reported." The MSHA data was not available for the Draft EIS but is discussed in Section 4.6 of the Final EIS.

6. COMMENT: The Draft EIS fails to Disclose Impacts from the Mine's Airborne Pollutants Outside of the Mine Site. The airborne emissions of pollutants from the mine are not confined to the mine site, and will almost certainly drift into the surrounding airshed. The Draft EIS fails entirely to discuss air pollution impacts off of the mine site. This violates NEPA's requirement that an EIS discuss all direct and indirect impacts, including those which are "farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8(b). (368)

RESPONSE: Fugitive emissions based on the alternatives were evaluated to receptors in the towns of Landusky and Zortman; both locations are "off site," and represent the closest population of human receptors.

7. COMMENT: The Draft EIS Fails to Address Mitigation for Air Impacts. Although the Draft EIS claims that "[i]t is likely additional mitigation could be applied to help reduce the magnitude of significant impacts," the Draft EIS fails to discuss even briefly what those mitigation measures might be. This violates NEPA's mandate that an EIS discuss "[m]eans to mitigate adverse environmental impacts" of the proposed action." 40 C.F.R. § 1502.16(h). This discussion must "analyze[] the mitigation measures in detail" and "explain[] how effective the measures would be." The EIS must discuss mitigation "in sufficient detail to ensure that environmental consequences have been fairly evaluated." Although an EIS need not include a complete mitigation plan, "omission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA." "A mere listing of mitigation measures is insufficient to qualify as the reasoned discussion required by NEPA." The Draft EIS does not even list mitigation measures; it merely suggests that mitigation might be possible. The Draft EIS thus does not meet even the barest minimum interpretation of NEPA's requirements. (368)

RESPONSE: The Final EIS discusses how a reduction in the haul trips through town and the use of water or chemical suppressants, and equipment modifications are mitigations for particulate emissions.

8. COMMENT: The dust from blasting is harmful. Especially to people with sinus, hay fever, and respiratory problems. (58)

RESPONSE: ZMI is required to meet state and federal air quality standards at their facility boundaries for current and future mining activities. These standards are health based and designed to preserve human health. If ZMI continues to meet these standards the particulate emissions from their mining operations should not contribute to health problems of people living near the mine area.

9. COMMENT: Page 4-145 discussed the air quality impacts from hydrogen cyanide. We note that the short term exposure limit ceiling (STEL-C) for hydrogen cyanide is 4.7 ppm as indicated by the 1995-96 documentation. This is a "not to be exceeded for any duration" limit opposed to the 15 minute time weighted average. If ambient concentrations of hydrogen cyanide are 1 ppm, it is plausible that excursions above this limit may occur. This could present a problem for workers. (337)

RESPONSE: As indicated in the Draft EIS, page 4-145, monitoring performed on the leach pads showed concentrations of 1 ppm or lower. This value is below the 15 minute STEL-C of 4.7 ppm and the eight hour Threshold Limit Value of 10 ppm. It is plausible that through accidental release or other upset conditions the ambient air quality concentrations of hydrogen cyanide could exceed the 4.7 ppm limit, and this could impact the health of the workers.

10. COMMENT: The Draft EIS's discussion of attainment areas is misleading. Pursuant to the Federal Clean Air Act (FCAA), 42 U.S.C. §§ 7401 et seq., and the Montana SIP, approved 40 C.F.R. § 52.1372, each region within the state is classified as either violating National Ambient Air Quality Standards (non-attainment) or meeting or exceeding those standards (attainment) for each criteria pollutant. The area encompassing the Zortman and Landusky mines is classified as an attainment area for the pollutant PM_{10}. 40 C.F.R. § 81.327.

However, the analysis of an attainment area does not end there. Designation as an attainment area does not give industry free reign to pollute up to the level of the National Ambient Air Quality Standards. The FCAA requires that the state take the necessary steps to prevent significant deterioration of the existing air quality in an attainment area. 40 U.S.C. § 7471. Therefore, industries can allow a designated incremental increase in PM_{10} (or any other pollutant) in an attainment area.

DEQ can claim that a full FCAA analysis for the mine expansions will be provided in an air quality permit. However, the agency chose to use the FCAA's "enforceable standards" as a measurement of significance in the Draft EIS. Draft EIS at 4-142. Therefore, instead of misleading the reviewer with an incorrect analysis in the Draft EIS, DEQ needs to provide a correct and legally defensible one. (340)

RESPONSE: No pre-mining (1979) baseline air quality data was collected for these mines. Therefore, the determination of any available increment and the use of Prevention of Significant Deterioration (PSD) increments for assessing impacts is not possible. The reference to PSD Increments has been deleted in the Final EIS and the National Ambient Air Quality Standards (NAAQS) are used for the assessment of air quality impacts. The Zortman and Landusky mines are not a PSD source.

11. COMMENT: The baseline data found in the Draft EIS are inadequate. For DEQ to assess the significance of pollution from PM_{10} emissions, it must first determine the baseline concentration of PM_{10} that existed at the earliest time, after August 7, 1977, that a major source submitted a completed air quality permit application for the attainment area. A.R.M. § 16.8.945(4)(a), (21)(b). This information is crucial in determining the amount of increment that is still available for pollution. Without this data there is no basis to compare increases or decreases in pollution, and claims that pollution impacts are insignificant are without scientific support.

The Draft EIS states that "no air quality monitoring data was available to determine baseline (pre-1979) conditions." Draft EIS at 4-145. However, if the baseline date is set by the first completed PSD application after August 7, 1977, the data is provided in that application. Since mining operations appeared to commence around 1979, the data provided by ZMI at that time is crucial to the determination of baseline levels. Without this determinative data, the following analysis is meaningless. (340)

RESPONSE: There have been no major source permit applications in the project area and no air quality particulate data collected in the project area prior to 1990. There may have been air quality data collected by ZMI as a requirement of the 1983 air permit, but attempts to find this data in files at BLM and DEQ have been unsuccessful.

The determination of available increment is not required for the Zortman and Landusky mines. The pollutant of major concern is particulate matter less than 10 microns in aerodynamic diameter (PM_{10}). Point source emissions from the Zortman and Landusky mines are estimated in the permit application. A source is considered major if it has the potential to emit 100 tons or more of a regulated pollutant (A.R.M. § 16.8.945). The emissions from the Zortman and Landusky mines are below the 100 tpy trigger level. Therefore, the mines are classified as minor sources and not subject to a PSD incremental analysis.

All available air monitoring data and site meteorological data have been used in conjunction with an analysis of mining activities to determine if any of the air quality monitors were not impacted by mining activities during selected periods. Data from these monitors have been used to estimate baseline conditions. This method would not provide true baseline concentrations but it does provide an approximation of likely baseline conditions.

There have been no PSD applications made in the project area and no data collected at the site prior to 1990. It should be noted that any particulate data that might have been collected before 1984 (i.e., preconstruction data at the ZMI mines) would have been total suspended particulates (TSP). This data would not be comparable to particulate air concentrations collected since monitoring began in 1990, or to estimated projects impacts which are both PM_{10}.

12. COMMENT: The Draft EIS's air quality analysis is inadequate. Montana SIP regulations require that DEQ provide an analysis of ambient air quality in the area of mine expansion. A.R.M. § 16.8.957(1). The purpose of this analysis is determine how much of the pollution increment is still available for industrial growth. To determine the existing environment under this analysis, DEQ or the mine applicant must provide continuous air monitoring data over the year preceding receipt of application for an air quality permit. A.R.M. § 16.8.957(6).

The data provided in the Draft EIS for this analysis do not come close to meeting the regulations. First, DEQ used data provided by a 1983 and a 1993 air quality permit applications. Draft EIS at 4-142. None of this data represents the current air quality at the mining site; portions of the data are over 12 years old. As much as determining the baseline concentration is crucial to assessing significance, so is determining the currently existing air quality.

Secondly, while the information is dated, the Draft EIS reveals PM_{10} concentrations only for "select" monitoring periods during the years 1990-1993. Draft EIS at 4-142, Tables 3.6-1 through 3.6-3. Assuming that the actual monitoring was at least continuous, the complete data should be provided in a Draft EIS. (It is curious, given the massive increase in PM_{10} concentration associated with the preferred alternative, that DEQ provided no technical appendix for air quality impacts or extensive data.) Trends in PM_{10} concentrations would be very useful in assessing current air quality in the region.

Third, the Draft EIS fails to even make a realistic estimate of the available increment. Using the 1990-1993 data, the Draft EIS assumes that:

> At these two sites, average concentrations were between 9 and 13 mg/m^3 for the three monitoring durations. Baseline air quality in the study area would be expected to be at or less than those values, since the baseline condition is represented by average air quality prior to the beginning of large-scale mining in the Little Rocky Mountains.

Draft EIS at 4-143. There is no historical survey of pre-mining industrial processes in the region that would contribute to PM_{10} emissions and substantiate the statement that the baseline is "at" existing levels. Certainly, ten years of mining would have contributed significantly to the average levels found in 1990-1993. (340)

RESPONSE: Montana regulations as stated in A.R.M. §16.8.957 refer to major sources of air pollution. The Zortman and Landusky mines are classified as minor sources and therefore, not subject to the analysis described in A.R.M. §16.8.957.

Data from the 1993 permit applications were used to estimate particulate emissions from mining activities. These emissions were then input to the air quality dispersion modeling. The on-site air quality measurements have all been collected since 1990 and were used to assess baseline conditions. Summaries of all available air quality data collected at the Zortman/Landusky monitoring locations have been included in Section 3.6.

As discussed in response 6.10-11, the Zortman and Landusky mines are classified as minor sources and not subject to a PSD Increment analysis. The discussion on baseline data has been refined in the Final EIS. Also see response index number 6.10-11.

13. COMMENT: Emissions resulting from implementation of the preferred alternative would exceed the allowable increment. After the baseline and existing air quality is determined, the mining applicant must then demonstrate that the proposed expansion of mining operations would not cause or contribute to air pollution in violation of any applicable maximum increase over the baseline concentration. A.R.M. § 16.8.955. This is the substantive requirement of the FCAA. Based on modelling data, the proposed alternative far exceeds this increment threshold.

The Draft EIS, curiously enough, reports that applicable baseline increment for PM_{10} is not applicable, Draft EIS at 4-144, and nowhere is the reasoning for this assumption given. On the contrary, the increment is applicable. It demonstrates how far the proposed mining expansion would exceed the allowable increment. For PM_{10}, the allowable increment for a Class II area is 19 mg/m^3 annual geometric mean and 37 mg/m^3 24-hour maximum. While there is no (pre-mining) baseline provided, the emissions levels provided by DEQ modeling is unacceptable, even in the best possible scenario.

Even assuming that the baseline PM_{10} concentration is "at" the average concentration for 1990-1993, and the full increment is still available, the annual cumulative increase at the Zortman mine would exceed the allowable increment <u>six fold</u> for the preferred alternative at Zortman. In fact, the increment would be exceeded for all action alternatives at Zortman. Even more troubling is that the 24-hour maximum for all alternatives at both the Zortman and Landusky mines exceeds the allowable increment by as much as three to thirteen times.

While the Draft EIS attempts to assuage these numbers with statements that the modeling employed would overestimate the impacts, Draft EIS at 4-142, these increases cannot be ignored by modeling alone. Based on the emissions concentrations provided by modeling, the applicant cannot demonstrate that the proposed expansion of mining operations would not cause or contribute to air pollution in violation of any applicable maximum increase over the baseline concentration. (While no baseline 24-hour maximum concentration is provided for comparison, it is questionable whether the mine is currently meeting 24-hour maximum limits. If the baseline represents the pre-mining scenario, the concentration should be close to zero, and the no action alternative models all reveal cumulative concentrations well over the 37 mg/m^3 increment.) (340)

RESPONSE: As stated in A.R.M.§16.8.955 a source may not cause or contribute to air pollution in violation of the NAAQS. Results of a refined modeling analysis in the Final EIS has been compared to the NAAQS. An assessment of increment is not required as discussed in the response to comments number 6.10-11.

14. COMMENT: The Draft EIS fails to discuss visibility and control technology issues. The above analysis was only half of that required in an attainment area. The mining applicant should also provide a Control Technology Review. A.R.M. § 16.8.954. The mining applicant must apply the best available control technology to mitigate the harms caused by PM_{10} emissions. However, nowhere in this section is technology or mitigation assessed.

Equally important, the Draft EIS provides no Visibility Impact Assessment as required by law. A.R.M. § 16.8.1001. The Draft EIS does not identify any Class I areas that could be impacted by the mining expansion. A.R.M. § 16.8.1003. While it is possible that the mine will have no visibility impact on a Class I area, the Draft EIS should examine that possibility and construct visibility models if necessary. Even if no Class I areas are impacted, the reviewing public has the right to know what the effect to opacity will be from such a vast expansion of mining operations. (340)

RESPONSE: The review required in A.R.M§16.8.954 applies to major sources. As discussed in the response to comment number 6.10-11, the Zortman and Landusky mines are classified as minor sources. Pollution mitigation measures were included in the calculation of particulate emissions. These measures have been discussed in the Final EIS and include limiting the number of haul trips, 90 percent "wetting" efficiency on roads, and low truck travel speeds.

The Zortman and Landusky mines are classified as minor sources and not subject the visibility analysis required in a PSD analysis. It is likely that the particulate emissions from mining activities would contribute to degradation of visibility in the Zortman/Landusky area.

15. COMMENT: The models used hypothetical worst case meteorological data. The meteorological data was for a one hour period. The resulting one hour pollutant concentration was converted to twenty-four hour and annual concentrations by multiplying by a factor of 0.4 and 0.1, respectively. EPA recommends using a twenty-four hour factor of 0.4 +/- 0.2 and an annual factor of 0.08 +/- 0.02.

Considering the magnitude of these factors, for example, the Alternative 4 impacts from the screening model presented in Section 4.6.6.1 Paragraph 1 could vary from 174 to 522 $\mu g/m^3$ depending on the range of the factor used. This demonstrates the accuracy of the screening model. The importance of the Zortman EIS would seem to dictate a more refined approach to the modeling, especially when considering that measured on-site meteorological data are available and more refined models are readily available.

The emission rates listed in the modeling analysis did not consider some of the control measures shown in the application. The primary crusher and ore dumping was shown in the application as having the emissions controlled by water misters. The modeling analysis showed no control measures. The conveyor transfer points particulate emissions were shown in the application controlled by baghouses with a 99.5 percent control whereas the modeling analysis showed a control effectiveness of only 50 percent. The 50 percent figure is typical of water spray where baghouses typically exceed 99 percent control. The modeling analysis showed no control for the ore dumping off the end of the stacking conveyor. The application showed water spray with a control of 50 percent. The clay hauling in the modeling analysis at one point showed no control, however the actual figure used was 80 percent control. Zortman Mining Inc. has proposed chemical stabilizer control which can be 90 percent effective. (342)

RESPONSE: The modeling analysis has been revised to include a more refined model and actual meteorological data. The model will now predict the 24 hour and annual concentrations without the use of the conversion factors.

The emissions have been recalculated as part of the revised modeling analysis. The calculations would include the most appropriate emission factors and control efficiencies as recommended by EPA.

16. COMMENT: Neither Section 3.6.1.1 nor 3.6.1.2 address existing sources of air pollution other than mine related activities. Traffic on unpaved roads, wood burning for residential heating, forest fires, and agricultural activities are very significant sources for particulates in the area. Particularly in the towns of Zortman and Landusky, traffic and wood burning contribute a large amount of particulates. (342)

RESPONSE: A discussion of other existing air pollution sources has been included in the Final EIS.

17. COMMENT: The Montana ambient lead standard is averaged over 90 days and not to be exceeded. The federal ambient lead standard is averaged over a calendar quarter and also not to be exceeded. These standards can not be directly compared to the maximum measured lead concentration of 0.03 $\mu g/m^3$ since this concentration is averaged over only a twenty-four hour period. (342)

RESPONSE: It is true that a direct comparison cannot be drawn between the 24 hour lead concentration and the 90 day or quarterly standards. Assuming the assay laboratory operated each day of the 90 day period or quarter, and this resulted in ambient 24 hour lead air impacts of 0.03 $\mu g/m^3$, the 90 day or quarterly averages would equal the 24 hour value of 0.03 $\mu g/m^3$. The value is still below the standard of 1.5 $\mu g/m^3$.

18. COMMENT: Note should be made in Section 4.6.1.1 that the "worst case" meteorological data used were hypothetical not actual measured on site data. The reader is led to assume that the worst case measured data were used, which is definitely not the case. It should also be noted that none of the modeling used actual on site meteorological data. Also, the factor used to convert the one hour concentrations to twenty-four hour and annual concentrations should be discussed. (342)

RESPONSE: The modeling analysis has been refined to include actual on-site meteorological data. The model has calculated the 24 hour and annual concentrations without the use of the conversion factors.

19. COMMENT: The paragraph on page 4-142 of the Draft EIS is the most important cautionary note for the reader. EPA, which is their guidance for screening model applications such as this one, states that the assumptions of the modeling are made conservative enough that if the model shows compliance with the ambient standards, then there is essentially no chance that the standards would be exceeded. EPA intentionally makes the assumptions conservative for this reason. Likewise, if the screening model shows the ambient standards are exceeded, this does not mean the standards will be exceeded. What it means is further modeling is required using a more refined model and more refined input data. This is the only point that the reader is cautioned about interpreting the model results. Back under Alternatives 4 through 7 this cautionary note becomes critical. Somehow this cautionary note needs to be re-addressed under the impact discussions and expanded here. (342)

RESPONSE: The modeling analysis has been refined to include actual on-site meteorological data. The model will calculate the 24 hour and annual concentrations. Appropriate caution is included in the Final EIS concerning model assumptions and error of analysis.

20. COMMENT: The footnote (2) on Table 4.6-1 implies that the lead standard may be exceeded once a year. This is not the case, the lead standard may not be exceeded. Also the Montana lead standard is for 90 days and the federal lead standard is for a calendar quarter. Montana does not have a three-hour ambient sulfur dioxide standard. Montana does have a one-hour sulfur dioxide standard that allows 18 exceedences per year. (342)

RESPONSE: The Final EIS has been changed to reflect this information.

21. COMMENT: The twenty-four hour maximum PM_{10} concentrations measured at Zortman and Landusky townsites are not background concentrations. The sampling sites are directly impacted by the existing mining activities including traffic on the unpaved roads. Even though no mining was occurring at the Zortman Mine at this time, the activities related to the Landusky Mine affect the Zortman townsite monitor. The "representative" background PM_{10} concentrations that should be used are the Sites 6 or 7. Even Site 1 is affected by traffic on the road to Landusky townsite. (Comment is applicable to Sections 4.6.3.2, 4.6.4.2, 4.6.4.3, 4.6.5.2, and 4.6.5.3). (342)

RESPONSE: The ambient air quality data collected at the Zortman Mine have been reanalyzed to determine what data is the most representative of background concentrations. A discussion of this analysis has been included in the Final EIS. Data from monitoring site 7 on Seven-Mile road were selected for background concentrations, because this site is the closest to the mines which has not been impacted by mining activity.

22. COMMENT: Section 4.6.6.1 compares the modeling submitted with the application for an air quality permit alteration with the screening model results presented here. The paragraph should clarify that the modeling in the application used a more refined model and also actual measured on-site meteorological data. The reader is led to the assumption that both modeling approaches were the same and yet one model predicts significantly higher concentrations. (342)

RESPONSE: The modeling analysis has been refined to include on-site meteorological data. The comparisons between modeling efforts have been discussed in the Final EIS.

23. COMMENT: On page 4-150 of the Draft EIS, what were the background concentrations used? Also this is a good point to add a cautionary note to the reader regarding the screening model results discussed in Section 4.6.1.1 Paragraph 5. (342)

RESPONSE: The ambient air quality data collected at the Zortman Mine have been reanalyzed to determine what data is the most representative of background concentrations. The modeling analysis has been refined to include on-site meteorological data, and the discussion on modeling results modified.

24. COMMENT: The first paragraph of Section 4.6.6.3 (page 4-151) needs expansion. Before the reader is left with the impression that the "impacts described are considered unavoidable and adverse," the magnitude and accuracy of the results should be discussed. These results are from a screening model using hypothetical worst case meteorology. Before any decision can be made considering the impact, further refined modeling would need to be completed using measured on-site meteorological data. (Comment is applicable to Sections 4.6.6.3, 4.6.7.2, 4.6.7.3, 4.6.8.1, 4.6.8.2, 4.6.8.3, 4.6.9.1, 4.6.9.2, and 4.6.9.3). (342)

RESPONSE: The modeling analysis has been refined to include on-site meteorological data. Model assumptions are included in the Final EIS.

25. COMMENT: Where is the baseline data to support ZMI's action that they are not exceeding the emission standards since the beginning of their mining operations, 1979? (348)

RESPONSE: The ambient air quality data collected at the Zortman Mine have been reanalyzed to determine what data is the most representative of background conditions. Air quality data collected at Zortman since 1990 indicate that there have been no exceedences of state and federal air quality standards for particulate matter. However, no time "baseline" data were collected prior to the beginning of large scale mining.

There are emission limits set for the Zortman/Landusky facilities in the state air permits. ZMI is required to perform compliance monitoring and report the results of the compliance monitoring to the Montana Air Quality Bureau. These test results would show compliance or exceedence of the permit emission limits.

26. COMMENT: We have video footage containing dust contamination to adjacent properties during current leaching operations. This was noted while a foreign substance was being hopper loaded, into empty trucks and then hauled onto their respective leaching pad. We question how this and other air pollution will affect the adjacent Turtle Mountain Indians, Federal, State, and private properties to this proposed Goslin Flat expansions? (360)

RESPONSE: ZMI is required to meet state and federal ambient air quality standards for dust (particulates) and other regulated pollutants at all facility boundaries. The federal and state air quality standards were designed to preserve human health; therefore, if the applicable air quality standards are being met, and are met in the future, there should be little effect to human health from mine air pollution. The particulate emissions from the mine may result in short-term degradation of visibility in the mine area.

27. COMMENT: The Draft EIS is premature because of lack of air quality monitoring to the north and east of the mines. (352)

RESPONSE: Section 3.6 of the EIS includes tables that summarize monitoring data concerning respirable particulates (PM_{10}) that were collected from March 1990 to April 1995 within the project area. These tables (3.6-1 to 3.6-6) also list the monitoring sites within the project area. Sufficient air quality monitoring information is available for NEPA/MEPA analysis.

6.11 VISUAL QUALITY

1. **COMMENT:** The mine pits will not even remotely blend in with the surrounding area as required in § 82-4-336(7) subsection 1(c) if not fully reclaimed. (340)

RESPONSE: Mine pits would be backfilled in to a level that would allow free-flowing drainage out of the mine pit. Sculpturing of the remaining exposed mine pit highwalls by selective blasting to remove the geometric lines and form of the highwall was considered as a visual mitigation, but was not recommended due to concerns about the potential for creating acid rock drainage. The highwalls would remain as a visual contrast in the landscape as discussed in Section 4.7 and shown in several of the photographic simulations found in Appendix D of the Draft EIS.

2. **COMMENT:** While I was not in favor personally of putting the leach pad on the flats, I do now understand that the water quality of this project can be better protected than in the mountain sites. In addition, I would like to see contour formations conforming to existing land structures for any piles of materials outside of the mountain mining sites. (27)

RESPONSE: Visual mitigation for Alternatives 3, 5, 6, and 7 include rounding straight edges of landforms and planting of trees in scattered locations as needed to improve the visual appearance of the reclaimed facilities. Please see Appendix D, Figures D-12 and D-13 in particular, of the Draft EIS for photographic simulations showing what the facilities would look like after reclamation using plans for the Company Proposed Action. These simulations do not reflect mitigations for visual appearance incorporated into mitigated alternatives.

3. **COMMENT:** As the current disturbance at both the Zortman and Landusky mines is not compatible with the scenery management objectives of VRM Class II landscapes, perhaps the BLM should reclassify to reflect mining activities that have taken place in the Little Rocky Mountains since the late 1800's. (342)

RESPONSE: Although the current and proposed mining activities are not within VRM Class II objectives, this classification is retained for all of the Little Rocky Mountains to identify the potential scenic resources of the area and to maintain VRM Class II objectives as the goal for future reclamation activities in disturbed areas.

6.12 RECREATION, LAND USE, AND TRANSPORTATION

1. COMMENT: A thematic map that can be used to illustrate and assess land use conflicts is noticeably missing from Section 3.7, Recreation and Land Use. (364)

RESPONSE: Please see Figure 3.7-1 in the Final EIS depicting recreational uses and land ownership which has been added to Section 3.7.

2. COMMENT: Throughout the Transportation section, references are made that public access will improve or open up upon cessation of mine activities. While this is possible, it should be noted that access through the mine sites is on private property controlled by ZMI and access will be by permission of the landowner. The Final EIS should include reference to the fact access through the mine sites after closure will still require permission of the landowner. (342)

RESPONSE: The discussions for Alternatives 1 through 7 regarding public access to the Little Rocky Mountains in Section 4.11 have been revised to reflect access to privately-owned lands would require permission of the landowner.

3. COMMENT: Mining conducted at Zortman and Landusky is mostly on privately owned ground with no land within the boundaries of the Fort Belknap Indian Reservation. Another thing to consider, is, of the total amount of land being disturbed under the Alternative 7, 91% is ZMI's private property. Only 9% or 100 acres of Federal land would be disturbed. (175, 233)

RESPONSE: No lands within the Fort Belknap Indian Reservation would be directly impacted by the proposed mine expansion. Approximately ½ of the existing disturbance is on public lands. Of the approximately 772 acres of new disturbance associated with Alternative 7, 82 acres (about 11 percent) would occur on public lands managed by BLM. Information on acres of disturbance can be found in Figure 4.7-1 and in Table 4.7-1.

4. COMMENT: A map showing all land ownership, including patented lands, mining claims, etc. should be provided in the section on Recreation and Land Use in the EIS (page 3-167). Section 1.2.1 (page 1-9) needs an aerial photo that shows land ownership and patented lands in the study area to enable the reader to better understand direct, indirect, and cumulative impacts. (346)

RESPONSE: While maps showing land ownership are informative they are not necessary for evaluating the environmental impacts of the alternatives. The EIS must address the environmental effects regardless of land ownership. Figure 3.7-1 in the Final EIS shows land ownership. Other maps are available from the U.S. Geological Survey and the BLM.

5. COMMENT: What is the basis for the statement that there has been significant short-term impacts to the local recreational environment caused primarily by direct visual impacts? Most of the disturbed ground is located on private property and access is by permission of the landowner, with or without mining activity. (342)

RESPONSE: Visual impacts have occurred to recreationists on the surrounding public lands (i.e., Old Scraggy Peak, Saddle Butte, Mission Peak) where there are views of the mining disturbance. In addition, mining facilities are easily seen from certain vantages to the north, including areas on the Fort Belknap Indian Reservation. Approximately half of the disturbance from mining has been on public lands (see Table 4.7-1).

6. COMMENT: A discussion of the management plans in effect in accordance with the Resource Management Plan (RMP) should be provided. (346)

RESPONSE: A discussion of land use management guidelines for BLM land was included under "Recreation and Land Use" on pages 3-166 and 3-167 of the Draft EIS. More detailed information can be found in the Phillips Resource Area RMP (September 1994).

6.13 NOISE

1. COMMENT: In your reference to the EIS section on sound, you state that the sound levels in Landusky would be the same as living in a large residential area. While living in Landusky I never heard a single blast nor any sounds that would come close to anything loud. While in Landusky, Gold Bug and Mill Gulch reclamation projects were being constructed yet the town was more like a ghost town. In the Draft EIS you document 14 different reading sites but don't tell where they were plus there are very few odds that all heavy equipment would operate at once. (130)

RESPONSE: The perception of noise is very subjective. Individuals have varying thresholds of annoyance depending on past experience with noise. The noise data collection locations are described in Section 3.9 of the EIS and listed in Table 3.9-1. The assumption that all heavy equipment would operate at the same time is very conservative. This assumption is used so that the worst case noise impacts can be predicted. It is very unlikely that all equipment would be operated at the same time in the same place.

2. COMMENT: Page 3-170 of the Draft EIS states that measured baseline noise levels at the Pow Wow Grounds ranged from 35 to 58 dBA. Page 4-189 of the Draft EIS then states that the cumulative impacts, including reasonably foreseeable developments for Alternative 4, would result in cumulative noise levels at the Pow Wow Grounds of 59 dBA. Paragraph 3 then goes on to state that cumulative impacts at all receptor locations, including the Pow Wow Grounds, would be significant and of a high magnitude. Does 1 dBA over background constitute a significant and high magnitude impact? The noise impacts to the Pow Wow Grounds are not significant with present mining and are not expected to change as a result of the extension. Assuming concurrent mining at both mines and at Pony Gulch (a reasonably foreseeable development) may be conservative and represent "worst case", but it is unlikely that this scenario represents conditions proposed for the site. (342)

RESPONSE: An increase on 1 dBA over background would be barely noticeable, but what is important is the determination of a suitable baseline value. The 10-minute equivalent noise level (L_{eq}) as measured at the Pow Wow grounds on September 18, 1990, was 43.6 dBA. This value better represents the average noise level at the Pow Wow grounds. Using this L_{eq} value of 43.6 dBA for background and a predicted noise impact of 59 dBA, the resulting noise level would be considered significant. Impacts are considered to be significant if the levels estimated at the receptor locations would interfere with outdoor activity (above 57 dBA).

6.14 SOCIOECONOMICS

1. COMMENT: Who farms Goslin Flats and who will lose revenue and jobs because of the Goslin Flats leach pad, proposed under Alternatives 4, 6 and 7? (3)

RESPONSE: Privately-owned lands that would be affected by the proposed heap leach pad and conveyor system are currently owned by ZMI and are being leased to local ranchers for use as livestock pasture (see Section 3.7). The lands are a very small portion of these ranchers' total operations. Under Alternatives 4, 6 and 7, these privately-owned lands would no longer be used for livestock grazing. This would have a minor effect on the total amount of grazing land in the region (see Section 4.7.6). Under Alternatives 4, 6, and 7, ZMI would lose revenue now earned by leasing the land to local ranchers; however, this would be offset by converting the land to industrial use as proposed under these alternatives. The local ranchers who currently lease the land would incur revenue losses if they are unable to find replacement pasture. Due to the high percentage of the county's total acreage classified as agricultural, the potential for finding alternative forage sources is high: 97.5 percent of Phillips County's land area is devoted to cropland and rangeland (see Section 3.7). The heap leach pad and adjacent facilities would cover about 250 acres. This represents about 45 AUMs (animal unit months) at the rate of about 5.5 AUMs per acre that is typical of this part of Phillips County. The revenue impacts to the agriculture sector of the local economy of converting privately-owned lands in Goslin Flats from agricultural use to industrial use would be minor, and it is unlikely that any agricultural jobs would be lost as a direct result of this conversion.

2. COMMENT: Has the EIS fully considered and accurately evaluated the impacts of the alternatives upon the Fort Belknap Native American Community. In particular, given high unemployment on the Reservation, the jobs offered by the mine should generate support for the expansion among members of the Fort Belknap Native American Community. Continued employment by the mine would allow some Native American employees to live comfortably on the Fort Belknap Indian Reservation, support local business, and take part in civic and cultural activities. Continued mining will provide a strong tax base and employment source in the Fort Belknap Indian Reservation to offset the impacts of reduced government spending. (3, 7, 9, 48, 181, 189, 204, 218, LO-29)

RESPONSE: For this analysis, information was considered on existing economic and social conditions, estimates of direct personal benefits and costs of the Company Proposed Action and alternatives due to direct employment at the mine and indirect employment attributable to the mine, published reports about attitudes and opinions held by the Fort Belknap community, findings of other disciplines as reported in the EIS, interviews with a few representatives, and information from the initial scoping and public participation activities. Following the receipt of comments, Sections 3.10 and 4.10 of the EIS were revised.

Particular attention was given to preparation of Sections 4.10.2 through 4.10.9 which identified the estimated direct and indirect impacts of the Zortman and Landusky mines from 1979 to 1994 and the predicted direct and indirect impacts of the Company Proposed Action and alternatives. These sections considered the following topics as they affect Native Americans: the economic impact upon the Fort Belknap Indian Reservation, employment of households residing on the Fort Belknap Indian Reservation, direct fiscal benefits to facilities and services of the Fort Belknap Indian Reservation, and social impacts on Native Americans residing on the Fort Belknap Indian Reservation. These sections consider the relative importance of direct and indirect employment and economic benefits to Reservation households versus impacts on the sense of well-being of residents of the reservation because of impacts on social and cultural activities. The sections also disclose cumulative impacts of the alternatives, identify unavoidable adverse impacts, and evaluate short-term use versus long-term productivity. The amount and type of information presented in these sections and its evaluation is sufficient and fundamentally correct.

3. COMMENT: Is it true that Native Americans are not employed at the existing mine? The agencies should note that the long-term socioeconomic benefits associated with mining are "short term" while the negative impacts are "forever (long-term)." (3, 48, 181, 320, 341, LO-11, GF-74)

RESPONSE: The EIS reported that 41 Native Americans were directly employed by the existing mine in 1993, all of whom lived within the study area of Phillips and Blaine counties (see Section 3.10.2.7). This, among many other factors, was considered in predicting and evaluating the effects on economic and social well-being and perception of quality of life within the Fort Belknap Native American community.

4. **COMMENT:** Has the Draft EIS fully considered and evaluated the socioeconomic impacts of the alternatives, or have they been understated in some cases? As an example, could schools, hospital, and many businesses in Phillips County survive if the mine is not allowed to expand? "If you lay off the mine workers ..., can you tell me what will happen to Malta?" Many communities in the state of Montana besides Phillips County would feel the impact if the proposed expansion were not permitted. In addition, communities and individuals would not have ample time to prepare for closure of the mine under the no expansion alternatives and would have to forego the economic and financial benefits and the opportunity "to begin the transition from an industry based economy back to an exclusively agricultural one" that would be afforded by the expansion alternatives. Analysis of the socioeconomic impacts of expansion should include impacts to both Phillips and Blaine counties and the Fort Belknap Indian Reservation. Specific impact topics should include losses of jobs and income, taxes, school enrollment and funding, and utilities paid by ZMI. (10, 25, 28, 31, 59, 174, 175, 179, 190, 270, 340, 342, 351, LO-49, GF-7, GF-9, GF-56)

RESPONSE: Sections 4.10.3 through 4.10.9 of the EIS predicts the direct and indirect economic, fiscal and facilities and services impacts of the alternatives on Malta, Zortman, Landusky, Phillips County, Blaine County, and the Fort Belknap Indian Reservation. The EIS predicts the employment, income and taxes that would accumulate by individuals, businesses and governments under both the expansion and no expansion alternatives. The comparison of the amounts presented in Table 4.10-7 and Table 4.10-8 quantifies and discloses the benefits foregone due to closure of the mines sooner under the no expansion alternatives and closure later under the expansion alternatives. Other differences in impact between the no expansion and expansion alternatives are disclosed in qualitative terms. The EIS also predicts the potential employment and income effects on the state of Montana as a whole (see Table 4.10-7 and Table 4.10-8) and discloses which specific communities elsewhere in Montana would incur the largest shares of these effects based on the share of ZMI spending captured by suppliers located in those communities (see Section 4.10.3.1). Closure impacts are addressed for all alternatives.

Potential negative impacts to retail business, public facilities (such as hospitals), and schools in Malta, Zortman, Landusky, Phillips County, Blaine County, and the Fort Belknap Indian Reservation are all disclosed in the EIS. Closures of businesses, public facilities, and schools are not predicted, except that closure of the Zortman Elementary School is identified as a distinct possibility due to predicted enrollment losses. The possibility of loss of capacity in Malta and Phillips County is identified for services for the elderly and medical services.

There is inherent uncertainty in predicting economic, financial, and fiscal impacts, so it is difficult to say whether the level of any particular impact disclosed in the EIS is understated, overstated, or exactly correct. However, the range of impacts identified and how they are quantified or characterized in the EIS provide a reasonable indication of what may occur in the future, in terms of the socioeconomic impacts of no expansion and how they differ from the impacts of expansion.

In the specific case of how much employment and income impact would occur in Phillips and Blaine counties, the predicted levels of impact will probably turn out to be overstated for the following reason. The employment and income impacts to Phillips and Blaine counties are estimated by using the state employment and income multipliers for Montana instead of the county employment and income multipliers for Phillips and Blaine counties. This was because reliable county multipliers are not available for Montana counties. The result of this substitution will probably be the overstatement of county impacts since theory implies that the amount of the state-level multiplier is higher than the amount of the county-level multipliers for most if not all types of economic activity.

5. **COMMENT:** Please note that the benefits of ZMI employment and industrial purchases are felt statewide in Montana. ZMI spent $18.5 million to $20 million for goods and services in Montana in 1994. About $5.5 million was spent in Phillips County, and the remainder was spent in other communities around the state. The volume of ZMI's purchases allows ZMI's suppliers to earn volume discounts which are passed on to other customers. The entire state and many communities in Montana would feel the impact if the proposed expansion is not permitted. All other things being equal, it is possible that some of the volume discount savings may no longer be available to other customers. However, the extent to which this would happen is unknown. (13, 144, 327, MA-6, GF-4, GF-56)

RESPONSE: The statewide employment and earnings effects of ZMI's payroll and industrial purchasing activities are described in detail in Section 3.10.2.7 and illustrated on Table 3.10-9. The EIS also discloses the impact of losing these economic effects under the no expansion alternatives in Section 4.10.3 through Section 4.10.5 and the impact of sustaining these effects under the expansion alternatives in Section 4.10.6 through Section 4.10.9. For example, disclosure of these effects under Alternative 1 was made in Section 4.10.3.1and 4-215. Disclosure of these effects under Alternative 4 was made in Section 4.10.6.1.

6. COMMENT: The EIS should consider information about donations, contributions and volunteer labor provided by ZMI or ZMI's employees to facilities and services in Phillips County and elsewhere and the potential to lose such contribution under the no expansion alternatives. Cash donations by ZMI were about $25,500 in 1994, including $12,900 (or more than half) donated to entities on the Fort Belknap Indian Reservation. Funds and construction work have been donated to Phillips County and Hays-Lodgepole schools. ZMI has supplied cash and in-kind contributions to emergency management services (EMS), fire service, disaster and emergency service, and search and rescue service in Malta and Phillips County and elsewhere, and ZMI employees are active providing emergency services in these areas. For example, there are 15 skilled ZMI employees who volunteer and cover 23 positions in these services, playing a vital role in the services within the communities where they live, including Malta and Phillips County. The closure of the mines would cause a fiscal impact to the Hays-Lodgepole schools since ZMI has made emergency donations of funds to the schools in the past (see page 4-219 of the Draft EIS). (25, 142, 232, 177, MA-12, LA-1, GF-10, GF-36)

RESPONSE: Information about donations, contributions and volunteer labor provided by ZMI or ZMI's employees to facilities and services in Phillips County and elsewhere and the potential to lose such contributions under the no expansion alternatives is disclosed in the EIS in Section 4.10.2 through Section 4.10.5. The beneficial social impacts of ZMI's employees in Malta and Zortman are reported in Section 4.10.2. The loss of these benefits under Alternative 1 and ZMI's contribution to the Hays-Lodgepole School district are reported in Section 4.10.3.1.

7. COMMENT: The proposed expansion would involve increased use of electricity by ZMI which, in turn, would result in a major increase in electricity bills to other customers within the Big Flat Electric Cooperative service area. ZMI's closure would have the effect of increasing the cost of power to Big Flat's customers. Also, there would be an economic and fiscal impact of Big Flat losing ZMI's business. Seventy large power irrigators who buy electricity from Big Flat would also be affected, in addition Big Flat's residential and commercial customers. (48, 63, 181, 189, 224, MA-4, GF-34)

RESPONSE: More electricity would be used on an annual basis by ZMI under Alternatives 4, 6, and 7 because of the overland conveyor system serving the Goslin Flats heap leach facility. However, electricity bills would not increase for customers of the Big Flat Electric Cooperative (Big Flat) as a result of the increased demand. Historically, ZMI's demand for electricity and the round-the-clock constancy of that demand has enabled Big Flat to buy wholesale power at a discount. This has tended to stabilize what Big Flat charges its consumers for electricity, a fact that was disclosed in the EIS. The impact of ZMI's closure on the cost of power to Big Flat's customers is disclosed in Sections 4.10.3 through 4.10.9. Information on the impact to 70 large power irrigators has been included in the EIS in Sections 4.10.2 through 4.10.9. The economic impact of Big Flat's loss of ZMI's business is included within the total employment and earnings impact estimates presented in the EIS. Only changes in direct revenues to taxing jurisdictions (that is, taxes paid directly by ZMI) were estimated in the Draft EIS. However, fiscal impacts, and their consequences for local facilities and services, were characterized. Please note that costs associated with construction of a new powerline could be passed on to all ratepayers, should it actually be proposed and approved.

8. COMMENT: The EIS should consider the socioeconomic impacts of delay while a decision on the proposed action is pending. Employee households may be affected economically, and employees also may be affected socially and psychologically. Socioeconomic impacts would occur because of delay as well as because of closure. (135, 144, GF-37)

RESPONSE: Layoffs have occured while the permitting decision is pending because ZMI has run out of permitted ore or processing capacity. The socioeconomic effects of interim layoffs potentially would resemble those of closure. The range of impacts that would occur and their severity would depend on the number and duration of layoffs. Section 3.10.2.7 and Sections 4.10.3 through 4.10.9 have been revised to reflect this consideration.

9. COMMENT: The EIS should include a comparison among north central and eastern Montana counties in terms of the rate of population change from 1980 to 1990 to illustrate the importance of employment opportunities provided by ZMI in sustaining Phillips County's economy. (182, GF-56)

RESPONSE: The EIS emphasizes the important role that mining and ZMI in particular have played since 1979 in diversifying the Phillips County economy (see Section 4.10.2).

10. COMMENT: We do not agree with the statement on page ES-18 the Draft EIS, with regard to Alternative 7, "In the long term, the quality of life, as perceived by all groups within the study area, may improve somewhat because surface disturbance would be reduced and there would be a greater probability of reclamation success and correction of existing water quality problems." Similar statements were made on pages ES-13, ES-14, ES-16, and ES-17, regarding Alternatives 2, 3, 5, and 6. (211, 320)

RESPONSE: These statements refer to a long-term effect, meaning that it would occur after closure of ZMI operations and final reclamation. Also the improvement in the quality of life as perceived by groups within the study area is an improvement as compared to the long-term effect occurring under Alternatives 1 and 4 and not to baseline or existing conditions.

11. COMMENT: Page 3-189, paragraph 1, line 12, should be revised to reflect the fact that Phillips County has 911 emergency calling. (342)

RESPONSE: Section 3.10.3.1 has been updated to reflect this information.

12. COMMENT: The socioeconomic analysis overstated the beneficial impact of mine closure to the local recreation economy. The comments stated, "Employees of the mines are active 'hunters, campers, hikers and sightseers' using lands surrounding the Zortman and Landusky mines, and that part of the contribution which mine employment makes to the local economy is in the purchase of goods and services in the local recreation economy which will not be made up by an influx of recreationists due to mine closure." In fact, it is possible that closure of the mine would have an adverse effect on recreation in the area by decreasing the population of recreationists. (342)

RESPONSE: The analysis of impacts to the local recreation economy has been and continues to be constrained by the lack of information about recreation use and recreation spending in the Little Rocky Mountains. The socioeconomic analysis identifies and qualitatively characterizes a set of economic impacts that logically could be expected to flow from the land use, access, noise, and visual impacts to recreation resources identified by other resource specialists and analyzed elsewhere in the Draft EIS. The comment suggested an alternative set of the economic impacts that may be valid, too, namely that households who directly or indirectly depend on the mine for employment constitute a pool of potential recreationists who stimulate the local recreation economy. Unfortunately, information is not available to quantify these potentially offsetting impacts, either. Therefore, the analysis has been amended to disclose the possibility that both potential impacts exist, and also to disclose the uncertainty surrounding their net effect upon the local recreation economy (see various pages in Section 4.10.2 through Section 4.10.9). In the long run, the impacts to recreation and recreation-related economic activity could be positive for these reasons: after the mine closes and the population of the area stabilizes, the remaining population may be more likely to indulge in recreation activities in the Little Rocky Mountains more often since the mine is gone, reclamation would improve wildlife habitat, and people from outside the region who may not even consider the Little Rocky Mountains because they know a large open-pit mine is operating may be more inclined to travel to the Little Rocky Mountains more often for hunting and other outdoor activities because they know the mine is gone. These are some factors to consider, however uncertain their effect may be, that may increase recreation and recreation-related economic activity in the Little Rocky Mountains over the long-term after the closure and reclamation of the mine.

13. COMMENT: The EIS ignored the environmental impacts to the Fort Belknap Indian community and the ecosystem upon which our economic livelihood is based. (350)

RESPONSE: The socioeconomic impacts to Native Americans of the Fort Belknap Indian Reservation are addressed in Section 4.10 of the Draft EIS and the Final EIS.

14. COMMENT: The perceived health risk issues were not "fully and forthrightly" addressed in the Draft EIS. (350, 364)

RESPONSE: The economic aspects of perceived health risk issues among Native American residents of the Fort Belknap Indian Reservation were addressed in Section 3.10.2.5. The impact to the social well-being of Native American residents of the Fort Belknap Indian Reservation because of past impacts of the Zortman and Landusky mines on watersheds which drain into the Fort Belknap Indian Reservation was addressed in Section 4.10.2. The impact to the social well-being of Native

American residents of the Fort Belknap Indian Reservation because of predicted impacts to watersheds which drain into the Fort Belknap Indian Reservation was addressed in Sections 4.10.3 through 4.10.9. Impacts to water resources potentially affecting the Fort Belknap Indian Reservation were addressed in Sections 3.2 and 4.2. Perceived health risk to the people of the Fort Belknap Indian Reservation due to water quality impacts was addressed in Section 3.2.5.

15. COMMENT: More information is needed about the Native Americans employed at the Zortman and Landusky mines. Information requested is an employee's degree of ancestry, place of residence, and whether an employee is an enrolled members of the Fort Belknap Indian Community or a descendent with strong ties to the Fort Belknap tribes. Also requested is the method ZMI used to develop this information. (351, LO-34)

RESPONSE: Information on how Native American employees of ZMI were identified and the residency of those employees has been provided in Section 4.10.2. Information on ancestry, enrollment in the Fort Belknap Community, or family or other ties to the Fort Belknap tribes is not available for ZMI's Native American employees.

16. COMMENT: The statement on page ES-3 of the Draft EIS that "This employment [at the Zortman and Landusky mines] represents a significant percentage of the total workforce in the surrounding region" is incorrect with reference to Blaine County. (HA-9)

RESPONSE: The executive summary has been changed to read, "This employment represents a significant percentage of the total workforce in Phillips County, although the mines have had little direct economic impact on Blaine County or the bulk of the Fort Belknap Indian Reservation."

17. COMMENT: The EIS should describe the impacts of the no-expansion alternatives on individual mine employees and their households. Specific impacts include loss or reduction of income, loss of benefits, potential for default on mortgages, reduced resale value of homes, and loss of retirement savings. (MA-16)

RESPONSE: The potential impacts of immediate closure under the no-expansion alternatives have been described in Sections 4.10.3 through 4.10.5. Closure impacts of the expansion alternatives have been described in Sections 4.10.6 through 4.10.9. Economic, fiscal, facilities and services, and social impacts were analyzed for counties and communities. Additional micro-analysis at the household level is not appropriate and would be unlikely to result in the finding of greater impacts than are already disclosed in the EIS. We acknowledge and empathize with the fact that the loss of employment, whether due to interim layoffs, immediate closure under the no-expansion alternatives, or closure later under the expansion alternatives, would potentially cause economic, financial, and social hardship for individual employees and individual employee households directly or indirectly dependent on ZMI's operations. This is described in Sections 4.10.3.1 and 4.10.6.1.

18. COMMENT: The EIS should take into account impacts to human health and long-term impacts to the surrounding environment, in addition to simply addressing social and economic impacts of the proposed action. (348, HA-23)

RESPONSE: The EIS addresses these issues under NEPA and MEPA, as allowed by existing data. The Agency for Toxic Substances and Disease Registry (ATSDR) study on lead in drinking water on the Fort Belknap Indian Reservation is cited in the socioeconomic baseline section (3.10.2.5). Potential impacts to human health has been considered using information provided by ATSDR and results of water quality monitoring. No health risk to local residents has been identified during this review.

6.15 CULTURAL

1. **COMMENT:** The National Historic Preservation Act requires federal agencies to identify sites eligible for listing on the National Register for Historic Places. 36 CFR 60.1 et seq. If a project will affect a listed or eligible site, the Advisory Council on Historic Preservation must have reasonable opportunity to comment. The Advisory Council comments must be taken into account and integrated into the decision making process. 36 CFR 60.2. (351)

RESPONSE: BLM consulted with the Montana State Historic Preservation Office, the Advisory Council on Historic Preservation and interested parties to develop a Programmatic Agreement to consider the effects of the proposed mine expansion. The Advisory Council signed the Programmatic Agreement on November 14, 1995, and forwarded the Agreement to BLM. This constitutes their comments under the requirements of Section 106 of the National Historic Preservation Act. The Final Programmatic Agreement is contained in Appendix E of the Final EIS.

2. **COMMENT:** The National Park Service is very concerned about the potential adverse effects to the Little Rocky Mountains Traditional Cultural Property (TCP). This property is eligible for the National Register and would therefore, encourage you to continue the consultation process with both the Montana State Historic Preservation Officer and American Indian people. Through continued consultation, other methods or alternatives to further protect this significant property may be developed. (252)

RESPONSE: Consultation efforts for the proposed mine expansion have been completed. A signed Programmatic Agreement for this project is contained in Appendix E of the Final EIS. However, BLM, BIA and the Fort Belknap Community Council are continuing to study the Little Rocky Mountains TCP to assure its protection when considering other undertakings.

3. **COMMENT:** Cultural, historic, and ethnographic studies and reviews need to be collected for the Little Rocky Mountains Traditional Cultural Property (TCP) District to determine the boundaries and impacts to those properties caused by the existing project and the proposed expansion. The Draft EIS did not adequately address impacts to archaeological resources. The BLM's failure to gather adequate data on the TCP District and how it will be impacted by the proposed expansion violates the BLM's federal trust obligation to "preserve and protect" the interests of the Tribes when it makes decisions on the use of public lands. The impact assessment is based upon a preliminary and incomplete sample of the sites and associated Native American values present in the Little Rocky Mountains TCP Historic District. "The analysis should not be considered as exhaustive." Draft EIS at 4-268, 4-269. This inadequate analysis violated 40 CFR 1502.22. Any attempt to assess mitigation would be premature until a comprehensive study and ultimately a National Register nomination is completed for the area. (181, 186, 320, 340, 341, 344, 367, HA-23)

RESPONSE: Cultural, historic and ethnographic studies have been conducted as discussed in Section 3.12 of the Draft EIS. The identification effort for National Register eligible properties was reviewed by the Montana State Historic Preservation Office (SHPO) and they concurred in its methods and findings. Review and consideration of National Register eligible properties potentially affected by the proposed mine expansion culminated in a Programmatic Agreement, signed by the Montana SHPO as well as the federal Advisory Council on Historic Preservation, thus completing Section 106 review under the National Historic Preservation Act. BLM's federal trust responsibilities to the tribes have been honored by adherence to applicable federal laws and regulations. 40 CFR Section 1502.22 does not require an exhaustive (encyclopedic) analysis. The analysis of the projects potential impacts to cultural resources and the development of mitigation has been extensive and provides sufficient information needed to make a reasoned choice among the alternatives.

4. **COMMENT:** Congress has specified that a Tribe's religious and cultural associations with an area are only relevant for purposes of NHPA in so far as that significance applies to "tangible" connections to property. [See, e.g. 16 U.S.C. §§ 470w; 470a and 38 National Register Bulletin 9 ("[I]t should be clearly recognized at the outset that the National Register does not include intangible resources themselves. The entity evaluated must be a tangible property"); 15 National Historic Register Bulletin 27 (1990, revised 1991) stating that "a religious property cannot be eligible simply because it was the place of religious services for a community," and that the importance of the region must be "ethnographically documented" and "clearly defined." The Draft EIS should be clarified to reflect the requirements for identifying historic or traditional cultural properties under NHPA (see page 3-219

describing criteria to be listed as a traditional cultural property consistent with Bulletin 39). (342)

RESPONSE: Section 3.12 and particularly 3.12.1 of the Draft EIS describes the requirements for listing a historic property on the National Register of Historic Places, including those special requirements which apply to the listing of Traditional Cultural Properties (TCP). Bulletin 38 is cited here in some detail and in Section 3.12.4.4 the evaluation of the TCP in the Little Rocky Mountains by Deaver and Kooistra (1992) is summarized, including how the various listing requirements are or are not met. The tangibility requirement has been added to Section 3.12.1 of the Final EIS.

5. COMMENT: The historic landmarks, etc. lie almost exclusively on private land, and I find it appalling that a landowner should be hindered from developing their own property. (219, HA-6)

RESPONSE: The proposed action requires federal approval, which in turn requires consideration of historic properties by the federal agency, regardless of who owns the land where the affected properties are located. In this case, the property owner (ZMI) has agreed to mitigative measures for these historic properties. ZMI could not have been forced to pay for such mitigative measures under the mining regulations at 43 CFR 3809, had they chose not to do so.

6. COMMENT: The Memorandum of Agreement has been changed to a Programmatic Agreement under Section 106 of the NHPA. Additionally, a signed MOA or PA is not required for mine expansion or reclamation activities if the BLM is unable to get interested parties or other agencies to agree to the MOA or PA. The BLM has the authority to require Treatment Plans independent of a signed agreement. (342)

RESPONSE: The signed Programmatic Agreement is in Appendix E of the Final EIS.

7. COMMENT: The Draft EIS states that all expansion and reclamation activities would be carried out in accordance with the memorandum of agreement in Appendix E, but the MOA is not signed nor approved by the various agencies mentioned as parties. (352)

RESPONSE: The Memorandum of Agreement has been changed to a Programmatic Agreement. The signed Programmatic Agreement is in Appendix E of the Final EIS.

8. COMMENT: Bureau of Land Management has defined an Area of Potential Effect (APE) for cultural properties illustrated on Fig. 3.12-1. The Area of Potential Effect contains approximately 12,000 acres. The proposed Little Rocky Mountains Cultural "working boundary" as described on page 3-238 paragraph one consists of approximately 100,000 acres. I propose that the Traditional Cultural "working boundary" be changed to the Area of Potential Effect for cultural properties. The total acreage that wold be disturbed under Alternative 7 is 1.170 acres. 12,000 acres encompassed in the Area of Potential Effect is more than enough area to study the cultural effects of mining expansion. Private property rights have not been considered through this entire process. There are over 1200 private property owners within the current Traditional Cultural "working boundary." This does not include the landowners on the Reservation. (233, 340, 341)

RESPONSE: As noted, the current Traditional Cultural Property (TCP) boundary is a "working boundary" and may be changed with additional studies of the individual historic properties within the TCP. The working boundary of the TCP and APE are not the same because they have different purposes. The APE is specific to the mine expansion and the working TCP boundary will be refined independent of the mine expansion.

9. COMMENT: The Little Rocky Mountains are considered eligible for listing on the National Register for Historic Places as a Traditional Cultural Property (TCP). The Draft EIS does not discuss whether the Advisory Council on Historic Preservation has been given an opportunity to comment. If the Advisory Council has prepared comments, these comments have not been taken into account and integrated into the decision making process as required in the regulations. The National Historic Preservation Act requires federal agencies to identify sites eligible for listing on the National Register of Historic Places. 36 CFR 60.1 et seq. If a project will affect a listed or eligible site, the Advisory Council on Historic Preservation must have reasonable opportunity to comment. The Advisory Council comments must be taken into account and integrated into the decision making process. 36 CFR 60.2. (340, 351)

RESPONSE: The Advisory Council on Historic Preservation has been given the opportunity to comment and has done so as a signatory to the Programmatic Agreement (Appendix E).

10. COMMENT: Insufficient data exists to adequately evaluate impacts to tribal traditional cultural properties.

BLM claims that it has consulted with the State Historic Preservation Office (SHPO) regarding the proposed extension and reclamation and has therefore satisfied the National Historic Preservation Act. The Draft EIS admits, however, that BLM lacks complete information as to the native Traditional Cultural Properties. Furthermore, the SHPO has stated that an independent ethnographic study must be done before the boundaries of the Little Rocky Mountains Cultural Property District can be determined. It does not appear that such a study has been completed. (233, 340, 341)

RESPONSE: The Programmatic Agreement appended to the Final EIS evidences BLM compliance with Section 106 of NHPA, including consultation with SHPO.

11. COMMENT: Although the MOA of June, 1994 acknowledges that the Little Rocky Mountains are eligible as a TCP (Traditional Cultural Property), it does not eliminate the need for further study to identify the cultural values present and assess the impact to those values from mine expansion. Any attempt to assess mitigation alternatives to traditional values in the Little Rocky Mountains under 36 CFR 800, the implementing guidelines of the National Historic Preservation Act, would be premature until a comprehensive study and ultimately a Nation Register nomination is completed for the area. The agency should not be too quick to assume that the loss of significant sites from past and modern mining as outlined by McConnell (3-239) means that the entire area, including the area of proposed expansion, have also now lost their cultural significance. (341)

RESPONSE: The Programmatic Agreement provides for compliance with Section 106 (see Appendix E). It is not assumed that damage or loss of some cultural sites within the Little Rocky Mountains will diminish the cultural significance of the TCP District to native peoples, nor is this notion included anywhere in the EIS. A National Register nomination is not needed to assess effects or develop mitigation.

12. COMMENT: The entire area of the Little Rocky Mountains although <u>eligible</u> for protection under the NHPA, has yet to be adequately evaluated for its historic and cultural significance. Plans and criteria for how, whether, and when the existing mine operations will achieve compliance with environmental laws are not yet developed. (344, 352, GF-39)

RESPONSE: Compliance with Section 106 and it's implementing regulations (36 CFR 800) was undertaken through the Programmatic Agreement appended to the Final EIS which provides mitigation of historic and cultural properties. The Programmatic Agreement includes provisions for continued documentation of historical/traditional associations of the Little Rocky Mountains if Alternative 4, 5, 6, or 7 is selected.

13. COMMENT: Section 302(b) of the Federal Land Policy and Management Act of 1976 (FLPMA) directs the Secretary of Interior to take any action necessary to prevent unnecessary or undue degradation of lands. BLM regulations provide that neither unnecessary nor undue degradation means: (1) failure to take into consideration the effects of operations on other resources and land uses; (2) failure to initiate and complete reasonable mitigating measures; (3) failure to comply with applicable environmental statutes and regulations; and (4) where specific statutory authority requires the attainment of a stated level of protection or reclamation, that level of protection shall be met. 43 CFR 3809.0-5(k).

The Draft EIS does not provide for any mitigation measures to be initiated against destruction of cultural resources and sites as required in 43 CFR 3809-5(k). This failure to provide for reasonable mitigation measures creates unnecessary and undue degradation. This must be addressed before BLM can approve ZMI's significant modifications to the current Plan of Operations.

Although the Draft EIS states that BLM complies with the American Religious Freedom Act (AIRFA), the Draft EIS does not disclose how the agencies sought and considered views of American Indian traditional leaders/elders, who they consulted with, or how they determined whether a proposed land use would conflict with religious beliefs or practices. The Draft EIS states that mine expansion would cause minimal damage compared with the destruction that has already occurred. ZMI and the agencies' past failures to protect these sites should not provide a justification for continued losses. The Draft EIS should disclose the procedures that will be taken in the future to protect sites of religious significance to the Gros Ventre, Assiniboine, and other Tribes with cultural ties to the Little Rocky Mountains. (340, 343, 346, 351, 353, LO-21, LO-37, GF-73)

RESPONSE: Mitigation has been developed for impacts to cultural resources and is included in the EIS. A Programmatic Agreement was developed to mitigate impacts to cultural resources through preparation and implementation of Treatment Plans. This includes mitigation of impacts to Native American cultural resources in the Little Rocky Mountains.

14. COMMENT: Any serious attempt to mitigate the continued impacts of mining upon these cultural resources must recognize that most traditional Native Americans view the Little Rocky Mountains as a physically and spiritually interrelated totality. Thus, in the view those who cherish and utilize these cultural resources the most, the potential effects of the proposed mining expansion cannot and should not be limited simply to the Goslin Flats areas, but must take into consideration the cumulative impacts to the broader cultural context in question. (356)

RESPONSE: The concept of the Little Rocky Mountains as a physically and spiritually interrelated totality is recognized in Sections 3.12 and 3.12.4.3 of the EIS. This is one reason that Deaver and Kooistra (1992) expanded their study area to include all of the Little Rocky Mountains, and why the Traditional Cultural Property (TCP) District boundaries encompass a similarly broad area of the mountains. Further, the signed Programmatic Agreement recognizes the working boundaries encompassing the Little Rocky Mountains for mitigative studies.

15. COMMENT: The mine expansion may pose a threat to the area's listing on the National Register. Grounds for removal of a property from the list include that the property has ceased to meet criteria for listing in the National Register because the qualities which originally caused it to be listed have been lost or destroyed. The Draft EIS states that the mine expansion will increase destruction within the area's boundaries, and cause irreversible damage to cultural and historic sites. The agencies state that this destruction is minimal compared with the destruction which has already occurred. ZMI and the agencies' past failures to protect these sites should not provide a justification for continued losses. (340, 351)

RESPONSE: The qualities which make the Little Rocky Mountains eligible for listing on the National Register of Historic Places as a Traditional Cultural Property (TCP) District would not be lost or destroyed as a result of impacts from the proposed mining expansion, regardless of which alternative is selected. The TCP District is too vast and the sites too many for mining expansion as currently proposed to have this kind of effect.

16. COMMENT: Also, we have archaeology up there. There is a couple laws protecting that. I don't see anybody enforcing those laws. Those lands have been sacred to our Indian ancestors, not only Fort Belknap tribes, but other tribes, Canada and around here, for countless generations. And we love and respect those mountains. (344, 352, GF-39)

RESPONSE: Archaeology sites, both prehistoric and historic, are protected and treated through compliance with Section 106 of the National Historic Preservation Act (NHPA) and the implementing guidelines for Section 106 (36 CFR 800). Surveys to locate these sites have been completed (see Sections 3.12.2.3 and 3.12.3.3). Application and compliance with the NHPA is discussed throughout the cultural resources sections, and particularly in Sections 3.12, 3.12.1, 4.12, and 4.12.2. The Programmatic Agreement appended to the Final EIS provides for mitigation of impacts to these sites.

17. COMMENT: I am basically in favor of the Programmatic Agreement and am glad to see this coming to completion. I am concerned, however, about Alternative III. A. 1. a through e. I am troubled about the cultural study. I think this has been asked for because a land owner (the mine) is changing the look of his property. If this were a farmer wanting to put up grain bins on his property but in someone's line of view, what would happen? If there were some reason for a disturbance where Section 106 had to be invoked, what would happen to the grain bins? I think this could be a bad precedent. (5, 23, 218, 231, 342, LA-4)

RESPONSE: The cultural study as referenced has been included to mitigate by preserving through recordation, resources of particular cultural and religious concern to Native Americans in accordance with Section 106 and its implementing guidelines (36 CFR 800) of the National Historic Preservation Act and following the provisions of National Register Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties (TCP). In the example given, Section 106 would not apply unless construction of the grain bins in question qualified as a federal action or project. In such a case, the federal agency would be required to take into account the potential effects of construction of the grain bins on any National Register or National Register eligible historic properties in the area that might be affected. The key directives for identifying and protecting historic properties, including TCP, are described and discussed in Section 3.12.1 of the EIS.

18. COMMENT: Since the drafting of the Draft EIS, the Bureau of Land Management (BLM), Montana State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (Council) and ZMI have entered into a Programmatic Agreement intended to thoroughly address issues under the National Historic Preservation Act (NHPA). Portions of the Draft EIS should be revised to reflect more current information with respect to the agencies' compliance with the NHPA.

The Draft EIS should be amended to incorporate an appropriate description of the Programmatic Agreement which would require, among other things, that Zortman prepare Treatment Plans for implementation of mitigation measures according to the Alternative selected. The Draft EIS should also be revised to indicate that the decision to require Treatment Plans is likely to mitigate the magnitude and incidence of impacts on native American cultural properties (see, for example, pages 4-270 to 4-281 - assessing impacts associated with alternatives on Native American cultural resources). (5, 23, 218, 231, 342, LA-4)

RESPONSE: A description of the Programmatic Agreement has been added to the EIS in Section 4.12.1. The first paragraph includes a statement that the "treatment plans would be designed to eliminate or reduce impacts to prehistoric, historic, and Native American cultural resources as a result of mining activities."

19. COMMENT: The American Indian Religious Freedom Act (AIRFA) requires government agencies to evaluate their policies and procedures with the aim of protecting Indian religious freedom, to refrain from prohibiting access, possession and use of religious objects and performance of religious ceremonies, and to consult with Indian organizations in regard to proposed actions (42 U.S.C. § 1996). Throughout the period of mining activities, pre-1979 and post-1979, members of the Assiniboine, Gros Ventre and other tribes that depend upon the Island Mountains (Little Rocky Mountains) have expressed objections and concern related to diminished ability to utilize the resources of the Island Mountains for religious, cultural, historical, traditional, and economic purposes. No consideration has been afforded the AIRFA which requires Federal and State agencies to deny activities that infringe upon the free exercise of religious activities of Native Americans. What mitigation or avoidance will be implemented to address the Native American issues and concerns that will be impacted by the proposed action including the destruction of cultural resources and sites. The Draft EIS states on page 1-14 that BLM complies with AIRFA by "seeking and considering the views of Native American traditional leaders when a proposed land use might conflict with traditional Native American religious beliefs or practices." The Draft EIS does not disclose how the agencies sought and considered views of Native Americans traditional leaders/elders, who they consulted with, or how they determined whether a proposed land use would conflict with religious beliefs or practices. What were the conflicts cited during the Bureau's inventory/survey to comply with AIRFA. To fully comply with the act, these processes should be disclosed. In addition, the Draft EIS does not state what steps, if any, were set forth for protecting sites of religious significance to the tribes. These steps must be addressed to show that sites of religious significance were adequately evaluated as required. (181, 186, 348, 351, 352, 353, 367, HA-23, GF-39)

RESPONSE: The BLM used cultural studies conducted in the Little Rocky Mountains (c.f. Flemmer 1990, 1991; Melton 1990, Deaver and Kooistra 1992) which report on the views and concerns of Native American elders and traditionalists. BLM also communicated with political and traditional leaders from Fort Belknap, as well as meeting with them on several occasions to hear their concerns. Six public meetings were held to develop a Memorandum of Agreement and ultimately a Programmatic Agreement for the treatment and mitigation of historic properties in the Little Rocky Mountains. This is in addition to the four EIS scoping meetings and the five Draft EIS comment meetings. The Programmatic Agreement provides for mitigation of impacts to Native American traditional cultural resources through preservation by recordation and study of the traditional and historical associations of the Little Rocky Mountains.

Conflicts identified included visual and noise disruption of Native American activities by mining, and desecration of the sacred mountains by intrusive activities. While the entire mountain range is regarded by Native Americans as sacred, no specific sites (vision quest sites, graves, sacred plant gathering areas, etc.) were identified that would be directly affected by mine expansion. No mitigation to these impacts was viewed as acceptable to Native Americans. The American Indian Religious Freedom Act requires consultation with Native Americans regarding proposed activities that might impact religious activities. It does not require the BLM to deny such activities.

20. COMMENT: "There must be a determination by the United States Commission on Civil Rights whether violations of the Indian Religion Freedom Act has, or, will occur with the proposed expansion of the gold mine." (184)

RESPONSE: The U.S. Commission on Civil Rights does not have a permit review or approval function for the activity under consideration.

21. COMMENT: "On pages 1-17 the Draft EIS says the Permitting Agencies must comply with American

Religious Freedom Act and the National Historic Preservation Act, but fails to specify how these will be met under the varied alternatives." (352)

RESPONSE: Compliance with the American Indian Religious Freedom Act is achieved by obtaining and considering the views of Native Americans when making decisions. It does not necessarily mean deferring to those views or obtaining the consent of Native Americans. Compliance with the National Historic Preservation Act (NHPA) is achieved through a process (36 CFR 800) of identifying cultural resources, determining their significance, identifying adverse affects, and consulting with interested parties and the Advisory Council on Historic Preservation to development of appropriate mitigation. The Programmatic Agreement in Appendix E documents the agencies' compliance with the NHPA.

22. COMMENT: The Draft EIS states that mine expansion will increase destruction within the area's boundaries, and cause irreversible damage to cultural and historic sites. The agencies state that this destruction is minimal compared with the destruction which has already occurred. ZMI and the agencies' past failures to protect these sites should not provide a justification for continued losses. The Draft EIS should disclose the procedures that will be taken in the future to protect sites of religious significance to the Gros Ventre, Assiniboine, and other Tribes with cultural ties to the Little Rocky Mountains. (351, 353)

RESPONSE: The intent of the Draft EIS is to acknowledge that significant impacts have occurred to Native American traditional cultural values from past mining activities and to explain the loss of integrity that has already taken place in the general area. This information was not presented as a "justification for continued losses," nor intended as such. Consideration of sites with religious significance is done in conformance with the American Indian Religious Freedom Act and the National Historic Preservation Act as discussed in Section 3.12.1 of the Draft EIS.

23. COMMENT: The description of applicable law is inaccurate. The Religious Freedom Restoration Act of 1993, P.L. 103-141, provides that governmental activity may substantially burden a person's free exercise of religion only if the activity is in furtherance of a compelling governmental interest and is the least restrictive means of furthering that interest. As stated in the legislative history, "the definition of governmental activity covered by the bill is meant to be all inclusive. All governmental actions which have a substantial external impact on the practice of religion would be subject to the restrictions in the bill." This Act is not mentioned in the Draft EIS, nor an analysis done of whether the mine expansion would burden Native Americans' religious free exercise rights, the Government has a compelling interest and whether there is a less restrictive alternative. In fact, in terms of the latter criteria, the Draft EIS explicitly chooses an option most destructive of sacred sites in the area. (343, 353, LO-21, LO-37, GF-73)

RESPONSE: A discussion of the Religious Freedom Restoration Act of 1993 has been added to the Final EIS (See Section 1.5.2). The compelling government interest in this case is to ensure that when ZMI develops their private mineral rights it is done in a manner consistent with the state and federal environmental requirements. Selection of any of the seven alternatives does not have the potential to substantially burden a person's free exercise of religion. Although access restrictions could result from some alternatives, no legal access currently exists in these areas and this situation would not change with selection of any alternative.

24. COMMENT: We have a lot of our ancestors buried in and around the Little Rocky Mountains. I don't see anyone trying to enforce the Native American Graves Protection and Repatriation Act. (GF-39, HA-23)

RESPONSE: The BLM is not aware of any violations of the Native American Graves Protection and Repatriation Act in the Little Rocky Mountains. If such violations have occurred on BLM land, they have never been reported to the BLM.

25. COMMENT: The hearings on the Draft EIS were structured to defeat the ability of Native American people to comment in a meaningful way. In particular, the people were limited to five minutes each, except for governmental representatives. The real issue in this thing is environmental injustice for the Native American people. An example of that is the way you set up this hearing, it's just the typical way the white man would do it without any consideration of how Native American people would feel comfortable in responding to the issues. You never consulted with them, how would you like to do it? How could we get more meaningful participation? It's just another example of BLM and Hard Rock Bureau racism. (183, 344, 361, LO-33)

RESPONSE: Prior to the beginning of each hearing the agencies sponsored a 2-hour open house with various resource staff specialists (geology, hydrology, archaeology, wildlife, etc.) available for individual issue discussions. During the hearing segment a standard hearing format was used. This format was used consistently at the hearings held both on and off the Fort Belknap Indian Reservation. Nor is this format new to the people of Fort Belknap. Since 1990 the BLM and DEQ have sponsored approximately 20 public meetings on mining issues on the Fort Belknap Indian Reservation. The overwhelmingly preferred format of the attendees has been the centralized hearing format instead of dividing into groups to discuss resource topics one-on-one. On past occasions, when a mining topic of concern arises, BLM received specific requests from Native American organizations asking us to hold "hearings." The only difference for this series of meetings was the 5-minute time limit per speaker. This time limit was necessary due to the number of individuals wishing to make comments. The majority of commentors finished their remarks within the allotted time. Those who did not finish were allowed to conclude their remarks toward the end of the hearing. Many of the speakers gave repeat testimony at three, or more, of the hearings. In addition to the hearings on the Draft EIS, BLM conducted public meetings on and off the Reservation specific to cultural resources that might be affected by mining. Considerable comments were received on the Draft EIS and the Programmatic Agreement from people identifying themselves as Native Americans. Many meaningful comments were received from Native Americans and considered in preparation of the Draft and Final EIS.

26. COMMENT: The BLM's failure to address environmental justice concerns in the Draft EIS violates not only NEPA's mandate of public disclosure but also Executive Order 12898. Specifically, the Order requires all federal agencies to identify "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations." At a very minimum, then, the BLM must <u>disclose</u> in the Draft EIS whether such disproportionate impacts are threatened by this proposal. The Draft EIS admits that the proposed expansion of the mine will have drastic and long-lasting impacts on the Native Americans who reside on the Fort Belknap Indian Reservation close to the mine and who use the areas near the mine for their livelihood, for vision quest, Sundances, Pow Wows, and other spiritual and cultural purposes, and who rely on water likely to be impacted by the mine. All of these impacts must be discussed in terms of whether environmental racism is implicated in the siting of this mine. To propose expansion in the face of ongoing violations of environmental laws continues this nation's history of inadequate enforcement of environmental laws in areas affecting minorities. (326, 340, 344, LO-33)

RESPONSE: No *Environmental Justice* issues have been identified relative to the Zortman and Landusky mines that would violate or be inconsistent with Executive Order 12898.

The EIS goes to great lengths to analyze the potential impacts that would occur to the people and environment of the Fort Belknap Indian Reservation. No direct impacts would occur to Reservation or trust resources. Secondary impacts such as visual and aural would affect non-Reservation communities at Zortman and Landusky more than Hays or Lodgepole.

The Fort Belknap resident's concerns are not receiving less regulatory attention (a key environmental justice factor). EPA, DOJ, ATSDR, BIA, DEQ and BLM have all devoted substantial regulatory resources to address the mines' potential effects on Fort Belknap; and to providing the residents direct access to their agency representatives.

Considerable technical and legal resources are available to the residents of Fort Belknap for making their concerns about mining known and influencing the process (another environmental justice factor). Numerous substantive and detailed legal and technical comments have been received on the Draft EIS from both government and private parties on behalf of the Fort Belknap residents.

Any formula to establish what would constitute an *equitable distribution* of project risks and benefits would be highly subjective. However, there do not appear to be any overwhelming imbalances either way. The majority of economic benefits are directed away from the Reservation, though so are the potential environmental impacts. Past and present mine facility siting alternatives have been specifically included or excluded from consideration based on the need to <u>avoid</u> potential impacts to Native American communities or resources. The residents of Fort Belknap are at less risk than non-Fort Belknap residents living in Zortman or Landusky from possible environmental effects of the mines. However, the Native Americans are more susceptible to impacts affecting traditional cultural practices and heritage values than non-Native Americans. Of the benefits associated with mining, most of the jobs are held by individuals that live outside the Reservation. Conversely, the mine jobs held by those that live on the Reservation may have a more beneficial economic and social impact due to the lower average income on the Reservation.

27. COMMENT: The Indian people rely on both the surface and ground waters that have been, are, and will continue to be, affected by the mine. The Draft EIS admits that the proposed expansion will have serious, long term impacts on the residents of the Fort Belknap Indian Reservation. But the document lacks a thorough review of just how serious those impacts will be. (Illustrative is the fact that Indian lands very close to the Goslin Flats leach pad were excluded from the study area.) This seems entirely inconsistent with the government's professed concern for "environmental justice," especially for Indian people to whom a special trust obligation is owed by the United States. (361)

RESPONSE: As described in Section 1.6 of the Draft EIS "The EIS study area is best represented geographically by the Little Rocky Mountains...but may vary according to each individual environmental resource." No particular tract of land has been excluded from the study area. The study area is based on where the resources that would be affected are located. This could include the land you mentioned depending on which resources it contained that could be affected by the proposed action and alternatives.

28. COMMENT: The Traditional Cultural Property (TCP) has been treated as a mono-cultural topic. Truthfully, this area has many TCP to be considered. Ranchers, loggers, miners, and hunters all have TCP in this area. These mountains aren't mono-cultural, but they are treated as such. No one culture is any more important than another. To address the TCP in a mono-cultural tone is in itself a form of discrimination. (231, LA-4)

RESPONSE: Section 3.12.3 of the EIS provides an inventory of historic sites in the Little Rocky Mountains and the historic context for these sites. The Alder Gulch Historic District has been determined eligible for the National Register, the Beaver Creek Historic District may be eligible, and a number of other individual historic sites may be eligible as well. Whether or not any of these properties meet the criteria for a TCP has not been determined, but clearly the mountains are not mono-cultural. The historic themes associated with these sites are primarily mining, but sites associated with the historic themes of ranching, logging, and hunting may yet be discovered. The Programmatic Agreement requires documentation of historic/traditional associations of the Little Rocky Mountains. The studies are not limited to Native American TCPs.

29. COMMENT: The Cultural Resource section states Alternative 7 as a big negative to Fort Belknap Indian Reservation. I believe it should be low negative for the following reasons: a) the end of mining would bring rate increases of 35 to 40 percent to Big Flat Electric; this would affect all rural Power users especially low income families on Fort Belknap Indian Reservation since most have electric heat, and b) BIA is going to take a major budget cut in Congress this year, possibly 30 percent. This is going to severely affect the Fort Belknap Indian Reservation with their 75 percent unemployment. It seems incredible that the tribe wants to get rid of its largest private employer. (189, 210, 342)

RESPONSE: The high negative impacts to cultural resources mentioned in the Executive Summary on page ES-18 of the EIS are described and explained in some detail in Section 4.12 of the EIS. Although the impacts to prehistoric and historic cultural resources are low negative, the impacts to Native American cultural resources and the values associated with those resources are high negative. This reflects Native American concerns for their culture and religion as embodied in the landscape of the Little Rocky Mountains. Economic and social effects are described in Section 4.10 of the EIS.

30. COMMENT: I would like to know why the government will not test our [Fort Belknap] children. They say it costs billions of dollars to test our children. Pregnant women, little children and elders are the ones who are affected by the heavy metals, not the cyanide. The cyanide doesn't hurt anybody, but the heavy metals do. (LO-41)

RESPONSE: Of the drainages which have their headwaters in the mining areas, contamination has not been identified entering the Fort Belknap Indian Reservation. Metal levels in these streams do not pose a human health risk and testing of individuals for contamination related to the mining activity is not warranted. This has been verified through studies or monitoring events conducted by: the Agency for Toxic Substances and Disease Registry (ATSDR), Council of Energy Resource Tribes (CERT), BIA, BLM, DEQ, EPA, Fort Belknap Community Council, and the USGS. Outside the scope of the mining issue, there may be other reasons for the testing of individuals. Suspect plumbing, use of lead-based paints, or water supplies with naturally high metal content, may all be cause for close monitoring of public health conditions. Requests for an assessment of such conditions, and the conducting of any follow-up individual health testing that may be necessary, should be directed to the Fort Belknap government and the Bureau of Indian Affairs.

31. COMMENT: "Long termed ATSDR studies are needed to assess if there are no human health impacts to the general public on the reservation as stated. One year (1993) studies is insufficient to generalized a no negative impact. In fact, this is highly 'unscientific' for any author to state in a legal document." (348)

RESPONSE: Streams emanating from the mining areas leading onto the Reservation are monitored and have been studied for potential contaminants which might pose a threat to human health. Results show these streams do not contain contaminant levels that would pose a human health risk. This has been verified in studies or monitoring events conducted by: the Agency for Toxic Substances and Disease Registry (ATSDR), Council of Energy Resource Tribes (CERT), BIA, BLM, DEQ, EPA, Fort Belknap Community Council, and the USGS. The ATSDR study was not a one year study. It was a review of existing data from a variety of sources collected over many years, not a single year. It has not been determined that there are abnormal incidents of health ailments among those populations living in proximity to drainages leaving the mining areas. Should a higher frequency of health problems be identified in these communities, the studies and monitoring done to date would suggest that the mines are <u>not</u> the contaminant source. It would therefore be highly "unscientific" to require long term health studies trying to prove the negative (that mining is not causing a health risk), when it has not even been determined that the incidence of health problems are abnormal for the Fort Belknap population; and where the data does not show that the mines pose a health risk to this population.

32. COMMENT: In the Draft EIS on page 3-182, the lumping of information on aesthetics, health risks and economic effects under the heading of perception trivializes each of the topics, but most particularly health risk. A community's perception of health risk is not to be taken lightly. The EPA knows that it cannot minimize the importance of any community perceptions of health risk in its CERCLA/SARA and RCRA programs. The risks of litigation and political backlash are too great. As NEPA lead agencies, these same risks face BLM and DEQ. It is especially important that perceived health risk issues be fully and forthrightly addressed in an EIS--and not buried with discussions of aesthetics and economics. (350, 364)

RESPONSE: The intent of that heading on page 3-182 is not to trivialize the topic but to acknowledge, as you suggest, that the *perception* of a health risk has its own effect independent of what actual risk may exist. A discussion of the various evaluations done with respect to what real health risk may exist is presented in the Draft EIS on pages 3-74 and 3-79.

33. COMMENT: As stated on page 3-226 of the Draft EIS, we [EPA and others] understand that the Tribes of the Fort Belknap Indian Reservation are concerned that they may retain rights to other natural resources such as timber and water under the Grinnell Agreement of 1896. Will this issue be settled prior to approval of an expansion that will affect the Tribe's claim to these other natural resources? (337, HA-23, GF-11)

RESPONSE: All lands involved in the current or expanded mining project are either private lands, or public lands that are open to mineral entry and development under the Mining Laws. Resolving treaty disputes is outside the scope of the EIS process and should be pursued through formal discussion between the involved parties. The EIS analyzes and discloses impacts to those resources of concern to Native Americans such as wildlife, traditional use plants, timber, and water resources. However, evaluating whether those resources are covered by the Grinnell Agreement or any other treaty, or whether impacts to those resources violate specific treaty rights, is beyond the scope of the analysis. Should a mine Plan of Operations be approved it does not convey title or rights to any property or resources, and could not change any treaty rights.

34. COMMENT: "Why was the treaty agreement between the US Government and the Fort Belknap Indian Tribes not considered in the draft document. We [BIA] are requesting your office (BLM) to review the agreement made between these two nations prior to rendering a decision." (348)

RESPONSE: The Grinnell Agreement is discussed in Section 3.12.4.3 of the Draft EIS. However, the identification of environmental impacts in the EIS is based upon the affected resources and the location, magnitude, incidence and duration of the various mining project components. These factors of analysis exist independent of the Treaty. The Draft EIS analyzes and discloses impacts to those resources of concern such as wildlife, traditional use plants, timber, and water resources. However, evaluating whether those resources are covered by the Grinnell Agreement or any other treaty, or whether impacts to those resources violate specific treaty rights, is beyond the scope of the analysis. Should a mine Plan of Operations be approved it does not convey title or rights to any property or resources, and could not change any treaty rights. We have reviewed the treaty and do not feel it precludes us from selecting any of the alternatives contained in the EIS.

35. COMMENT: The comment cites several pages from Docket No. 279-C and 250-A of the Indian Claims

Commission to support the idea that the government knew about and supported mining (including trespass) in the Little Rocky Mountains from its beginning in 1884 to the present. Also that the government has not honored its obligation to protect the integrity of the Reservation. Conclusion: Defendant has clearly breached its obligation to preserve and protect plaintiffs' Reservation. Valuable resources have been removed from plaintiffs' lands, either to be used for defendant's own "non-trust" purposes or to enrich trespassing miners. The Reservation's waters and land have been polluted and its wildlife and vegetation have been destroyed. (181, 211, 344, 351, LO-12, LO-20, HA-31, GF-34)

RESPONSE: The lands included in the proposed mine expansions and alternatives are either private lands or public lands open to mining. No trust resources are involved in the mine activities. Resolution of trespass that occurred prior to the 1895 Treaty is beyond the scope of this EIS process.

36. COMMENT: The Draft EIS ignores the conflict between Federal permitting of the Zortman-Landusky expansion and Federal trust responsibilities to Indian people. The government has a responsibility to address Native American issues. It's the mandate of the agencies to protect the environment and community interests of all Montanans. This must be addressed in the EIS. (184, 320, HA-31)

RESPONSE: Native American issues have been addressed throughout both the Draft and the Final EIS. These issues are specifically addressed in the sections on Cultural Resources, Socioeconomics and in Appendix E. The BLM must honor its Trust responsibilities to Native Americans as well as protect the public lands from unnecessary or undue degradation from activities authorized by the Mining Laws. No trust lands are included in the project area, nor would any trust lands be significantly impacted by mine expansion. BLM's Trust responsibilities have therefore been honored through compliance with federal laws and regulations which are designed to protect the environment.

37. COMMENT: The Draft EIS correctly states that much concern has been expressed "about impacts to cultural resources resulting from mine actions." In response, agencies have included analyses of impacts to cultural resources as a result of noise, air quality, water resources degradation, and "modification of visual perspective." These are important considerations. But the most important, the literal transformation and outright removal of a landscape that is profoundly connected with Assiniboine and Gros Ventre people by mining, is being ignored. This continues to bias the analysis. It also ignores the conflict between Federal permitting of a Zortman-Landusky expansion and Federal trust responsibilities to Indian people. This must be addressed in the EIS. (11, 181, 211, 320, 344, 346, 351, LO-11, LO-12, LO-20, HA-23, HA-31, GF-34, GF-74)

RESPONSE: Section 4.12 of the EIS describes the methodology and results of the impact assessment for Native American cultural resources. This assessment incorporates "the transformation and outright removal of [some places in] a landscape that is profoundly connected with Assiniboine and Gros Ventre people, by mining." Federal trust responsibilities have been upheld in compliance with federal law and regulations.

38. COMMENT: The people residing on the Fort Belknap Indian Reservation are the most affected by the current operation, as well as proposed future activity and having a perspective born of experience should be given priority as affected citizens in this process. BLM and DEQ should act to address the concerns and comments of these people, since they are most impacted by the mine. The BLM and the state DEQ seem to pay little attention to the rights of Native American people who thus far have been the most notable victims of the existing mine operation, and will be those who are most directly, and adversely, impacted by the expansion. (328, 361, 363)

RESPONSE: The permit decision will be based upon the requirement to prevent *unnecessary or undue degradation* and to achieve successful reclamation as defined by the Montana Metal Mine Reclamation Act. The people residing in the communities of Zortman and Landusky are potentially more affected than the residents of Fort Belknap from possible impacts to water quality, noise, air quality and visual setting. However, no one group of people are given priority consideration in the permit decision. All substantive comments and concerns are considered and addressed in the Final EIS. The decision process is one of objective analysis where technical issues are identified, mitigation is developed and residual impacts are considered with respect to the regulatory performance criteria applicable to the project.

39. COMMENT: It is both interesting and unfortunate that the Draft EIS characterizes the social values of the Native American community using off-the-shelf ethnographies, plans, EISs, socioeconomic studies, and just three interviews with local residents. In addition, The EIS characterization of social values and perceptions of quality of life is not always accurate.

Aloof as members of the community may be to outsiders, the community is alive and accessible--it is not a long-dead historical artifact tucked away in an exotic, remote location. Nor, should it be treated as such when preparing a profile of its social values. Why were representative organizations--including community government and not-for-profit agencies--and individuals not asked in a culturally appropriate manner for input to provide a more immediate and personal accounting of the community's social values? Why were the public scoping efforts described in Section 1.7 not better used to measure and report community attitudes and values? The profile of the social values of the Fort Belknap Native American community should have included more input from representative individuals and organizations, including tribal government, non-profit groups, and project opposition groups such as Red Thunder, Inc., and Island Mountain Protectors. (342, 350, 364)

RESPONSE: The social assessment contained in the EIS has predicted and evaluated the effects of the proposed action and alternatives on social well-being and perception of quality of life within the Fort Belknap Native American community. Direct input was solicited by BLM and DEQ from tribal elders, traditionalists and political leaders; including project opposition groups such as Red Thunder, Island Mountain Protectors and the Spirit Mountain Cultural Clan. Over 50 individuals were interviewed for preparation of the ethnographic study alone. Four scoping meetings were held to identify issues for analysis in the EIS. Nine additional public meetings were held specific to obtaining input on identification and mitigation of cultural resources along with face to face discussions between BLM or contract archaeologists and Native American traditionalists. Views of Native Americans regarding mining are profiled in Chapter 3.0 of the EIS under both the Cultural and Socioeconomic sections. The analysis and evaluation contained in these sections considered information on existing published reports about attitudes and opinions held by the Fort Belknap Native American community, interviews with community representatives, existing economic and social conditions, and direct personal benefits and costs of the proposed action and alternatives. Considerable discussion of the impacts of mining with traditional cultural values and practices is included in the EIS. The highest level of impact has been assigned to these consequences of the proposed action. The effort devoted to the social assessment has been appropriate in scope and form. The information and analysis presented in the EIS is fundamentally accurate and provides enough understanding of the situation to support decision-making.

40. COMMENT: It seems that no one is protecting the American Indian point of view at Fort Belknap. These American Indian rights and voice has been over run every turn of the screw. (3)

RESPONSE: The Fort Belknap Community Council (FBCC) and a number of Assiniboine and Gros Ventre individuals have been consulted regarding the proposed mine expansions. The point of view of the FBCC along with that of other groups and individuals from Fort Belknap has been expressed through written and verbal comments during the public scoping and comment periods and during development of the Programmatic Agreement. The FBCC declined the opportunity to be signators to the Programmatic Agreement (Appendix E).

41. COMMENT: ZMI has not seen the Strahn study cited on page 3-209 (Section 3.10.5.8) of the Draft EIS, but he concludes opposition to mining on the Fort Belknap Indian Reservation is a majority opinion. Based on comments heard from Native Americans at the public meetings in Lodgepole and Hays in September 1995, this conclusion was not necessarily supported. Many Native Americans spoke in favor of the mine for economic reasons. Additionally, the Fort Belknap Community Council was soliciting mining companies to do exploration on the reservation in 1989. While the incumbent Community Council is not requesting exploration at this time, it does point out Native American attitudes towards mining are diverse. (189, 210, 342)

RESPONSE: The assessment is based on a recent vote on the Reservation over whether to allow mineral exploration on tribal lands. This initiative was defeated. Native American attitudes toward mining are diverse, however, at this time it appears the majority is opposed to the activity on tribal lands.

42. COMMENT: Starting about 1986, indications of developing acid mine drainage were showing up in water tests. Unfortunately, no one at the agency, State Hard Rock Bureau or BLM, read the tests, or perhaps they didn't understand them or they ignored them. This was error with a massive impact on the Native American people and the Little Rocky Mountains. (GF-2)

RESPONSE: Prior to 1990 acid rock drainage (ARD) was thought to be confined to several specific drainages such as Ruby Gulch and Mill Gulch. Rock characterization tests conducted during 1990 identified only minor potential for this to become a significant issue and mitigation was included in the mine plans. During the completeness review for the proposed

Zortman Mine Expansion Application in 1992, ARD was recognized as a much more widespread concern. In response the agencies ordered that modifications to both the Zortman and Landusky mining and reclamation plans be submitted by ZMI. Those modifications, and associated alternative measures, are one of the subjects of this EIS. While the impacts of ARD to date are significant and must be corrected they are not considered "massive." There have been no impacts to domestic water supplies, fisheries have not been degraded, impacts are confined mostly to within the mine permit boundaries, and impacts do not extend downstream onto the Fort Belknap Indian Reservation. Interim and final improvements in reclamation and water management plans would address existing and future impacts associated with ARD.

43. COMMENT: "The State of Montana has not adjudicated its water rights with the Fort Belknap Tribes. Therefore, in our [BIA] opinion as trustee for the tribes, the State cannot issue a water right decree to ZMI for its proposed mining operations." (348)

RESPONSE: Adjudicating water rights is outside the scope of the EIS process for this action. The EIS does assess potential impacts to water quantity under the various alternatives. However, whether the impact to water quantity violates specific water rights is outside the scope of the agencies' jurisdiction to determine. Should an amended Operating Permit or Plan of Operations be approved it does not negate the legal requirement for ZMI to obtain water rights necessary for water use. The current groundwater appropriation issued by the Montana Department of Natural Resources to ZMI is reportedly adequate for the 190 gpm average water consumption required by the proposed mine expansion.

44. COMMENT: On page 2-47 of the Draft EIS, did the interim drainages that were constructed for the purpose of rerouting the runoff around the mine facilities receive prior approval from the permitting agencies, i.e., US Army Corps of Engineers, etc., and are some of those drainages draining to Fort Belknap Indian Reservation rerouted? If some were rerouted, we [BIA] need to discuss possible damages caused by your action, i.e., monetary loss from the use of surface and subsurface runoff by downstream water users on the reservation, and also the infringement of water rights to the tribal government. This includes drainage draining to Turtle Mountain trustlands. (348)

RESPONSE: The subject interim drainages are shown on Figure 2.5-3 in the Draft EIS. These were constructed in the area where surface runoff already reports to drainages that flow to the south, away from the Fort Belknap Indian Reservation. These diversions were constructed with the concurrence of the BLM and DEQ to keep storm runoff from flowing into the mine facilities and possibly becoming contaminated, and not to appropriate water for use in mining. Permits from the Corps of Engineers were not necessary for these constructions. Impacts to water quantity are discussed in the EIS. No impacts to water availability in drainages that flow to the north have been identified from these interim diversions. Any discussion of possible damages or monetary loss should be undertaken with the operator.

45. COMMENT: "Any surface water diversion undertaken by ZMI, BLM or MT-DSL will need our (BIA) review to ensure tribal waters are not taken without tribal approval for the proposed action." (348)

RESPONSE: BLM and the State of Montana are not the proponents of this project and have no plans to initiate any surface water diversions. Should an amended Operating Permit or Plan of Operations be approved it does not negate any legal requirement for ZMI to obtain appropriate water rights for water use. It is our understanding that the current groundwater appropriation issued by the Montana Department of Natural Resources to ZMI would be adequate for the 190 gpm average water consumption required by the proposed mine expansion. The EIS, operator's proposed Federal Plan of Operations, State Operating Permit Application and other supporting material continue to be available to BIA for review.

46. COMMENT: The Draft EIS does not adequately discuss impacts to water quantity to the north, especially in light of the Tribe's Reserved Water Rights. The Draft EIS admits that the mine currently diverts water from the Reservation. (3-110). The Tribe has aboriginal (United States v. Adair, 723 F.2d 1394, 1414 (9th Cir. 1983), cert. *denied*, 450 U.S. 1015 (1983)) and reserved rights to these waters. Winters v. United States, 207 U.S. 564 (1908). The Draft EIS acknowledges the reserved rights (see page 3-102). However, it fails to acknowledge that the tribes are already suing ZMI for degrading their water rights. It merely states that there is "little useful information" as to the extent mining has impacted surface water flows of the Little Rocky Mountains because the data has been "irregular and often estimated" (page 3-102). (340, 361)

RESPONSE: Page 3-102 of the Draft EIS acknowledges that surface water flow and spring discharge to the north of the Landusky mining operation would have decreased when the August and Gold Bug Adits were completed in the 1960's, prior to ZMI's operations. On page 4-36 the Draft EIS discusses the impacts on surface flow caused by the mine pits diverting surface flow from the Lodgepole and King Creek drainages. Impacts to Lodgepole Creek are not considered significant and impacts to King Creek are considered significant above its' confluence with South Big Horn Creek. Alternatives 5 and 7 required post-reclamation runoff from the pit areas to be routed into King Creek to address the presently diminished flows. This design feature received no support and has been dropped from the preferred alternative. Impact discussions on water quantity are carried through for all the alternatives. However, adjudicating water rights is outside the scope of the EIS process. Acknowledging the lawsuit does not change either the impacts assessment in the EIS nor the merits of the suit itself. Should an amended Operating Permit or Plan of Operations be approved it does not negate the legal requirement for ZMI to obtain appropriate water rights for water use.

47. COMMENT: The Winters Doctrines of 1908 says all water arising upon, flowing through or adjoining the Fort Belknap Indian Reservation belonged to the Native Americans of the Fort Belknap Indian Reservation. The BLM, as a part of the federal government directed by congress, have a trust responsibility to protect and preserve the trust of the native peoples that the BLM are responsible for protecting, and the aboriginal water rights. (181, 211, 244, 352, L0-12, L0-20, HA-31, GF-34)

RESPONSE: Significant impacts caused by existing or expanded mining operation on the amount of water entering the Fort Belknap Indian Reservation have not been identified. The BLM and DEQ would not be conveying any water rights to ZMI should an amended Operating Permit or Plan of Operations be approved. Such an approval does not negate the legal requirement for ZMI to obtain appropriate water rights for water use.

48. COMMENT: "Page 242; We [BIA] are requesting your office (BLM) to develop a 'Hydrologic Budget for the Little Rocky Mountains' and determine what amount of the water budget is being withdrawn by ZMI on an annual basis. We are receiving numerous complaints from the tribal members around the foothills of the Little Rocky Mountains that their streams and creeks are drying up, that they don't run year around anymore, they are blaming ZMI for the loss of their waters. Please submit your findings to my office as soon as possible as the information will be forward to the Solicitor's office for their review to determine if tribal water rights are not being affected by ZMI." (348)

RESPONSE: BIA requests for assistance from BLM should be made outside of the EIS comment-response forum. The Draft and Final EIS contains the BLM and DEQ assessment of the effect that ZMI is having, or would have under the various alternatives, to available water quantity. Significant impacts to water quantity extending downstream as far as the Reservation have not been identified.

49. COMMENT: "The Zortman and Landusky mine expansion will pollute the remaining lands of the Gros Ventre and Assiniboine people." (184)

RESPONSE: The mine expansion activities would not occur on lands belonging to the Gros Ventre or Assiniboine people. Of the 772 acres that would be disturbed by expansion under the preferred alternative, 67 acres of that disturbance would occur in a drainage (Lodgepole Creek) which enters the Reservation lands; but not for some 3-miles distant where monitoring and contingency measures would be employed to prevent contamination from entering the Reservation. The preferred alternative has been modified so that all run-off is routed away from drainages that flow onto the Reservation. The limestone quarries have been relocated so disturbance would not occur in watersheds which include Reservation lands.

50. COMMENT: "The Native American cultural resources inventory of the Draft EIS did not enlist the assistance of tribal elders, spiritual leaders, on frequency of use of religious and cultural practices and location of cultural sites. According to 40 CFR 1508.14 of NEPA regulations, 'When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.' The Draft EIS woefully fails to comply with this requirement by not integrating analysis of cultural and religious impact with the physical impact of the mine proposal, nor does it discuss why further study of cultural and religious impacts is not warranted. The level of study of cultural resources is not proportionate with the significance of the irreversible destruction that will be caused by mine expansion." (340, 343, 344, 351, 353)

RESPONSE: Input on traditional cultural values, significance, and use was solicited and received from tribal elders, traditionalists and political leaders. Public meetings were held specific to identification and mitigation of cultural concerns. Considerable discussion of the impacts of mining with traditional cultural values and practices is included in the EIS. The highest level of impact was assigned to these consequences of mining. As such, it is extremely unlikely that additional studies would increase the impact level assigned to the proposed action or change the analysis of the alternatives. Provisions for the preservation of knowledge about the traditional and historic values of the Little Rocky Mountains are contained in the Programmatic Agreement in Appendix E.

51. COMMENT: On page 3-233 of the Draft EIS, it is noted that anthropologists believe that further study is needed to adequately identify culturally significant sites. In the same paragraph, however, the Draft EIS states that the current inventory "is adequate for the present analysis and assessment." Will this apparent discrepancy be resolved? (41, 337, 340, 344, 351, 352, 356, LO-39)

RESPONSE: The paragraph cited refers specifically to the establishment of boundaries as follows: "Deaver and Kooistra note on their confidential map of several vision questing and other sacred areas that, 'Boundaries are indeterminate at this point in time. Further survey and consultation is needed to determine boundaries' (ZMI Permit Application, Appendix 17). Still, the inventory represents the kinds of sites and associated values present within the Little Rocky Mountains and is adequate for the present analysis and assessment." The entire Zortman/Landusky project area is contained within the working boundaries of the TCP District and mitigation was developed under that assumption. Though additional studies of cultural sites in the Little Rocky Mountains might enhance the analysis and assessment, it is highly unlikely that such a study would provide additional data of a type that would change the impact assessment, influence the selection among alternatives or result in better mitigation. Areas potentially disturbed by any of the alternatives have been inventoried and all sites in these areas have been evaluated. The Programmatic Agreement in Appendix E includes a Treatment Plan which provides for mitigation to document and preserve the historical/traditional associations of the Little Rocky Mountains.

52. COMMENT: "Clearly, the cultural significance of the Little Rocky Mountains has not been, and cannot be, thoroughly documented without the full cooperation of those groups of individuals who have been traditionally associated with these mountains...Therefore, if the Bureau of Land Management is serious about mitigating the impacts to Traditional Cultural Properties in the Little Rocky Mountains, no mineral expansion should be permitted to take place until an accurate assessment of the area's cultural importance can be completed." In the meantime, possible compromise solutions, such as visual screening, regularly-timed blasting intervals, or the elimination of night lighting during certain times of the year, should also be thoughtfully developed and presented. (41, 337, 340, 344, 351, 352, 356, LO-39)

RESPONSE: Direct input was solicited by BLM from tribal elders, traditionalists and political leaders; including project opposition groups such as Red Thunder, Island Mountain Protectors and the Spirit Mountain Cultural Clan. Four scoping meetings were held to identify issues for analysis in the EIS. Nine additional public meetings were held specific to obtaining input on identification and mitigation of cultural resources along with face to face discussions between BLM or contract archaeologists and Native American traditionalists. Though additional information might enhance the analysis and assessment, it is highly unlikely that further study would provide additional data of a type that would change the impact assessment, influence the selection among alternatives or result in better mitigation.

53. COMMENT: Cultural, historic, and ethnographic studies and reviews have been insufficient to date. A lack of information is admitted in the Draft EIS but the problem is ignored. Proper measures to correct this should include meaningful participation of local Native American people. (11, 181, 211, 320, 340, 344, 346, 351, LO-8, HA-23)

RESPONSE: Section 3.12 of the EIS documents the importance of the Little Rocky Mountains to the local Native American people. Section 4.12 of the EIS describes the methodology and results of the impact assessment for Native American cultural resources. Native American views have been solicited throughout the studies by numerous interviews and public meetings. The Programmatic Agreement appended to the Final EIS provides funding for mitigation of historical/traditional associations of the Little Rocky Mountains, if Alternative 4, 5, 6, or 7 is selected, through study and recordation.

54. COMMENT: The Draft EIS is inadequate in its evaluation of cultural resources. The Draft EIS states on page 3-225 that the agencies conducted no systematic interviewing of Fort Belknap Gros Ventre and Assiniboine residents, and no site visits were undertaken. The only preparer listed for this Draft EIS who focused on Native American cultural resources is Professor Clyde Woods of Evergreen, Colorado. Throughout the review process for this expansion, tribal members requested the opportunity to complete a comprehensive cultural resource inventory of the Little Rocky

Mountains, with particular attention to areas that would be impacted by proposed mine expansion. The tribes proposed that this inventory be completed by tribal elders, who are best able to identify cultural resources and sites, and determine their significance and function. The agencies rejected this request and hired Professor Woods to perform the cultural resource inventory. Professor Woods spent April 15-17 in the area, and according to tribal members, he spoke primarily with members of the Treaty Commission, who are not cultural traditionalists. (181, 320, 340, 344, 351, 353, LO-8, HA-23)

RESPONSE: Dr. Clyde Woods was retained to prepare the Native American component of the EIS from existing information, not to "perform the cultural resources inventory." The inventory was developed from an ethnographic study of the Little Rocky Mountains conducted by Deaver and Kooistra (1992) and other published and unpublished sources available for the study area. As described in Section 3.12.4.1 of the EIS, "The Deaver and Kooistra study (1992) included a cultural resources file search at the Montana State Historic Preservation Office (SHPO). Appropriate BLM and BIA reports were consulted as well. An extensive review of ethnographic, ethnohistoric, historic and other relevant literature for the study area was completed. Interviews with 54 Native Americans and other knowledgeable individuals were undertaken, with some interviews involving field reconnaissance." Individuals at Fort Belknap have commented that they would like to do their own study. However, the Tribes (Fort Belknap Community Council) have never proposed such a study, nor did the agencies reject such a study.

55. COMMENT: The Draft EIS also cites Rubelmann's 1983 hypothesis that island mountain ranges of north-central Montana were used "only on a seasonal basis by the native prehistoric inhabitants." Taken out of context, this statement suggests that the Little Rocky Mountains were of marginal significance in the seasonal cycle of prehistoric groups. It is important to note that at the time of Rubelmann's report very few of these island mountain areas in north-central Montana (conservatively, less than 3% of the upland mountain land areas) were systematically surveyed for cultural resources. At the same time, large tracts of land on the north-central Montana plains and river bottoms had been systematically surveyed for cultural resources under the requirements of the National Historic Preservation Act. Clearly, Rubelmann's statement was conjecture based on incomplete evidence. (341)

RESPONSE: The entire life cycle of most native prehistoric inhabitants of north-central Montana was based on utilizing resources across the region as they were available on a seasonal basis. The evidence collected from recent surveys (Rossillion 1993 and Munson 1994) seems to support this (Ruebelmann 1983) hypothesis, as no permanent or large habitation sites were recorded (see Section 3.12.2.3 of the Draft EIS). This in no way belittles or marginalizes the importance of the resources in the Little Rocky Mountains or their use by American Indians for specific purposes at certain times of the year.

56. COMMENT: Clearly, the best and most complete source of information about the traditional cultural value of the Little Rocky Mountains lies within the Fort Belknap community and among surrounding Native American groups. I support the desire of the Fort Belknap Community to conduct their own cultural resource study and their contention that the entire Little Rocky Mountains should be the focus of consideration. Clearly some of the spiritual values of the region have been diminished by past and modern mining activity, but a complete and thorough understanding of the initial cultural values of the Little Rocky Mountains and the impact of development on those values has not been achieved through the various ethnographic and archaeological studies. This is demonstrated by the statement of Deaver and Kooistra that "Boundaries are indeterminate at this point in time. Further survey and consultation is needed to determine boundaries" (Draft EIS page 3-233). (233, 340, 341)

RESPONSE: The refinement of boundaries is not necessary to assess effects and develop appropriate mitigation. The entire mining project area is assumed to lie within the Traditional Cultural Property (TCP) and mitigation has been developed accordingly. This is presented in Appendix E of the Final EIS. The type of resource values under consideration do not lend themselves to specific boundary determination. Aspects such as spiritual values are all encompassing and cannot be defined within a set boundary.

57. COMMENT: The Draft EIS fails to disclose that the SHPO found that proper assessment requires a comprehensive study. Instead, the Draft EIS relies upon a study based on "comments made by Native Americans at Fort Belknap during and after the public meetings at Lodgepole, the writer's considerable experience with similar kinds of analyses and . . . the fact that most of the inventoried sites are of a spiritual or religious nature." Draft EIS at 4-268. This violates NEPA's mandate that the agency obtain all relevant information regarding significant impacts, unless the agency can demonstrate that the costs of obtaining the information are "exorbitant." 40 CFR § 1502.22. (340, 344, 351, 353)

RESPONSE: The SHPO concurred in the methods and findings through signing the Programmatic Agreement in Appendix E of the Final EIS. Further, adequate information regarding significant impacts was obtained as shown in Table 4.12-1. The identification efforts were much more extensive than cited in the comment. Over 50 individuals were interviewed. An ethnographic study was prepared. A Class III on the ground inventory was undertaken of all proposed disturbance areas. Nine public meetings specific to cultural resources were held. A reasonable and good faith effort has been made to solicit input on cultural resources from Native American traditionalists and political leaders. NEPA does not require exhaustive, all inclusive data collection nor does the EIS present it as such.

58. COMMENT: The Draft EIS notes that "studies have been conducted in the Zortman and Landusky vicinity" to locate, record and evaluate archaeological, historic and ethnographic resources only in the immediate area of the proposed mining expansion. This blatant disregard of traditional cultural perspectives seems to indicate one of two things: either the Bureau of Land Management has had insufficient contact with tribal peoples in assessing the overall impacts in the Little Rocky Mountains; or, worse, alternatives to mineral expansion in the Little Rocky Mountains have never been seriously considered by the BLM. (356)

RESPONSE: The scope of the studies that were conducted varied with anticipated resource that could be impacted. Surveys for archaeological and historic sites were conducted in areas of potential direct impact. Inventory methodology is discussed in Section 3.12. Note also in Section 3.12.4.1 a discussion of how the Traditional Cultural Property (TCP) study by Deaver and Kooistra (1992) was expanded to include most of the Little Rocky Mountains. See also Table 3.12-3 for a selected inventory of Native American sites, and note that some sites are on reservation land. The Alternatives 1, 2, and 3 are "no expansion" alternatives. The Programmatic Agreement provides funding for preservation through recordation of traditional cultural values found in the entire TCP district.

59. COMMENT: My name is Paul English. I have been the archaeological representative for both Red Thunder and the Spirit Mountain Cultural Clan. I've been at this business for probably five years in the Little Rocky Mountains. My people on the Spirit Mountain Cultural Clan asked me to bring up the things they want assured will be covered in this EIS as good as possible. Recently Mr. Ryan made a statement about what a great ethnological research was done and paid for by them was just a drop in the bucket. I was with the representative. I know what was done. It was just enough to fill the book out and say we did it and go. This is their religion; this is their church. We've got to have a better program going than what we've had in the past. (41, 337, 340, 344, 351, 352, 356, LO-39)

RESPONSE: All areas potentially subjected to direct impact have been surveyed for archaeological sites, both historic and prehistoric. This includes identification of Traditional Cultural Properties. Legally required consultation concerning site significance, impacts and mitigation has been conducted (see the Programmatic Agreement in Appendix E).

60. COMMENT: The Draft EIS is premature because of lack of sufficient information on traditional cultural properties and sacred sites used by Tribal practitioners in the mining area. (352)

RESPONSE: Section 4.12 of the EIS describes the methodology and results of the impact assessment for Native American cultural resources. Input was solicited and received from tribal elders, traditionalists, and political leaders. Over 50 individuals were interviewed to prepare the ethnographic study. Nine public meetings were held specific to identification and mitigation of traditional cultural resources. Six of these meetings were on the Reservation and the other three were in close proximity. In addition, many one-on-one discussions between consulting or BLM archaeologists and Native American traditionalists were conducted. Often this included field visits to sites/areas of cultural significance. No specific sites of religious significance would be directly impacted by the proposed expansion. BLM has extended numerous offers for consultation, and solicited specific input from Native Americans, on suggestions for mitigation of impacts to traditional cultural locations and practices. The agencies have made a reasonable and good faith effort to obtain this information. Considerable discussion on the impacts of mining to traditional cultural values and practices is included in the EIS. The highest level of significance has been assigned to these impacts. No mitigation is viewed as acceptable by the Native Americans. Attempts by BLM and staff from the Advisory Council on Historic Preservation to ask for suggestions as to "what would make the totally unacceptable even slightly less unacceptable" have received only minimal response. The one suggestion that was received involves the recordation and preservation of knowledge on traditional plant use. Provisions for the preservation of knowledge on traditional plant use through documentation, and on other traditional cultural resource topics, is contained in the Programmatic Agreement in Appendix E.

61. COMMENT: My name is Virgil McConnell. These mountains were sacred to our people long before my time, your time, or anybody's that's in this room. They were always sacred to the Indian people. Every rock, every blade of grass, every tree, every drop of water up there is sacred to us. This is the way we'd like to keep our mountains.

The Little Rocky Mountains are named by the white man. The Indian people called these the Isle Mountains; the Blackfeet and the Gros Ventre call them the Furcap Mountains. Every peak in the mountain has a white man name, and it's kind of discouraging to all of us. We're cultural people. We have gone to the mountains time and again to fast. I can't go up there anymore to fast because of the mines. There's nowhere you can go in the Little Rocky Mountains that you don't hear the back-up whistles and the blasting and stuff like this. It isn't every day you hear this, but it's hard for people to go up there now to do any fasting or anything.

The BLM, the state, the BIA, the mining company, they've all done their studies of the mountains, so it's our turn now. This is what we're doing right now; and when we're through, you're going to be surprised at what we found, it's something that all the white people have overlooked, a lot of things up there. This is what I'm asking the BLM, the state, whoever I can, to give us an extension on our time to doing the study of the mountain. At first I said it will take two years. We've been on it a year and we haven't even touched the tip of the iceberg. I would say it will take closer to four years to do this study. We found villages where our people lived thousands of years ago. These things are all coming out now. And no, we're not going to let anyone see any of our study until we're through, and the reason for this is destruction of the sites.

There's been a lot of Indian graves in the mountains that have been destroyed. I'm not blaming the miners. Maybe it's their own people who done it, we don't know, but somebody has destroyed these graves. A lot of the people ask me what we found; I can't tell them.

Our sacred plants in the mountains, these are the things that we work with. I know an old man that is an old Assiniboine, they threw him in jail one time because they told him he was using medicine without a license, and I'm scared that's what will happen to me, but we do have an awful lot of medicines that are good, maybe some day the white man will get them, I don't know. Our medicines come from mother earth; they're pure; we don't mix them with anything. So I'd like a little more time for the study, and to do a real thorough plant study of the Little Rocky Mountains. It's hard because a lot of our plants are actually disappearing.

When Deaver did their study, I went with her and she asked me what we'd lose in the way of medicines, I stood in one spot at Bear Gulch and I pointed out seven to her. This didn't come out in her report, nothing like that, nothing I told her did. (39, 41, 344, LO-39, LO-43, GF-13)

RESPONSE: An extensive review of ethnographic, ethnohistoric, historic and other relevant literature for the study area was completed. Interviews with 54 Native Americans and other knowledgeable individuals were undertaken, with some interviews involving field reconnaissance. Deaver and Kooistra (1992) indicate on Table 2.5 (page 2.29) that V. McConnell was interviewed three times for their Ethnographic Overview of the Little Rocky Mountains. V. McConnell is cited 18 times regarding the location of cultural sites on Table 2.6 (page 2.36) and 21 times regarding the identification of plants, animals, and mineral resources on Table 2.7 (page 2.40).

While we believe the existing inventories are adequate for purposes of impact analysis, alternative development and mitigation plan preparation, any new information regarding additional cultural resources present in the area of potential effect should be provided to the BLM as soon as it is available. This information would be kept confidential in order to protect resources from possible vandalism.

62. COMMENT: The regulations under MEPA direct the agencies to discuss the impacts of a proposed action in a level of detail that is proportionate to their significance. A.R.M. Section 26.2.648(2). Given the number of tribal members, and the substantial negative effect the expansion will have on them, the level of study of cultural resources is clearly inadequate. The agencies state throughout the Draft EIS that information is not available regarding frequency of use of religious and cultural practices and location of cultural sites, and that the cumulative effect and significance of impact is unknown. Draft EIS at 4-280. The Draft EIS does not indicate any reason why further study to determine the extent of these impacts is not warranted. (41, 337, 340, 344, 351, 356, 357, LO-39)

RESPONSE: Considerable discussion on the impacts of mining with traditional cultural values and practices is included in the EIS. The highest level of impact rating has been assigned to these conflicts.

The statement from the Draft EIS regarding cumulative impacts being "not known" when read in context is specific to past impacts to prehistoric and historic sites. This is because in the early history of mining (late 1800s-1960s) there was no requirement for inventory of cultural resources. Consequently, if cultural sites were present in these areas, they were lost without recordation during historic mining. However, on the same page of the Draft EIS (4-280) the cumulative impacts to Native American cultural resources are acknowledged as "100 plus years of significant disruption to...traditional cultural practices in portions of the Little Rocky Mountains."

63. COMMENT: "[In] the view [of] those who cherish and utilize these cultural resources the most, the potential effects of the proposed mining expansion cannot and should not be limited simply to the Goslin Flats area, but must take into consideration the cumulative impacts to the broader cultural context in question." (356)

RESPONSE: The analysis does not limit its discussion of either impacts or mitigation to just the Goslin Flats area. Indirect (visual and aural) effects beyond the area of physical disturbance are factors used in the assessment of impacts to the various locations of traditional cultural importance (see Section 4.12.1).

64. COMMENT: Page #ES-1 (Purpose and Need): Baseline for this analysis is circa 1979 which marks the beginning of modern, large-scale mining in the Little Rocky Mountains. Earlier baseline is used when discussing specific historic mining disturbances such as the Ruby Gulch tailing. This "section" is grossly insufficient to explain and support the Native American view-point and objection to mining activities associated with the Island Mountains (Little Rocky Mountains) which are so near and dear to the hearts, minds, and well being of the Assiniboine, Gros Ventre and other Tribes. (181, 320, 340, 344, LO-8, HA-23)

RESPONSE: Section 3.12.4 provides an assessment of Native American cultural resources along with associated values and concerns for these resources and the Little Rocky Mountains Traditional Cultural Property.

65. COMMENT: An equal number of the public, many of them Indian people living in the shadow of the Zortman and Landusky mines, spoke of "community security" as well but in a far deeper way. More to the point, they spoke of community security being severely harmed by the mining. Assiniboine and Gros Ventre identity as a community, as a people, was articulated very clearly many times as being profoundly connected with a small mountain range which, from the Indian perspective, is being destroyed. This concept has been neglected in the Draft EIS and yet it is the crux of the entire issue.

What will continued and expanded mining in the Little Rocky Mountains mean to the culture and well being of Assiniboine and Gros Ventre people?

The Draft EIS must recognize that, to Indian people, the impacts of open pit cyanide heap leach gold mining cannot be "mitigated." Analyzing noise and air pollution and alteration of "visual perspective" is not enough. Those concerns, while important, sidestep the main issue. To Indian people mountains to which they are profoundly connected as a people are being destroyed. From what I heard at the hearings, talk of "reclamation" with an open pit cyanide leach mine is a farce to many Indian people and to much of the larger population as well. You can not reclaim something that is no longer there. (181, 320, 341, LO-11, GF-74)

RESPONSE: Section 3.12 of the EIS documents the importance of the Little Rocky Mountains to the Assiniboine, Gros Ventre, and other Native Americans. This is done through the identification of spiritual, cultural, and gathering locations throughout the mountains and by a review of the literature which describes the importance of the "island mountains" and their resources to the history and culture of the people. See in particular Sections 3.12.3.4, 3.12.4.4, 3.12.4.5, and 3.12.4.6. Clearly, some mining-related impacts cannot be mitigated, and this is not uncommon for Native American sites, particularly those of high cultural and spiritual significance. In Section 4.12 of the EIS, the terms irretrievable and irreversible effects of mining are used in the impact assessment for each alternative. These effects are clearly more evident for the expansion alternatives.

66. COMMENT: The Draft EIS is deficient because it does not explore what impact the loss of significant cultural use sites will have on the cultural identity, traditional activities, group cohesiveness and long term stability of the Assiniboine and Gros Ventre people on the Fort Belknap Indian Reservation.

What will the long-term social and cultural consequences be to the Fort Belknap community from the accelerated loss and destruction of the Little Rocky Mountains? How will it effect the efforts on the reservation to improve the quality of life for present and future generations of Assiniboine and Gros Ventre people through a revival of cultural practices and reconnection with sacred sites on and near the reservation? (181, 320, 341, LO-11, GF-74)

RESPONSE: Section 3.12 of the EIS documents the importance of the Little Rocky Mountains to the Assiniboine, Gros Ventre, and other Native Americans. This is done through the identification of spiritual, cultural, and gathering locations throughout the mountains and by a review of the literature which describes the importance of the "island mountains" and their resources to the history and culture of the people (see in particular Sections 3.12.3.4, 3.12.4.4, 3.12.4.5, and 3.12.4.6). As indicated in the Draft EIS, impacts are considered negative and high under all alternatives. However, projections of individual social and cultural consequences directly attributable to mining in the Little Rocky Mountains would be conjectural at best.

67. COMMENT: Will the restricted public access further impede the Indian use of the land and was an accurate assessment of the sites ever made? (3)

RESPONSE: Please see Figure 3.7-1 recreation and land ownership which has been added to Section 3.7. Restricted public access under any of the alternatives should not impede Native American use of the land any more than it has during past mining operations. An assessment of Native American sites is provided in Section 3.12.4 of the EIS. Current access restrictions, and new access restrictions that would occur with the proposed action are discussed in Sections 4.7.2 and 4.7.6 of the EIS. Since 1979 there has been a loss of access to areas that were previously accessed by the Zortman/Landusky county road over Antoine Butte. Under the proposed action or preferred alternative the overland conveyor, which would carry ore from the mine to the heap leach pad, and the Goslin Flats heap leach pad, would restrict access to Goslin Gulch. Access would be maintained into Pony Gulch.

68. COMMENT: Within the Environmental Consequences section, Alternative 3, cultural resources are addressed. The following portion of the discussion seems contradictory. "Alternative 3 has the least impact to cultural resources of all the alternatives considered with an overall low negative impact ranking. Alternative 3 does represent a high and negative impact to the cultural resources of the area because of the existing disturbance." Table ES-3 also rates Alternative 3 as low negative. Do these statements mean that <u>relatively</u> Alternative 3 is least detrimental, but it is still detrimental? (11, 211, 320, 344, 346, 351, HA-23)

RESPONSE: Impacts to cultural resources have been ongoing since mining began in the Little Rocky Mountains and continue into the present. As such, Alternative 3 is, as you suggest, relatively the least detrimental of the alternatives, but impacts are expected to continue under any of the alternatives.

69. COMMENT: Medicines and Sacred Herbs. All plants & herbs in the Little Rocky Mountains are sacred to all Indians, not only the people from Fort Belknap. Each plant we use has its own individual use, also some have a high a 154 uses, some have only 1 use some have more. A few can be mixed for other uses but most have their own individual uses. And again to do this study it would be for our own people to give permission to be used by other cultures such as Black, Hispanic, White, Japanese, & Chinese. I would have to go talk to the other medicine people & elders. but mostly the elders. In order for the other nationalities to be able to get the medicines they would have to live with the people that have these medicines, such as cancer medicines. There are 7 different herbs that go into cancer medicine.

Each one of these medicines is held by an elder, who has fasted for the use of it. In order to get even one of these medicines you would have to live with this individual for at least 1 week to one month or longer with the understanding that these medicines would not be misused or played with. Also these medicines should not be taken to any lab and analyzed, as this would be considered playing with them, and the medicine would not work anyway. Our medicines should have studies on them, as well as videos. Until we can do this we will not give out any information on the medicines. The only time you could get these are in the summer months. They are only beginning to come up in June. By then you could tell them all apart from one another. Each one has different leaves and textures.

Cultural Resources. Cultural sites on & around the Fort Belknap Indian Reservation need more study, we need additional time to complete them. We have done some studies on the reservation from the Little Rocky Mountains to the Milk River. Then we went west as far as the Bears Paw Mountains, to the Missouri River. However, more study is needed. The biggest reason we do not want to tell people about these sites is because of vandalism and destruction of these sites. The pictographs on Snake Butte are being defaced & chipped out by people. The people are unknown. We do not want anyone to know where these sites are located. The reason for this is the destruction that has occurred previously. I am totally against any and all mining. (39, 41, 337, 340, 344, 351, 352, 356, LO-39, LO-43, GF-13)

RESPONSE: Native American use of plants and herbs gathered in the Little Rocky Mountains and surrounding areas is addressed in Section 3.12.4.3 and Table 3.12-2 of the EIS. The Programmatic Agreement (Appendix E) includes preservation through recordation of historic/traditional associations such as medicinal plant use in the Little Rocky Mountains if Alternative 4, 5, 6, or 7 is selected.

70. COMMENT: The Draft EIS admits on pages 4-268 and 4-280 that the entire Little Rocky Mountains area "should be assigned a high level of heritage significance" to the tribes, and the preferred alternative would "increase overall impact levels" to Native American cultural resources. Under the proposed alternative, "The cumulative impact is approximately 100 plus years of significant disruption to Native American cultural resources in portions of the Little Rocky Mountains" (Draft EIS page 4-280). These include impacts to at least 42 discrete ethnographic sites, including vision quest sites, rock art sites, burial grounds, medicine springs, sweat lodges, Sundance sites, plant gathering sites, and a Pow Wow grounds (Draft EIS pages 4-271 to 4-272). Existing "physical, visual, and aural impacts" from both the Zortman and Landusky mines to these cultural sites "are all high, yielding an overall impact assessment of high" (Draft EIS page 4-270). The Draft EIS admits that "as long as the mines continue to operate, these impacts remain a significant and serious issue for Native American Traditionalists" (Draft EIS page 4-270). The no-expansion alternatives "represent the least amount of time" for transition back to Native American use of traditional cultural areas (Draft EIS page 4-275).

Yet the Draft EIS admits on pages 4-268 and 4-269 that "no systematic data were collected to determine the level of contemporary or heritage significance of the inventoried sites or areas to the Native Americans," and that "in several instances, the actual location and extent of the resources identified in the Little Rocky Mountains study area are unknown. . . . Impacts to these activities are, therefore, assigned as unknown. . . . The impact assessment is based upon a preliminary and incomplete sample of sites and associated Native American values present in the Little Rocky Mountains TCP Historic District. . . . The analysis should not be considered as exhaustive" (Draft EIS pages 4-268, 4-269). This inadequate analysis violated 40 CFR § 1502.22. Similarly, as to information used to evaluate impacts to Native American use of plants in the area for food, medicine, and ceremonial purposes, the Draft EIS states on page 4-96 that "the list may or may not be complete, however, for this analysis, it is assumed to be a complete listing of relevant species." (340)

RESPONSE: The statements cited in this comment are meant to alert the reader to data limitations and to qualify the nature of the data base available for the analysis and assessment, and lack meaning when taken out of context. The fact that the data are limited does not mean that they are inadequate for the analysis presented in the EIS. Even though their studies are not exhaustive, Deaver and Kooistra provide a broad framework of ethnographic information for sites and activities in the Little Rocky Mountains, which in fact, was sufficient to qualify the area as a TCP District. As described in Section 4.12.1, lacking systematic data on heritage and contemporary significance, all sites were assigned a high level of heritage significance for purposes of impact assessment. This allowed impacts to be assessed based solely upon their distance from proposed mining activities for each of the alternatives. The result, as described in Section 4.12.9.4, of the EIS is that all of the alternatives represent relatively high and negative impacts to Native American cultural resources, and that Alternative 3 is favored due to no additional expansion and improved reclamation measures. It is highly unlikely that additional ethnographic information would change the impact levels or the outcome of the alternative selection for Native American cultural resources.

71. COMMENT: For the BLM to propose expansion without gathering and disclosing adequate information on how an expansion will impact cultural resources, or even what the boundaries of the TCP District are, violates NEPA and the BLM's trust obligation. The BLM must withdraw the Draft EIS and wait until a proper ethnological study is completed before circulating a new draft. (344)

RESPONSE: ZMI is proposing the expansion, not the BLM. The BLM and DEQ have disclosed and analyzed the potential effects of expansion as described in Chapters 2.0 through 4.0 of the EIS.

72. COMMENT: Alternative 7 states that "surface disturbance would be reduced", "improving the quality of life as perceived by all groups within the study area." This notion is ludicrous and misleading. According to the Draft EIS, total disturbance at the Zortman portion of the operation alone would increase from a grossly understated 401 acres to 1,292 acres. There is nothing that can logically support a conclusion that tearing up more of the Little Rockies somehow benefits Indian people who consider those mountains profoundly connected with their culture! (181, 211, 320, 344, L0-12, L0-20, HA-31, GF-34)

RESPONSE: Under Alternative 7, the preferred alternative, the disturbance at the Zortman Mine would increase. Disturbance at the Landusky Mine would also increase. Any reference to "surface disturbance would be reduced" refers to the placement of waste rock on existing facilities at the Zortman Mine under Alternative 7 rather than in Carter Gulch (Alternatives 4 and 5) or on Ruby Flats (Alternative 6). For the expansion alternatives, the placement of waste rock on existing facilities reduces the amount of land disturbance associated with expanded mining activities by approximately 200 acres from Alternative 4.

The impacts of Alternative 7 on Native American cultural resources and the social environment on the Fort Belknap Indian Reservation are indeed significant. As stated in the section on "Unavoidable Adverse Impacts" in the Draft EIS, "impacts to Native American cultural resources, including high levels of disturbance to sacred places such as Shell Butte (Zortman) and Gold Bug Butte (Landusky) are permanent, and unavoidable" (page 4-281) and "many Native Americans who oppose the mine and have expressed a high level of concern about its presence would continue to be adversely affected during the extended mining phase before closure activities begin and the mines ultimately are closed" (page 4-237).

73. COMMENT: I take exception to several of the comments made in the cultural resource section of the Draft EIS. The most offensive comment is found on page ES-15. In paragraph 2 the author(s) state "A positive effect {of the mine expansion} would be the increase in knowledge concerning Native American and historic mining activity in the Little Rocky Mountains due to impact mitigation." In my opinion, this statement demonstrates an incredible ignorance of archaeological ethical values. To suggest that a limited amount of collections and information derived from excavations at numerous sites in the Little Rocky Mountains is "positive" in light of the complete and total destruction of these sites and their irreversible loss for future scientific investigations is troubling. It also shows a complete lack of sensitivity toward Native American's general discomfort with archaeological excavation, and in particular, their disdain for disturbances at traditional cultural sites in the Little Rocky Mountains. (341)

RESPONSE: Any collection of data from archaeological investigations including site recordation, ethnographic research, and full-scale excavation can be seen as a "positive" effect upon the pursuit of the history of man, as part of impact mitigation. This statement was made in the Executive Summary as part of a summary of impact mitigation under Alternative 4. Section 4.12.6 explains that only one historic site would be directly impacted and one prehistoric site may be impacted; therefore there will not be "excavations at numerous sites." Data collection (non-destructive) for impact mitigation at traditional cultural sites is stipulated in the Programmatic Agreement. Existing "disturbances at traditional cultural sites" are examined in Section 4.12.2. Potential impacts are examined in Section 4.12.3 through Section 4.12.9. Furthermore, to ignore potential benefits derived from mitigating impacts to sites would certainly be a violation of "archaeological ethical values." As you pointed out in your letter "More recent studies of island mountain ranges give us a more complete understanding of the role of island mountain ranges in prehistoric and early historic Native American subsistence and spirituality."

74. COMMENT: On page 4-280 of the Draft EIS, it is stated that the existing impact level for Native American cultural resources is high and that Alternative 7 would add impacts and continue and accelerate impacts. The cumulative impact is stated as approximately 100 plus years of significant disruption to Native American traditional cultural practices in portions of the Little Rocky Mountains. A thorough discussion of ways and means to mitigate a significant and adverse impact of this magnitude seems obviously necessary. The discussion on page 4-274 seems to say one way to mitigate is to incorporate more effective reclamation procedures which should result in more effective restoration of heavily disturbed areas. The discussion goes on to simply say that such mitigation reduces high negative impacts to low negative impacts. How was this level of reduction determined? (11, 211, 320, 340, 344, 346, 351, HA-23)

RESPONSE: The methodology employed to assess impacts to Native American cultural resources is described in Section 4.12.1. This section does not deal with mitigation. The discussion on page 4-274 does indicate that more effective reclamation procedures should lead to more effective restoration of heavily disturbed portions of the Little Rocky Mountains but does not go so far as to say that more effective reclamation will mitigate the adverse effects of mining on Traditional Cultural Properties. The impacts have been reduced to low based primarily upon the fact that like Alternatives 1 and 2, Alternative 3 is a non-expansion alternative. Additionally, Alternative 3 calls for reclamation procedures beyond those indicated for the other non-expansion alternatives. Mitigation in the Programmatic Agreement by preservation of cultural heritage through identification and recordation reduces impacts to Native American and other cultural resources though impact after mitigation would still be significant for all mine expansion alternatives to Native American traditional cultural values and practices.

75. COMMENT: We feel that the agencies need to better address what sort of shape will the Little Rocky Mountains be in when Pegasus leaves and particularly what does continued mining in the Little Rocky Mountains mean to Assiniboine and Gros Ventre people, to their well being and to their culture.

Mining is destroying their sense of community and security. Destroying the mountains is destroying the people....We feel that analyzing air and noise pollution and "alteration of visual perspective" is not enough. That's not what this is about.

To Indian people, mountains that are rightfully theirs are being destroyed. In sum, the cumulative effects of each incremental expansion of the Zortman-Landusky Mine and additional expansions that are likely need to be considered. So far the document does not adequately begin to address the interests of Indian people. (181, 320, 341, LO-11)

RESPONSE: The social and cultural impacts of mining to Native American peoples are described in Sections 4.10 and 4.12 of the Final EIS. The cumulative impacts of mine expansion on many peoples cultural and religious values would be significant and cannot be mitigated to less than significant.

6.16 HAZARDOUS MATERIALS

1. COMMENT: The term waste should be replaced with the word reject. Mined rock is rejected as ore because it does not meet economic cut-off grade or recovery requirements. The rejected rock is not hazardous waste as some would have us believe. (217)

RESPONSE: Waste rock and spent ore on the leach pads are not hazardous wastes as defined by EPA regulations. The term "waste rock" has been used extensively in the ZMI Plan of Operations, in the Company Proposed Action and is commonly used in the mining industry as a whole.

2. COMMENT: The discussion on the use of antifreeze in the Draft EIS (pages 3-244 and 3-246) should also state that "waste antifreeze is transported to a temporary storage area on containment in the Landusky fuel farm. It is subsequently transported off-site for recycling". (342)

RESPONSE: The text of the EIS has been modified.

3. COMMENT: In the Draft EIS, page 3-245, the sentence "a small percentage of empty cyanide drums and all flocculent containers are crushed and disposed of on the 89 leach pad" is in error. A small percentage of cyanide containers are neutralized and either reused for process related purposes or crushed and sent to the county landfill. Only acceptable laboratory liquid wastes are disposed of in the 89 pad. Flocculents are purchased in recyclable bins which are returned to the manufacturer. (342)

RESPONSE: The text of the EIS has been modified.

4. COMMENT: In the Draft EIS, page 3-247, the last part of the sentence in the discussion on solid waste states "Empty zinc barrels are rinsed..., while empty flocculent containers are disposed of on the leach pad." This statement is incorrect. Flocculents, as well as anti-scalants and coagulants, are purchased in recyclable bins which are returned to the manufacturer. (342)

RESPONSE: The text of the EIS has been modified.

5. COMMENT: What extent would cyanide have on the human body, our environment, on the ground, everything, on our plants, our sacred plants and stuff that we use? (HA-20)

RESPONSE: The toxic hazards of cyanide to humans and wildlife are described in Section 4.14.2 of the Draft EIS. Cyanide exposure in sufficiently high concentrations can be lethal to plants, as well as people and animals. Given the enclosed nature of leach pads and process circuits, it is unlikely that people, wildlife, or plants (including plants sacred to Native Americans) would be exposed to cyanide from routine mine operations at Zortman or Landusky except for mine worker exposure to leach spray. However, accidental releases or spills are a more serious concern, as described in Section 4.14 of the Draft EIS. While acutely toxic at high concentrations, once released in the environment cyanide degrades quite rapidly to non-toxic levels. Cyanide is not a cumulative poison and is not a carcinogen.

6. COMMENT: Is drift from cyanide solution application to leach pads being monitored? It is evident from on-site visits that drift can be significant during windy conditions. What effect does this drift have on the environment? (346)

RESPONSE: ZMI has collected cyanide data in air at the leach pads. A discussion of the potential for drift and environmental impacts is presented in Sections 4.6 and 4.14. However, cyanide drift is anticipated to have little or no effect, since it does not bioaccumulate and breaks down quickly in the atmosphere.

7. COMMENT: I don't feel that this cyanide leach water has anything to do with being any kind of poison or anything else. I don't think you could drink enough of it to kill you, because I lived with it for some 60 years and I'm still here. (LA-9)

RESPONSE: Section 4.14.4 of the Draft EIS describes accidental spills and/or uncontrolled releases of cyanide solution that occurred at the mines between 1982 and 1993. Although no injuries or deaths to humans occurred as a result of these spills, cyanide can cause detrimental impacts to aquatic habitat in extremely low concentrations. Based on the Manufacturer's Material Safety Data Sheet for sodium cyanide, the lethal dose for animals, and probably humans, is on the order of 15 mg/kg. Cyanide leach solution could be lethal if a sufficient volume (approximately 1 liter) was ingested.

8. COMMENT: The Draft EIS states that there were no pre-mining spills of hazardous materials (including cyanide). This directly contradicts the statement that cyanide spills destroyed the Little Peoples Creek fishery (page 4-122). (342)

RESPONSE: Upon reviewing the available data, no substantive information was found that confirmed that historic fisheries in Little Peoples Creek were destroyed by spills of cyanide due to mining in the past. Thus, the statement in Section 4.5.2 regarding cyanide poisoning in Little Peoples Creek has been deleted.

9. COMMENT: With reference to the Draft EIS, page 4-289, which stations did cyanide exceed the aquatic standard for cyanide? Were these chronic criteria? Also, since it is stated that lower aquatic species density and diversity related to cyanide contamination cannot be confirmed, shouldn't the sentence on the low aquatic species density and diversity in Lower Alder Gulch start that it is "possible that" rather than "likely that"? (342)

RESPONSE: In Alder Gulch, Station Z-8 measured cyanide at levels of up to 0.48 mg/l; in Ruby Gulch, Station Z-1 measured cyanide levels of up to 1.38 mg/l; in Mill Gulch, Station L-18 measured cyanide levels of up to 0.12 mg/l; and in Montana Gulch, Station L-3 measured cyanide levels of up to 0.14 mg/l and Station L-2 measured cyanide levels of up to 0.13 mg/l. The text does refer to the state chronic aquatic life criteria (0.0054 mg/l). Given that lower aquatic species density and diversity due to cyanide contamination can't be confirmed, the text has been revised to state that it is possible, rather than likely.

10. COMMENT: The Draft EIS fails to coordinate the "site assessment" with ongoing spill reporting and monitoring obligations. To the extent that "spills or accidental releases" have occurred in the past, or would occur between approval of the mine extensions and eventual mine closure, those events will be reported to BLM and DEQ and appropriate remedial measures taken. Similarly, BLM and DEQ have required substantial monitoring of groundwater which will identify any potential contamination as a result of spills or releases. Any pre-closure inspection to identify potential releases of hazardous materials should recognize the on-going reporting and monitoring efforts. In addition, the description of the inspection as an "Environmental Site Assessment" is unfortunate and perhaps misleading, for that term has developed an established meaning in connection with permitted hazardous waste facilities. See 40 C.F.R. §§280.62(a)(5); 280.70(c); 280.71(c) (referring to "site assessment" in accordance with 40 C.F.R. §280.72). The term has also been adopted by the Environmental Protection Agency in other contexts, including EPA's guidance on agreements with prospective purchasers of contaminated property and model prospective purchaser agreement, 60 Fed. Reg. 34, 792 (July 3, 1994) and EPA's Supplemental Environmental Projects Policy, 60 Fed. Reg. 24, 856 (May 10, 1995). Because the term has acquired a particular meaning in these uses, Zortman recommends that BLM and DEQ not adopt the same term to describe what is essentially a closure inspection.

ZMI recommends the language of the Draft EIS be modified as follows: "To minimize the risk of long-term contamination of soil and water resources, the entire Zortman mine permit area would be reviewed and inspected prior to mine closure. The pre-closure inspection would include a review of surface and groundwater monitoring data and an inspection of all areas where hazardous materials were stored or used to identify evidence of spills or accidental releases that may have contaminated soil and groundwater. Should evidence of possible soil or groundwater contamination be identified, further sampling would be required to determine the extent of any contamination." (342)

RESPONSE: The text of the EIS has been modified to acknowledge ZMI's spill monitoring and reporting obligations and mentions that the mine closure hazardous waste inspection would incorporate and follow up on ZMI's spill monitoring data and associated reports.

The BLM and DEQ recognize ZMI's concerns about using the term "Environmental Site Assessment." However, the intent is that, prior to final bond release of the public lands portions of the project, a Site Assessment as described by EPA regulations would be conducted. This would be done to ensure that lands returned to multiple use management are free from contamination by hazardous materials. Please see Section 1.5.1.

11. COMMENT: The agencies should consider requiring ZMI to perform an environmental site assessment on an annual basis (as opposed to once at the end of mine life) to provide early detection of spills, leaks, or other problems which could contribute to contamination of soil or water resources. (11)

RESPONSE: Spills and leaks are detected through the water resources monitoring program. The early detection of potential contamination by performing an annual environmental site assessment could help preclude a later need for extensive, possibly expensive remediation programs. However, other existing permit requirements and regulatory programs would provide adequate oversight. In the Final EIS, the environmental site assessment would not be a required mitigation but would be required prior to final bond release as discussed in Section 1.5.1.

12. COMMENT: Page 2-107 of the Draft EIS says a comprehensive environmental site assessment would be performed, but it does not say who would do the assessment or pay for it. (352)

RESPONSE: The assessment would be the responsibility of the mine operator upon requesting final release of the reclamation bond.

13. COMMENT: Several of the alternatives include, as an agency proposed modification to the reclamation plan, the performance of an annual "Environmental Audit" relating to the leak detection and spill containment systems. Zortman agrees that such a review would be a useful component of the inspection and monitoring system, but believes that the term "Environmental Audit" may be confusing and misleading. That term has acquired a particular meaning in usage by EPA and American corporate environmental management which does not appear to be consistent with the process described by the Draft EIS. For example, EPA's interim policy on voluntary environmental self-policing and self-disclosure defines environmental auditing to mean "a systematic, documented, period and objective review by regulated entities of facility operations and practices related to meeting environmental requirements [60 Fed. Reg. 16,875, 16,877 (April 3, 1995). EPA has also adopted the term in connection with its policy on supplemental environmental projects [60 Fed. Reg. 24,856 (May 10, 1995)]. Because of this usage, the term "environmental audit" has acquired legal significance which is inappropriate for the monitoring process described in the Draft EIS.

ZMI recommends the language of the Draft EIS be modified as follows: "Monitoring would be required to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be realistically implemented through review of company training programs and inspection of emergency response equipment. Existing monitoring requirements would be supplemented to require an annual review of these systems and procedures and a report to BLM and DEQ certifying that the review was completed and any necessary corrective measure identified and taken by ZMI." (342)

RESPONSE: The annual Environmental Audit mitigation has been eliminated from the Final EIS. Existing spill reporting and monitoring obligations currently require ZMI to report any spill or release to BLM and DEQ and to take appropriate remedial measures.

14. COMMENT: The environmental audit performance should be completed on a quarterly basis, instead of the recommended level (annually), because of past violations of the Clean Water Act by ZMI. (348)

RESPONSE: The annual Environmental Audit mitigation has been eliminated from the Final EIS. Existing spill reporting and monitoring obligations currently require ZMI to report any spill or release to BLM and DEQ and to take appropriate remedial measures. In the Final EIS, the environmental site assessment would not be a required mitigation but would be required prior to final bond release as discussed in Section 1.5.1.

15. COMMENT: The requirement for an annual independent Environmental Audit and an Environmental Site Assessment. We question whether the agencies have the legal authority to require this as a condition of the permit. Who would perform a comprehensive environmental site assessment and would pay for it? (274, 352)

RESPONSE: Compliance with appropriate hazardous material laws and regulations is a general requirement for all mine operators. An independent audit for compliance with the complex hazardous materials regulations would address this issue. The site assessment, to occur at the end of mine life, would provide some assurance to BLM that the land was free from contamination by hazardous materials before final mine closure. It may also provide some protection for the operator regarding liability from actions occurring on the site after closure during secondary land use.

The reclamation bond would not be released until future liability has been established. Prior to the release of the bond, a final inspection must be conducted in order to ensure that reclamation and closure has been conducted in accordance with the approved plan and all procedures have been successful. The objective of the Site Assessment is to ensure and document that the operator has remediated any spills or leaks of hazardous materials in the appropriate manner as to minimize the potential that the Government would incur subsequent costs or liabilities or suffer future damages to any resources at the site.

The annual Environmental Audit mitigation has been eliminated from the Final EIS. Existing spill reporting and monitoring obligations currently require ZMI to report any spill or release to BLM and DEQ and to take appropriate remedial measures. In the Final EIS, the environmental site assessment would not be a required mitigation but would be required prior to final bond release as discussed in Section 1.5.1.

6.17 EDITORIAL

1. **COMMENT:** Title (Volumes I and II) should be changed from "Draft Environmental Impact Statement, Zortman and Landusky Mines, Reclamation Plan Modifications and Mine Life Extensions" to "...Mine Expansions." (17)

RESPONSE: The name of the Final Environmental Impact Statement has remained unchanged. The Draft EIS evaluates "mine life extensions" which were proposed by ZMI. The term is reasonably accurate. "Mine expansions" and "expanded mining" are used throughout the document to describe how the "mine life extensions" would be accomplished.

2. **COMMENT:** Both volumes of the report are very fragmented, have too many references making it difficult to review and evaluate. For example, reference to one section which contains a reference to yet another section. (17)

RESPONSE: While editing and revising the Draft EIS to prepare the Final EIS, every effort has been made to simplify cross-references. In Sections 2.5-2.11, the operations and reclamation of the Zortman and Landusky mines have been reduced from four sections to two sections, which has resulted in simplified references.

3. **COMMENT:** Pages of tables should be numbered in the Draft EIS. (346)

RESPONSE: Pages with tables are typically not numbered in the text because they are often printed in a format different than the body of text. For consistency, none of the pages with only tables or figures are numbered. However, the figures and tables are easy to find in the document because they are coded to individual sections of the report.

4. **COMMENT:** Page 4-57, 4th paragraph, 1st sentence states, "Estimated ... on Table 4.2-2". This should be changed to Table 4.2-1. (17)

RESPONSE: This change has been made in the Final EIS.

5. **COMMENT:** The first sentence of the second paragraph on page 4-65 of the Draft EIS states, "Figure 4.2-2." There is no Figure 4.2-2 in the document. (17)

RESPONSE: Figure 4.2-2 does appear on the next page after this reference (i.e., page 4-66 but the figure page does not have a number). In addition, the reference to this table from the text is correct. It is possible that the commentor's copy of the document did not contain this page due to a printing error.

6. **COMMENT:** The Draft EIS is confusing with respect to directions of groundwater flow at the Landusky Mine. On page 3-46, Water Management Consultants (1995--which is not listed in the reference Section) is cited as indicating that northeast trending shear zones are the principal feature controlling ground water flow in that area. (267)

RESPONSE: Refer to Section 3.2.4 for clarified text on this issue. In addition, Water Management Consultants (1995) has been added to the reference section.

7. **COMMENT:** The Draft EIS contains no subject index. Lack of an index for such a complex document is a barrier to comprehension. Given the word processing and publishing technology available today, this is a needless and inconsiderate oversight. (273)

RESPONSE: A subject index was included in the Draft EIS directly following the Glossary (Section 7.0) and is included in the Final EIS. The index contains a listing of subjects and the page numbers on which they appear.

8. **COMMENT:** In 7.0 Glossary, we suggest adding: capillary break/drainage layers, reclamation cover, water-balance and approach, water-barrier and approach, Water Quality Improvement Plan, peregrine falcon hack sites, one foot of freeboard, convoys, Thermopolis shale. In the definition of "Best Management Practices", we suggest you add three or four examples of BMP measures. (337)

RESPONSE: Capillary break/drainage layers, water-balance and approach, water-barrier and approach, and convoys have been added to the Glossary. The term "freeboard" is defined in the Final EIS Glossary. Thermopolis shale is a geologic formation and therefore not included in the Glossary. The Water Quality Improvement Plan is referenced as being in Appendix A consistently throughout the text, and the reader may refer to the Section 1.0, Introduction of this plan for a complete and concise explanation of this document. Please note that the Glossary is Section 8.0 in the Final

EIS. Examples of BMPs have been added to the Glossary.

A peregrine falcon hack site is an artificial nest structure where young chicks are raised by human keepers until they can fly on their own. Establishment of peregrine falcon hack sites have been removed from the agency mitigations. Therefore, this term has not been added to Chapter 8.0 - Glossary

9. COMMENT: It keeps referencing mine pit footprints but doesn't identify what the term "footprints" means. (352)

RESPONSE: This term has been defined in the Final EIS text and added to Section 8.0, Glossary.

10. COMMENT: With reference to the second paragraph in the second column on page ES-1 of the Draft EIS, commentor suggests changing this paragraph to read, "The second need is to consider." (342)

RESPONSE: This change has been incorporated into the Final EIS.

11. COMMENT: The Goslin area is referred to as "Goslin Flat" rather than "Goslin Flats" as indicated throughout the document. (342)

RESPONSE: The term "Goslin Flats" has been used consistently throughout the document.

12. COMMENT: The terms "Water Quality Improvement Plan", "Water Quality Compliance Plan", "water quality improvement and monitoring compliance plan", and "compliance plan" are used is various locations throughout the Draft EIS. Are they referring to the same thing? (342)

RESPONSE: Reference to the Water Quality Improvement Plan contained in Appendix A has been made consistent throughout the Final EIS.

13. COMMENT: In Section 1.2.2 (page 1-9) of the Draft EIS, the word "repository" should be added after "a new waste rock." (342)

RESPONSE: This change has been incorporated into the Final EIS.

14. COMMENT: The conveyor system is approximately 12,000 feet in length, not 11,000 as stated in this Section 1.2.2. (342)

RESPONSE: This change has been incorporated into the Final EIS.

15. COMMENT: In Section 1.5.3.2 (page 1-20) of the Draft EIS, the statement "Rocky Mountains to the National Register, as a traditional cultural property district" is made twice. Delete duplicate statement. (342)

RESPONSE: This change has been incorporated into the Final EIS.

16. COMMENT: With reference to Section 2.6.4.5 (page 2-95) title of the Draft EIS, there are also repositories in Landusky. (342)

RESPONSE: The title (now Section 2.6.2.5) has been modified to "Waste Rock Facilities Reclamation."

17. COMMENT: The first paragraph in Section 2.5.4.7 of the Draft EIS (page 2-77) refers to Section 2.5.2.5 as describing various water control and leachate capture systems in effect at the Zortman Mine. Section 2.5.2.5 describes "Waste Rock Dump Reclamation". The listed features are described in Section 2.5.1.6. But wouldn't it be more appropriate to refer to the various water control and leachate capture systems for the Landusky Mine described in Section 2.5.3.6? It might also be more appropriate to include the discussion contained in Section 2.5.4.7 in Section 2.5.3.6 and as for Zortman, state that under this alternative, ZMI would capture and treat seepage in according to the Water Quality Improvement Plan. (342)

RESPONSE: Please refer to the revised text throughout Section 2.5 which has clarified this issue.

18. COMMENT: The terminology in Section 2.5.3.6 with respect to the Water Quality Improvement Plan is inconsistent with other sections. (342)

RESPONSE: Modifications have been made to the text to make terminology consistent.

19. COMMENT: Section 2.7.4.7, page 2-110, paragraph 1, line 1. The reference to section 2.5.2.6 is incorrect. Revise with the correct reference (Section 2.5.3.6). (342)

RESPONSE: The reference has been changed (now Section 2.5.1.6).

20. COMMENT: Section 2.8.4.8, page 2-174, paragraph 1. The discussion for Reclamation Quality Control lists depths for Reclamation Cover B only. Commentor suggests revising text as per Section 2.8.2.8 Reclamation Quality Control (for Zortman). (342)

RESPONSE: This revision was incorporated into the Final EIS text; please see Section 2.8.2.8 which now contains Reclamation Quality Control for both the Zortman and Landusky mines.

21. COMMENT: Section 3.2.3, page 3-43, column 1, paragraph 5, last line. Should this be "upper" Ruby Creek, versus "lower"? (342)

RESPONSE: See Section 3.2.3 of the EIS for edited text stating along Ruby Gulch through Zortman and into Ruby Creek.

22. COMMENT: Section 3.2.3.1, page 3-43. There is no Section 3.2.3.1, but there is a Section 3.2.3.2. (342)

RESPONSE: This revision has been incorporated into the Final EIS text.

23. COMMENT: Section 6.0 References, page 6-14, column 2, 5th reference. This reference is no longer valid. Replace the reference to the PDN with the following:

> ZMI, 1995. Application for Department of Army Permit - Zortman Mine, Phillips County, Montana September, 1995.
>
> ZMI, 1995. Application for Department of Army Permit - Landusky Mine, Phillips County, Montana September, 1995.

(342)

RESPONSE: This change has been incorporated into the text; please refer to Section 7.0 References.

24. COMMENT: In the Draft EIS Section 2.8.2.6, page 2-151, the roads described in the fifth paragraph will be 70 feet wide and will be reduced to 25 feet. Commentor suggests changing text from "4 to 5 feet" to "45 feet." (342)

RESPONSE: The text has been revised.

25. COMMENT: In Table 2.8-7, *Festuc ovina* should be replaced with *Festuca ovina*. (342)

RESPONSE: The text has been revised.

26. COMMENT: In Table 2.8-8, *Bouteloua gracillis* should be replaced with *Bouteloua gracilis*; Shrubs - *Artemesia trident* should be replaced with *Artemesia tridentata*. (342)

RESPONSE: The text has been revised.

27. COMMENT: Section 2.8.3.3, page 2-162, paragraph 1, last line. "19.5 million tons" should be corrected to "109.5 million tons." (342)

RESPONSE: The text has been revised.

28. COMMENT: The footnotes to Table 3.3-3, page 3-124 designated as 4 and 5 are incorrect and should be 5 and 6. (342)

RESPONSE: Table 3.3-3 has been revised and corrections to the footnotes have been made where appropriate.

29. COMMENT: The statement in Section 4.3.1, page 4-71, in the Draft EIS attributing a minimum thickness of suitable cover soil for mountain soil in the Little Rocky Mountains as approximately 16 inches to Noel and Houlton (1991) is not correct. (342)

RESPONSE: The statement has been deleted.

30. COMMENT: Section 3.10.5.5 (page 3-209, column 1, paragraph 3, last line) should be revised to identify or delete an editor's request for information. (342)

RESPONSE: Section 3.10.5.5 has been revised to correct this error.

CHAPTER 7.0

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CHAPTER 8.0

GLOSSARY

ADIT - A nearly horizontal passage, driven from the surface, by which a mine may be entered, ventilated, and dewatered.

AFFECTED ENVIRONMENT - The biological and physical environment that will or may be changed by actions proposed and the relationship of people to that environment.

ALLUVIAL - Pertaining to material or processes associated with transportation or deposition by running water.

ALLUVIUM - Soil and rock that is deposited by flowing water.

ALTERNATIVE - A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of the several policies, plans, or projects proposed for decision making. An alternative need not substitute for another in all respects.

AMBIENT - Surrounding, existing.

ANALYTE - A compound determined by an analysis.

AQUITARD - A rock unit with relatively low permeability that retards the flow of water.

AREA OF CRITICAL ENVIRONMENTAL CONCERN (ACEC) - An area where special attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values; fish and wildlife resources; or other natural systems or processes; or to protect life and safety from natural hazards.

BENTHIC - Pertaining to the bottom of a body of water.

BERM - A horizontal bench left in an exposed slope to increase slope stability and provide a place for sloughing material to collect.

BEST MANAGEMENT PRACTICES (BMPs) - Practices determined by the State of Montana to be the most effective and practicable means of preventing or reducing the amount of water pollution generated by non-point sources, to meet water quality goals. Examples of BMPs include: slope angle and/or slope length reduction of re-graded areas of disturbance to decrease the potential for accelerated erosion and soil loss; proper seed-bed preparation, seed-mix selection and application, fertilization, and mulching to optimize the re-establishment of a long-term, protective vegetative cover; or installation of short- and long-term erosion control features/structures such as hay bales, water bars, benches, and interception and conveyance ditches/channels to slow runoff and to capture and direct excess water to acceptable release points.

BIG GAME - Those species of large mammals normally managed as a sport hunting resource.

BIOLOGICAL ASSESSMENT - An evaluation conducted on federal actions in accordance with the Endangered Species Act. The purpose of the assessment is to determine whether the proposed action is likely to affect an endangered, threatened, or candidate species.

BORE HOLE - A drill hole from the surface to an orebody.

CAPILLARY BREAK - A layer of coarse grained soil designed to prevent the vertical upward migration of fluid by capillary action.

COLLUVIUM - Fragments of rock carried and deposited by gravity.

CONTACT METAMORPHISM - The process by which rocks surrounding an igneous intrusion are changed in appearance and composition by the heat, pressure, and chemicals emanating from that intrusion.

CONVOY - An escorted group of 8 to 15 trucks that travels together in single file. Convoys are used for hauling reclamation materials from various borrow sources to areas under reclamation.

COUNCIL ON ENVIRONMENTAL QUALITY - An advisory council to the President established by the National Environmental Policy Act (NEPA) of 1969. It reviews Federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

CULTURAL RESOURCES - Remains of human activity, occupation, or endeavor as reflected in sites, buildings, artifacts, ruins, etc.

DEWATERING - The act of removing water.

DRILL SEEDING - A mechanical method for planting seed in soil.

ENDANGERED SPECIES - Any plant or animal species which is in danger of extinction throughout all or a significant portion of its range. (Endangered Species Act of 1973).

ENVIRONMENTAL ASSESSMENT - A concise public document for which a Federal or State agency is responsible that serves to:
(1) Briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact.
(2) Aid an agency's compliance with the National or Montana Environmental Policy Act (NEPA or MEPA) when no environmental impact statement is necessary.
(3) Facilitate preparation of an environmental impact statement when one is necessary.

ENVIRONMENTAL IMPACT STATEMENT (EIS) - A detailed, written statement as required by Section 102(2)(c) of the National Environmental Policy Act of 1969.

EROSION - The group of processes whereby earthy or rocky material is worn away by natural sources such as wind, water, or ice and removed from any part of the earth's surface.

FELSIC - Pertaining to or composed dominantly of silica-rich minerals such as feldspar; typically forming light-colored rocks.

FLOODPLAIN - The lowland and relatively flat areas adjoining inland and coastal waters. A 100-year floodplain is that area subject to a one percent or greater chance of flooding in any given year.

FLOTATION AGENT - Any of a number of chemical agents used in the separation of ore minerals by the froth flotation process.

FOOTPRINT - See "mine pit footprint".

FORAGE - Vegetation used for food by wildlife, particularly big game wildlife and livestock.

FORB - Any herbaceous plant other than a grass, especially one growing in a field or meadow.

FREEBOARD - The distance from surface of a pond to top of a dam.

GAINING STREAM - A stream that gains water as flow proceeds downstream. Water is gained from groundwater inflow and/or tributary streams.

GLACIAL DEPOSIT - Any rock material, such as boulders, till, gravel, sand, or clay, transported by a glacier and deposited by or from ice or by or in the water derived from the melting of the ice.

GNEISS - A coarse-grained rock in which bands rich in granular minerals alternate with bands in which schistose minerals predominate.

HEAP LEACH PAD - A lined area upon which ore is placed and leached with cyanide. Leachate accumulates at the base of the ore heap, above the leach pad liner, and is processed to remove precious metals from the cyanide solution.

HYDRAULIC CONDUCTIVITY - A measure of the ease with which water moves through soil or rock; permeability.

HYDRIC SOIL - Soil which is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.

HYDROPHYTIC - Water-loving; ability to grow in water or saturated soil.

HYDROSEEDING - Distributing seed in a spray of water. Mulch and fertilizer may be added to the spray.

INDICATOR SPECIES - Species of fish, wildlife, or plants which reflect ecological changes caused by land management activities.

INTRUDE - To forcefully invade and displace pre-existing rocks. Molten rock can inject itself into surrounding rocks due to high temperatures and pressures.

JOINT - Fracture in rock, generally more or less vertical or transverse.

LOSING STREAM - A stream that loses water as flow proceeds downstream. Typically, water loss is via infiltration into the ground and evaporation.

MACROINVERTEBRATE - Animals without backbones that are visible without a microscope; insects.

MAFIC - Pertaining to or composed dominantly of the magnesian rock-forming silicates; said of some igneous rocks and their constituent minerals. Contrasted with felsic.

MANAGEMENT UNIT - Geographic areas, not necessarily contiguous, which have common management direction consistent with the BLM allocations.

MAXIMUM CREDIBLE EARTHQUAKE - The largest rationally conceivable earthquake that could occur in a particular area.

MAXIMUM PROBABLE FLOOD - The flood event that could cause the highest expected river stage.

METAMORPHOSE - To change into a different physical form.

MINE PIT FOOTPRINT - The surface expression of the area of disturbance caused by the mine pit.

MINERAL LODE CLAIM - A claim for possession of land in the public domain (especially national forests) containing minerals under the Mining Law of 1872.

MINERALIZATION - The process by which a valuable mineral or minerals are introduced into a rock resulting in a potential or actual ore deposit.

MITIGATION - Actions to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

ORE-GRADE - When minerals are found in sufficient concentration to warrant extraction by mining, the mineralized area is considered an ore deposit. Ore is mineral that can be extracted from the ground at a profit. Grade is a term used to define the amount of concentration of a mineral in rock, and is usually expressed in units of metal per ton of rock or in percentage.

PACKER - A compressible cylinder of rubber and metal that is placed in or outside a well to plug or seal the well at a specific point.

PEAK FLOW - The greatest flow attained during the melting of the winter snowpack.

PERIPHYTON - Microscopic organisms attached to and growing on the bottom of a waterway or on submerged objects.

PERMEABILITY - The capacity for transmitting a fluid; depends on the size and shape of the pores, the size and shape of their interconnections, and the extent of the latter. It is measured by the rate at which a fluid of standard viscosity can move a given distance through a given interval of time.

PICTOGRAPH - Any conventionalized representation of an object.

PIEZOMETER - A well, generally of small diameter, that is used to measure the elevation of the water table.

POTENTIOMETRIC SURFACE - The surface or level to which water will rise in a well. The water table is a particular potentiometric surface for an unconfined aquifer.

PROPOSED ACTION - In terms of NEPA or MEPA, the project, activity, or action that a Proponent intends to implement or undertake and which is the subject of an environmental analysis.

REAGENT - A substance used in a chemical reaction to detect, measure, examine, or produce other substances.

RECORD OF DECISION (ROD) - A document separate from but associated with an environmental impact statement that publicly and officially discloses the responsible official's decision on the proposed action.

RIPARIAN - Situated on or pertaining to the bank of a river, stream, or other body of water. Normally used to refer to the plants of all types that grow along or around springs.

ROADLESS AREA - That area which is absent of roads which have been improved and maintained by mechanical means to ensure relatively regular and continuous use, and is bounded by a road, the edge of a right-of-way, other land ownership, or a significant imprint of man.

SCOPING - A term used to identify the process for determining the scope of issues related to a proposed action and for identifying significant issues to be addressed.

SEDIMENTARY - Rock formed of sediment, especially: (1) Clastic rocks, as, conglomerate, sandstone, and shales, formed of fragments of other rock transported from their sources and deposited in water. (2) Rocks formed by precipitation from solution, as rock salt and gypsum, or from secretions of organisms, as most limestone.

SEISMIC - Of, or produced by, earthquakes.

SHAFT - A vertical excavation of limited area compared with its depth, located alongside or through an orebody for access.

SHEAR ZONE - A zone in which shearing has occurred on a large scale so that the rock is crushed and brecciated.

SIGNIFICANT - As used in NEPA, requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27).

SOIL PRODUCTIVITY - The capacity of a soil to produce a specific crop such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture and nutrients and length of growing season.

SPENT ORE - Ore which has been leached and no longer is yielding leachate that is economic to process.

SUBSIDENCE - The sinking of a large part of the earth's crust.

TAILING - Second grade or waste material derived when raw material is screened or processed.

TALUS - A collection of fallen disintegrated material which has formed a slope at the foot of a steeper declivity.

TECTONIC - Of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust.

THREATENED SPECIES - Any species of plant or animal which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

TRANSMISSIVITY - The rate at which water is transmitted through a unit width of aquifer under a hydraulic gradient.

UNNECESSARY OR UNDUE DEGRADATION - Surface disturbance greater than what would normally result when an activity is being accomplished by a prudent operator in usual, customary, and proficient operations of similar character and taking into consideration the effects of operations on other resources and land uses, including those resources and uses outside the area of operations.

VISUAL ABSORPTION CAPABILITY (VAC) - The relative ability of a landscape to accept management practices without affecting its visual characteristic. The capability to absorb visual change. A prediction of how difficult it will be for a landscape to meet recommended VQOs.

VISUAL QUALITY OBJECTIVES (VQO) - Descriptions of a different degree of alteration of the natural landscape based upon the importance of aesthetics.

WASTE ROCK - Rock that has to be mined to access precious metal-bearing ore, but does not contain enough mineral to be mined and processed at a profit.

WASTE ROCK DUMP - Area which waste rock is end-dumped from the top downward, typically without any selective handling criteria being used to sort the more reactive waste rock component.

WASTE ROCK REPOSITORY - An area where waste rock is placed, usually in lifts engineered for isolation of the reactive waste rock component. Typically constructed from the lower portions upward allowing for concurrent surface reclamation and built-in water management structures.

WATER BALANCE COVER - A cover system designed to maintain a moisture balance that results in the rapid physical, chemical, and biological stabilization of the waste.

WATER BARRIER COVER - A cover system designed, constructed, and maintained to prevent moisture infiltration to the waste below.

WETLAND - Lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface.

APPENDIX A
WATER QUALITY IMPROVEMENT PLAN

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WATER QUALITY IMPROVEMENT PLAN

1.0 INTRODUCTION

Water quality associated with discharges from existing or expanded mine facilities is a major issue identified during EIS scoping. This appendix summarizes the technical plans to improve and maintain water quality. The plan has been derived from water quality improvement measures proposed by Zortman Mining, Inc. (Hydrometrics 1995, ZMI 1996). Whether imposed through a Consent Decree and/or implemented as a stipulation to the mining and reclamation permits, this appendix describes the measures that would be used to achieve and maintain compliance with the water quality laws under the various EIS alternatives.

1.1 Purpose

This appendix describes actions that would be performed by the operator to improve and maintain water quality at the Zortman and Landusky mines and ensure compliance with applicable federal and state laws and regulations. Water quality management strategies and plans necessary to achieve and maintain compliance with federal and state standards have been developed for each alternative presented in the EIS.

The types of work described in this plan can be grouped into two categories:

1. construction of facilities and implementation of practices for improving water quality; and

2. water quality monitoring.

Sections 2 and 3 of this plan outline the basic framework for performing these two tasks and meeting water quality objectives in each drainage affected by existing and proposed mining operations. Section 4 is a discussion regarding the schedule for implementation of these plans. A set of figures (Figures A-1 through A-13) are attached which show the existing and proposed water quality management facilities under the various EIS alternatives.

1.2 Background

Both DEQ and BLM have concluded that additional water quality improvement facilities and practices are needed for existing or expanded mining at the Zortman and Landusky mines. The BLM has determined that measures to improve water quality are needed to prevent unnecessary or undue degradation of federal lands as required by the Federal Land Policy and Management Act. Similarly, the Montana Department of Environmental Quality has determined that the plan is needed to achieve comparable stability and utility of mined lands with adjacent lands as required by the Montana Metal Mine Reclamation Act, and to comply with the Montana water quality standards.

In addition to the mitigation requirements of DEQ and BLM, are the enforcement efforts of EPA and the Montana DEQ's Water Quality Division (WQD). The United States, for and on behalf of EPA, and the State of Montana, for and on behalf of the Montana Department of Environmental Quality (formerly the Montana Department of Health and Environmental Sciences), have filed civil lawsuits against ZMI and its parent company, Pegasus Gold Corporation. Citizen suits have also been filed by the Fort Belknap Community Council and Island Mountain Protectors. The lawsuits allege that discharges of mining wastewaters at the Zortman and

Landusky mines are in violation of the Federal Clean Water Act and the Montana Water Quality Act.

The United States and the State of Montana seek, among other things, injunctive relief to bring the Zortman and Landusky mines into compliance with Federal and State law. Any settlement of these charges would incorporate the major technical components described in this appendix to achieve that legal objective. Should supplemental measures, beyond those contained in the mine operating and reclamation permits that might be approved by BLM and DEQ as described in this appendix, result from settlement or litigation then the more restrictive (protective) measures would apply.

1.3 Water Quality Management Objectives

The objectives of the Water Quality Improvement Plan are:

- to prevent unnecessary or undue degradation of federal lands as required by the Federal Land Policy and Management Act; and
- to achieve comparable stability and utility of mined lands with adjacent lands as required by the Montana Metal Mine Reclamation Act.

Actions to improve and maintain discharge water quality, cease unpermitted discharges, and come into compliance with the Montana Water Quality Act and the Federal Clean Water Act are an integral part of compliance with these laws. This appendix provides an overview of work that will be performed by ZMI to achieve interim compliance at the Zortman and Landusky mines with BAT (Best Available Technology Economically Achievable, 40 CFR 440) effluent limits and requirements; and final compliance with Montana Pollution Discharge Elimination System (MPDES) water quality effluent limits and Montana Water Quality Standards for the existing mining operations. This appendix also provides a description of measures that would be used to meet water quality standards under the various alternatives presented in the EIS should future mine expansion be approved.

After successful completion of the water management facilities and practices described in this appendix for the respective EIS alternative, the DEQ would issue a Montana Pollution Discharge Elimination System (MPDES) permit. Interim and final effluent limits would be established in the MPDES permit. The work described in this appendix would be used to achieve compliance with the interim and final effluent limits. Successful attainment of the above objectives will be measured through compliance with applicable MPDES permit limitations and requirements.

To achieve the objectives, work to be performed by the mine operator would fall into two general categories:

- Construction and operation of water control, water capture and water treatment facilities used for improving and maintaining water quality; and
- Water quality monitoring to measure performance of these facilities and provide feedback to determine whether any modifications or implementation of contingency measures may be needed.

2.0 WATER MANAGEMENT PLAN

Based on the hydrogeologic conditions at the Zortman and Landusky mines (see Chapter 3, Section 3.2), the Water Management Plan provides for segregating various waters requiring differing control and treatment measures.

2.1 Water Management Zones

The water classification scheme provides a basis for determining which waters would be managed with sediment and erosion control practices (i.e. storm water areas) and which waters would be captured and treated (i.e., mine drainage areas). To this end, waters have been classified based on the source of the water, the materials contacted by water as it flows through the mine sites, the quality of the water as it is discharged and the regulatory requirements it must meet.

EPA regulations define four categories of surface water at mine sites: (1) unclassified water, (2) storm water, (3) mine drainage, and (4) process water. Waters within the ZMI mine permit area have been classified into one of these four types of water management zones. The type of water associated with each management zone is defined as follows:

- **Unclassified Water** - all water which has not come into contact with overburden, raw material, finished product, byproduct or waste products located within the permit boundaries including areas where storm runoff is channeled or diverted around mine areas through ditches or other structural devices.

- **Storm Water** - storm water runoff, snow melt runoff, and surface runoff and drainage which is directly related to manufacturing, processing or raw material storage areas at a mining facility, but which is not Mine Drainage or Process Water.

- **Mine Drainage** - all water drained, pumped or siphoned from the areas of a mine where work or other activity related to the extraction or recovery of ore is performed. Areas of a mine are defined to include all land and property placed under, or above the surface of such land, used in or resulting from the work of extracting metal ore or minerals from their natural deposits by any means or method, including secondary recovery of metal ore from refuse or other storage piles, wastes, or rock dumps and mill tailings derived from mining, cleaning, or concentration of metal ores.

- **Process Water** - all water used in and resulting from the beneficiation of ores, including water which has contacted leach pads, process ponds, mill discharges, or wastes associated with the heap leach process fluids, as well as any waters which commingle with any process water.

Unclassified zones include areas which have not been disturbed by mining activities. Storm water zones include access roads as well as reclaimed areas. Mine drainage zones typically consist of areas exhibiting surface manifestations, e.g. seeps of water originating in mining areas, or areas where water flows discharge from waste rock. Process water zones include heap leach pads and process water ponds. Process water zones are comprised of zero-discharge facilities which are lined and are managed to prevent discharge (seepage or runoff). Since process water management zones are closed systems and do not contribute to discharges, they are not addressed in this appendix. Past and potential releases (leaks, spills and LAD) of process water are addressed in the main body of the EIS.

2.2 Overall Approach to Water Quality Improvement

The general plan for improving water quality is to:

- reduce or eliminate long-term seepage from mine drainage areas through diversion of run-on water, isolation of reactive waste rock and the use of surface reclamation to limit the direct infiltration of precipitation into the mine facility;

- segregate good quality water (unclassified and storm water zones) from poor quality water (mine drainage zones and seeps);

- reduce surface water runoff, erosion and sediment production in storm water management zones by applying "Best Management Practices" (BMPs);

- apply BMPs in mine drainage water management zones to reduce sedimentation in capture systems; and

- capture surface water and alluvial seepage from mine drainage or stormwater (if necessary) management zones and seeps and treat this water to meet interim and final effluent limits.

Diversion ditches are used at the Zortman and Landusky mines to segregate storm water and unclassified runoff from mine drainage zones and seeps. The diversion ditches intercept runoff water from undisturbed (unclassified) or reclaimed (storm water) slopes before it has an opportunity to come into contact with areas disturbed by mining activities (mine drainage zones). These ditches then route the good quality water to discharge points downstream of mine drainage capture facilities. Permanent diversion ditches would be designed to transport the peak runoff from a 100-year, 24-hour storm event (6.33 inches).

Best Management Practices (BMPs), including revegetation, soil stabilization matting, sediment retention basins, dikes, drains, silt fences, check dams, level spreaders, and discharge dispersion structures, are used to control erosion and sediment production from storm water and mine drainage water management zones. BMPs, such as soil caps, geotextiles and geomembranes are used to reduce the infiltration of precipitation in areas which could contribute to mine drainage seeps.

To meet the objectives of this plan, poor quality water from both mine drainage runoff and alluvial seepage flow would be captured and treated prior to discharge. Capture systems vary depending on site-specific conditions, and may include one or more of the following:

- lined capture ponds,

- recovery wells,

- seepage capture trenches, and

- seepage capture sumps.

Figure A shows a schematic plan view and cross section of the water capture system components which could be constructed downgradient of mine waste units. Lined capture ponds are used in individual drainages to contain waters prior to transfer to the water treatment plants. Recovery wells are constructed as needed either through the mine waste unit to capture seepage or downgradient of the facility. These wells would be completed in either the alluvial or bedrock aquifers (or both) and used to recover impacted groundwater. Seepage capture trenches and capture sumps would consist either low permeability slurry walls composed of clay or grout, and high permeability infiltration galleries. The slurry walls would be used to intercept shallow groundwater which could then be retrieved by the recovery wells. Capture sumps would be small lined areas which may contain course drain rock and are used to intercept mine drainage at or near the drainage surface. Water collected in the capture sumps is transferred either directly to the water treatment plant or to the lined capture ponds. Not every component would be used in every drainage (See Section 2.3).

Captured mine drainage would be treated at the existing Zortman Water Treatment Plant or the proposed Landusky Water Treatment Plant, or used as make-up water in the ore processing circuit. The Zortman Water

Treatment Plant uses lime to precipitate metal hydroxides and to reduce acidity (See Section 2.4). A similarly designed water treatment plant would be constructed to service the Landusky Mine area. Other treatment steps may be added in the future, should they be necessary to meet final water quality effluent limits.

Under Alternatives 1, 2, and 4, the capture and treatment facilities would be designed to accommodate mine drainage runoff water from the 10-year, 24-hour storm event. This is the minimum design capacity and, where practical, facilities would be constructed with greater capacity. The sizing of these facilities would vary and depend in part upon the nature of the impacts which are predicted from the seepage source, the feasibility of capture system construction, and the expected schedule for operations and reclamation in a given area.

Under Alternatives 3, and 5 through 7, capture systems for mine drainage would be sized to handle seepage resulting from a 100-year, 24-hour storm event wherever the terrain accommodates such a facility.

A phased approach would be used to implement this plan and meet water quality improvement objectives. Phase I includes the construction and implementation of drainage-specific facilities and practices described below (Section 2.3) consistent with the alternative that is finally selected. Following Phase I, the DEQ would issue a Montana Pollution Discharge Elimination System (MPDES) permit. Interim and final water quality effluent limits would be established in the MPDES permit. The goal of Phase I water quality improvement facilities and practices is to achieve compliance with the MPDES effluent limits. However, if water quality objectives are not achieved in any specific drainage, then Phase II would be implemented in that drainage. If Phase II is necessary, the operator would identify the source of the deficiency, and either modify the existing water management facilities and practices, or construct additional capture facilities within the designated "compliance zone." These compliance zones have been identified to indicate the area in the drainages where Phase II water management facilities and monitoring sites could be constructed if needed.

2.3 Drainage-Specific Water Quality Improvement Facilities and Practices

Presented below are drainage-specific plans for improving water quality at the Zortman and Landusky mine sites. The following drainages are addressed:

<u>Zortman Mine Area</u>	<u>Landusky Mine Area</u>
Ruby Gulch	Sullivan Park
Alder Spur	Mill Gulch
Carter Gulch	Montana Gulch
Goslin Gulch	King Creek
Lodge Pole Creek	South Big Horn Creek/Swift Gulch

Information regarding the water quality for each drainage is contained in Sections 3.2 and 4.2 of the EIS.

The water management facilities and practices proposed below are based on site-specific conditions in each drainage. Specific water management plans have been developed to address conditions posed by each of the seven alternatives presented in the EIS. Figures A-1 through A-13 show the existing and proposed water quality improvement facilities and practices for each of the drainages discussed below.

Ruby Gulch

Ruby Gulch drains most of the eastern portion of the Zortman Mine. Unclassified, storm water and mine drainage water management zones are present within this drainage. Mine drainage seepage occurs along the downstream face of the buttress for the 85-86 leach pad. To prevent sediment accumulation in the existing capture pond erosion control practices such as revegetation and silt fences would be used to stabilize soil in areas adjacent to the stream. Existing diversion ditches would be improved and additional ditches would be constructed to collect and route unclassified and storm water runoff around mine drainage areas. The use of diversion ditches and other BMPs would reduce the volume of mine drainage water requiring treatment. The smaller volume of impacted water would then be captured in a pond, pumped to the Zortman Water Treatment Plant and then returned to Ruby Gulch (downstream of the capture pond). Impacted alluvial seepage would be collected in existing and recently completed capture sumps and trenches and treated in the same manner as mine drainage from the leach pad buttress area.

Water quality management facilities and practices proposed under EIS Alternatives 1 through 6 are shown on Figure A-1. These facilities include:

- diversion ditches for segregating unclassified surface water runoff from the east side of Ruby Gulch;
- storm water diversion ditches and sediment retention basins;
- a seepage capture sump below the 85-86 leach pad buttress;
- an alluvial seepage capture trench downgradient of the capture sump;
- a lined, 7.5 million gallon pond designed to capture seepage and mine runoff water;
- an alluvial seepage capture sump located immediately below the capture pond;
- a water treatment plant; and
- BMPs to stabilize slopes and reduce sedimentation.

Except for some additional storm water diversion ditches, sediment basins and other BMPs, the water quality improvement facilities listed above are now in-place. Construction of the capture pond, additional capture sump, and various other BMPs were initiated in 1995, as required by the DEQ's Interim Administrative Compliance Order (Docket No. WQ-95-001, August 11, 1995). The capacity of the new capture pond is sufficient to contain the estimated volume of mine drainage seepage and runoff from the 100-year, 24-hour storm event. The Zortman Water Treatment Plant was constructed in 1994 (See Section 2.4).

Water quality management facilities and practices under Alternative 7, the Preferred Alternative, are shown on Figure A-3 (See also Figure 2.11-3 in the Final EIS). The existing Ruby Gulch capture pond and downstream alluvial seepage sump would remain. An interceptor trench would be constructed immediately below the toe of the new waste rock repository to capture any alluvial seepage. The Zortman Water Treatment Plant would be relocated to a site below the existing capture pond. Both surface and ground water from the mine pit area would be preferentially directed into Ruby Gulch.

Alder Spur

Alder Spur is a tributary of Alder Gulch, which drains the southwestern and western edges of the Zortman mine area. Storm water runoff from the reclaimed buttress for the 83 and 84 leach pads is currently routed through the existing storm water retention pond to provide settling of suspended solids prior to release into Alder Spur. Seeps and flows from leach pad underdrains enter Alder Spur downstream of the existing storm water retention pond. An interim pumpack system presently captures this flow and routes it to the Zortman Water Treatment Plant.

The following water management facilities and practices will address water quality management for Alternatives 1 through 6 of the EIS (see Figure A-2).

Water management facilities and practices proposed for Alder Spur include collecting and treating mine drainage water from the leach pad underdrains using an alluvial seepage capture trench. The impacted water would then be pumped to the Zortman Water Treatment Plant for treatment at its new location. A suitable, stable location immediately downgradient of the proposed interceptor trench is not present for constructing a capture pond. Based on seepage flow information, the proposed trench can be designed with sufficient capacity to eliminate the need for a capture pond.

In addition, improvements in storm water quality will be achieved through the use of BMPs in the area. The existing storm water retention basin was recently converted from an existing contingency pond. This conversion along with the other BMPs were initiated in 1995 as required by the Interim Administrative Compliance Order (Docket No. WQ-95-001).

For Alternative 7, construction of the Zortman Mine waste rock repository would require that a seepage capture trench and a capture pond be constructed below the repository toe in Alder Spur (see Figure A-3).

Carter Gulch

Carter Gulch is one of several tributaries to Alder Gulch which drains the southwestern and western edges of the Zortman mine area. In Carter Gulch, the principal water quality issues are storm water management and seepage from the Alder Gulch waste rock dump. The dump surface was graded, topsoiled and seeded in 1992, however, seepage of mine drainage still occurs at its base, and several episodes of severe erosion have occurred on the dump surface. To collect the seepage, an interim capture system is in place which pumps the water to the Zortman Water Treatment Plant.

Under EIS Alternatives 1 and 2, water management plans proposed for this drainage include diversion of storm water, and collection and treatment of mine drainage seepage. There is limited space in Carter Gulch to construct a capture pond for seepage water that appears at the toe of the repository. Therefore, reducing infiltration into the repository and reducing the volume of seepage released is of particular importance.

Construction of the recovery wells, drainage benches, drainage ditches, and storm water sediment ponds, was initiated in 1995 as required by the Interim Administrative Compliance Order (Docket No. WQ-95-001). These facilities are shown on Figure A-4.

Improved lined drainage benches and ditches to route storm water off the repository were constructed in 1995 to reduce the volume of water infiltrating the dump. Mine drainage water within the repository would be captured by recovery wells which would intercept the water prior to release at the seep. Additional capture capacity would be provided by a seepage capture trench at the toe of the facility. In combination, these two systems would be used to capture the seepage flows of mine drainage while minimizing further disturbances in Carter Gulch.

Under EIS Alternatives 4 and 5, a large waste rock repository would be constructed in Carter Gulch (after removal of the existing waste rock dump). Under Alternative 5 only, a large leach pad would be constructed in upper Alder Gulch. A seepage capture trench and capture pond would be constructed at the toe of both the waste rock repository and the leach pad. Captured water would be pumped to the Zortman Water Treatment Plant. Following reclamation of the repository and leach pad, an extensive storm water diversion network would be constructed to route runoff around and downstream of the mine drainage capture facilities. The water management facilities and practices for the Carter Gulch and Alder Gulch areas under Alternatives 4 and 5 are shown on Figure A-5.

Under Alternatives 3, 6 and 7 of the EIS, the existing Alder Gulch waste rock dump would be removed to prevent continued mine drainage development. Water management under this scenario would include reclamation of the original surface, and construction of storm water diversion ditches and sediment retention ponds. In addition, capture systems would be maintained to collect any residual mine drainage seepage. The proposed facilities and practices under Alternatives 3, 6 and 7 are shown on Figure A-6.

Goslin Gulch

The Goslin Gulch drainage is a natural bowl created between Saddle Butte, Whitcomb Butte and the Ruby Creek drainage. This area is currently undisturbed by mining activities and produces unclassified surface water runoff. Under Alternatives 4, 6 and 7, an 80 million ton leach pad would be constructed in the area of Goslin Gulch referred to as Goslin Flat. Under Alternative 6 only, a waste rock repository would be constructed just east of the Goslin Flat leach pad in an area referred to as Ruby Flat.

Water management facilities and practices under these alternatives include diversion ditches for routing runoff around and downstream of the leach pad and repository, and a contingency capture pond below both the leach pad and waste rock repository to collect any seepage conveyed from beneath the facilities by the underdrains (Figure A-7). Any captured seepage from the Ruby Flats waste rock repository under Alternative 6 would be transferred to the process water circuit at the Goslin Flat leach pad. Post-reclamation seepage from these facilities which does not meet discharge criteria would be captured and treated at either the Zortman water treatment plant or at a new water treatment plant which could be constructed adjacent the leach pad.

Lodgepole Creek

Lodgepole Creek drains the northern side of the existing Zortman Mine pit complex. The mine has not significantly impacted the waters in Lodgepole Creek; therefore, no water capture systems are necessary. The drainage would continue to be monitored and capture systems could be constructed should monitoring identify impacts from mine drainage.

Post-reclamation stormwater drainage of the pit complex would route runoff from the mining areas away from Lodgepole Creek under all the Alternatives. Runoff would be directed instead to the Ruby Gulch drainage. Enhanced reclamation covers (especially under Alternatives 3 through 7) would be used to limit infiltration of precipitation into the groundwater beneath the pit complex. This would decrease the amount of groundwater movement beneath the mine pits that becomes contaminated as mine drainage and result in less water available for migration toward the adjacent drainages, including Lodgepole Creek.

Under Alternatives 4, 5, and 6 excavation within the Lodgepole Creek drainage for the limestone quarry and associated haul road would create potential impacts to water quality from sedimentation. Best Management Practices would be used to reduce sedimentation potential in this drainage.

Alternatives 3 and 7 relocate the limestone quarry out of the Lodgepole Creek drainage and eliminate it as a potential source of impacts to water quality.

Sullivan Creek

The principal water quality issues in Sullivan Creek are storm water runoff from the buttress for the 91 leach pad, seepage of mine drainage from the buttress and/or leach pad underdrain, and associated impacted alluvial seepage. Existing water management facilities include storm water diversion ditches and sediment retention basins, two lined capture ponds (two million gallons each), and a seepage capture system consisting of a recovery well and two seepage capture sumps. All captured water is presently transferred from the ponds to the leaching process water circuit.

Water management plans for Sullivan Creek under EIS Alternatives 1 through 7 include segregation of storm water from mine drainage water and collection and treatment of mine drainage water. These objectives would be achieved using diversion ditches to route storm water around the capture ponds, and by augmenting the existing alluvial seepage capture system with an alluvial seepage capture trench. Utilizing both of the existing capture ponds will provide over four million gallons of mine drainage capture and storage capacity. Mine water runoff from the upper buttress area would be segregated and collected in a capture pond located on the northeast corner of the Mill Gulch Waste Rock Repository. Treatment of captured mine drainage water would be accomplished at the Landusky Water Treatment Plant to be constructed in Montana Gulch. Existing and proposed water management facilities and practices for Sullivan Creek are shown on Figure A-8.

Mill Gulch

Mill Gulch is a tributary to Rock Creek which drains the southern side of the Landusky mine site. The principal water quality issues in Mill Gulch include seepage of mine drainage and storm water runoff from the reclaimed Mill Gulch Waste Rock Repository. Also, storm water and unclassified runoff waters are produced from the Gold Bug Butte area and access roads northwest and slopes south of the repository.

The Mill Gulch Waste Rock Repository is located near the head of the drainage immediately downstream of the 87 leach pad. The repository has been resloped and reclamation is nearly completed. To reduce the infiltration of water into the repository, much of the upper flat area was capped with a geosynthetic liner prior to placement of over four feet of reclamation cover. The repository slopes were reclaimed using a low permeability cap that included a compacted clay barrier layer. A series of diversion ditches have been constructed along benches located across the slope of the repository. The bench drains connect with a lateral diversion ditch which conveys storm water and unclassified runoff around and below the existing mine drainage capture pond. Capture of mine drainage is currently performed by a trench located near the toe of the repository. This water is then pumped to the process water circuit. Seepage can also be captured downgradient of the existing pond; however, waters in this area have maintained a near-neutral pH since placement of the reclamation cap.

Under EIS Alternatives 1 through 7, the existing surface water segregation and mine drainage capture systems will be augmented by a much larger capture pond and two additional seepage capture trenches (see Figure A-9). One of the capture trenches will be directly upstream of the new pond and one directly downstream. Mine drainage water captured in the trenches would be transferred to the new capture pond. Additional diversion ditches would be constructed to route runoff from adjacent storm water and unclassified zones around the new capture facilities. Seepage collected in the existing pond would be transferred to the larger proposed capture pond. All captured water would be pumped to the Landusky Water Treatment Plant to be constructed in Montana Gulch.

Montana Gulch

Montana Gulch drains the western portion of the Landusky mine site. Montana Gulch poses several unique situations when compared with the other drainages:

- multiple mine drainages exist within Montana Gulch, each of which differ chemically and physically;
- the historic Gold Bug Adit and the historic August Drain Tunnel provide continuous, relatively high flows of mine drainage into Montana Gulch; and

- Montana Gulch receives runoff water from relatively large undisturbed areas.

As with other drainages, the proposed water management practices include segregation of unclassified and storm water runoff from mine drainage, and collection and treatment of impacted water. However, the diversity of conditions requires a more complex water management plan than other drainages. The present water management plan for Montana Gulch is the result of extensive engineering evaluations by ZMI.

Under Alternatives 1 through 7 of the EIS, the water management plan is for the construction of:

- additional diversion structures to segregate unclassified and storm water runoff from mine drainage runoff;
- additional storm water sediment retention basins;
- BMPs to reduce erosion and sediment yield in storm water and mine drainage zones;
- alluvial seepage capture trenches located below the Montana Gulch Waste Rock Dump, the buttress to the 85/86 leach pad, and the buttress to the 83 leach pad;
- the conversion of the existing Gold Bug aeration pond into a mine drainage capture pond; and;
- a water treatment plant.

Existing and proposed water management facilities are shown on Figure A-10.

In addition to the water management plans described above, Alternatives 3, 6 and 7 of the EIS call for the construction of a "drainage notch" to facilitate surface water drainage out of the Landusky Mine pits and into Montana Gulch (see Figure A-11). Under this plan, storm water runoff would flow from the backfilled and reclaimed pit floor into an engineered ditch, and then through a sediment retention pond and into Montana Gulch. This would result in a decrease in water infiltration through the pit floor and decrease mine drainage seepage elsewhere.

Alternatives 3 and 7 include construction of a drainage trench in Montana Gulch where it confluences with a west fork tributary adjacent the 85/86 leach pad. This drainage trench would route runon water from the tributary around the leach pad instead of through the underdrain.

King Creek

King Creek drains the northwestern portion of the Landusky mine site towards the Fort Belknap Reservation. A large volume of tailings had been deposited in upper King Creek as a result of historic mining operations. The majority of these tailings above the existing Cumberland Dam were removed in the 1980s by ZMI. In 1993, ZMI removed the remaining tailings, which was followed by a revegetation program.

The upper King Creek drainage basin is classified as a storm water management zone, although one seep originates at the upper margin of King Creek and is classified as mine drainage. The water management practices proposed for this drainage under EIS Alternatives 1 through 4, 6 and 7, include capturing this seepage before it mixes with storm water runoff. Also, the Cumberland Dam, which is constructed of historic tailings, would be reconstructed as a storm water retention pond with non acid forming or carbonate rock. These plans are shown on Figure A-12.

Under Alternatives 5, rock fill would be removed from the head of King Creek and used as backfill to raise the pit floor. This would create a "notch" and a pit surface which would allow runoff to freely drain into King Creek. Mine related fill in King Creek would be removed to expose the original ground surface and used as pit backfill. The original surface would be revegetated. The Cumberland Dam would be removed and a new collection pond would be installed upgradient. Runoff from the mine pit highwalls would constitute mine drainage and would be routed to the water treatment plant and ultimately discharged into Montana Gulch. These constructions are shown on Figure A-13.

South Big Horn Creek/Swift Gulch

Swift Gulch drains the northern portion of the Landusky mine pit complex. The mine has not significantly impacted the waters in Swift Gulch or South Bighorn Creek; therefore, no water capture systems are necessary. Under all alternatives the drainage would continue to be monitored and capture systems could be constructed as appropriate should monitoring identify impacts from mine drainage. Post-reclamation stormwater drainage of the pit complex would route runoff from the mining areas away from Swift Gulch.

2.4 WATER TREATMENT

Zortman Mine Water Treatment Plant

A 2,000-gpm capacity water treatment plant was constructed in May 1994 to treat seepage water captured from the toe of existing mine waste rock dumps at the Zortman Mine. The water treatment plant is located approximately 120 feet west of the refinery and operates at a rate of 200 to 2,000 gpm depending on factors such as precipitation amounts and seasonal operating conditions.

The Zortman water treatment plant is designed to treat acidic water, such as seepage from waste rock dumps. The influent typically has a pH ranging from 2.2 to 5.5 and contains significant concentrations of iron, sulfate, and aluminum with lesser amounts of copper, manganese, zinc, nickel, lead and cadmium. The water treatment plant is operated under an Administrative Compliance Order issued by the Montana DEQ on June 29, 1994. Interim effluent discharge standards from the plant are Best Available Technology Economically Achievable (BAT) for mine waters (40 CFR 440.100). Establishment of final effluent limits and outfall points would occur as part of MPDES permit development.

Seepage water is being collected from Ruby, Carter and Alder Spur drainages, and pumped to the 4 million gallon water treatment plant flow equalization pond immediately south of the water treatment plant (Figure 2.5-3). Pumps in the pond deliver the water to the treatment facility which provides treatment using a metal hydroxide precipitation process. The treated effluent is discharged to Ruby Gulch. The precipitated metals form a sludge which is pumped to a containment trench on the Zortman 89 leach pad.

<u>Feed Water Collection</u> - Feed water is first collected from the mine site using pumpback systems which are operating in Alder Spur Gulch, Carter Gulch and Ruby Gulch. The feed water then gets pumped back to a flow equalization pond. The majority of the seepage water is collected in Ruby Gulch (80%) while Carter Gulch and Alder Spur Gulch contribute 10% each. Flows are highest during snowmelt runoff and the rainy season and lowest during the winter.

The water treatment flow equalization pond is a collection and storage facility for the seepage water. The water is stored in the pond to smooth out variations in concentrations and flow rates before being pumped to the treatment plant. The pond also serves to collect any recycle streams such as water collected in the treatment building sumps.

<u>Hydroxide Precipitation</u> - Most metals are removed from the water by hydroxide precipitation. Hydrated lime

($Ca(OH)_2$) is added to the water to precipitate the metals. The hydroxide precipitation is accomplished in a series of three continuously mixed tanks followed by a thickener. The first two tanks achieve metals precipitation. The third tank is used to flocculate the resulting solids for subsequent settling in the thickener.

In the first tank, the raw feed water is reacted with lime and recycled sludge to neutralize free acids and to precipitate metals. If the system is saturated with calcium sulfate, a portion of the calcium sulfate will also be precipitated in this step.

The second reactor provides additional residence time to complete the neutralizing reaction of lime and recycled sludge with the feed water. This reactor also provides additional opportunity for supersaturated calcium sulfate to precipitate before entering the flocculation tank.

The flocculation (third) tank allows time for the precipitated solids formed in the first two tanks to react with an ionic polymer flocculent. The flocculating agent aids in settling and clarification in the thickener. The flocculated material then flows to a thickener where the solids settle and are removed for recycle and disposal. Decant water from the thickener will be discharged to Ruby Gulch. About 75% of the sludge from the thickener is recycled to the first reactor where it reacts with the raw feed and lime to neutralize and precipitate metals in the feed water.

Treatment Duration - The Zortman water treatment plant is being operated as an interim measure to treat low pH seepage emanating from the base of existing waste rock facilities and leach pad buttresses. The water treatment plant would continue to operate until final reclamation measures have successfully produced effluent that meets the water quality standards. The duration that water treatment is likely to be necessary varies by alternative. For Alternatives 1 and 2 long-term operation of water treatment plants would most likely be necessary after mine closure to meet and maintain water quality objectives. Of the non-expansion alternatives only under Alternative 3 is there likely to be an opportunity to discontinue active water treatment and still meet water quality standards. Of the expansion alternatives Alternative 7 is most likely to provide for an opportunity to discontinue active water treatment. This is due to the smaller disturbance acreage receiving recharge and the increased likelihood for long-term success of surface reclamation compared to Alternatives 4, 5 and 6 (See also, Chapter 4).

Landusky Mine Water Treatment Plant

A second water treatment plant would be constructed at the Landusky Mine under any of the EIS alternatives to provide treatment of mine drainage water captured in Montana Gulch and throughout the Landusky mine site. The water treatment plant would be very similar to the existing Zortman water treatment plant, using lime to control pH and precipitate metals. It would be located in the Montana Gulch area southwest of the 83 leach pad as shown on Figure A-10. This location was selected to provide for gravity feed of the largest volumes of water likely to require treatment derived from mine facilities in the Montana Gulch area and from the reclaimed mine pit complex. This site was selected because of its topographic position and accessibility during winter. This site is downgradient of the Gold Bug Adit which is the largest continuous source of mine drainage water on the Landusky site.

3.0 WATER QUALITY MONITORING PLAN

3.1 Overall Approach to Water Quality Monitoring

Mine-wide water resources monitoring of surface and ground water conditions are described in Chapter 2 for each alternative presented in the EIS and are required components of a mine Plan of Operation and Operating Permit. In addition to the mine-wide monitoring program requirements are the requirements for more intensive monitoring of water quality and quantity that would be conducted in conjunction with implementation of the Water Quality Improvement Plan and development/administration of a MPDES Permit. Development of this monitoring program is described below:

The surface water and groundwater quality and flow monitoring program would be performed to:

- determine the effectiveness of capture and treatment facilities;
- determine the effectiveness of BMPs;
- document compliance with interim and final MPDES permit effluent limits; and
- monitor improvements in ambient water quality.

This section describes the basic framework for a detailed Sampling and Analysis Plan to be developed by ZMI to achieve the above objectives. Details regarding sample collection, flow measurements, analytical testing, monitoring frequency, data quality, data management, data evaluation and reporting will be presented in the final Sampling and Analysis Plan. The final Sampling and Analysis plan will be consistent with Montana Pollution Discharge Elimination System (MPDES) requirements and the EIS alternative selected for implementation in the Record of Decision.

The final Sampling and Analysis Plan will identify initial point-of-discharge monitoring locations and a compliance zone for each drainage. As water management facilities are completed, water quality monitoring of point source discharges from mine drainage capture facilities will be initiated. Groundwater monitoring will be conducted downgradient of mine drainage discharge points. Storm water releases will also be monitored at the point-of-discharge to waters of the state. Ambient monitoring stations would be located within the compliance zones to monitor in-stream quality. These ambient monitoring stations would generally be located at the downstream end of the compliance zone to establish a consistent reference point for evaluating water quality improvements.

3.2 Sample Collection

Field sampling procedures and frequencies will be documented in the final Sampling and Analysis Plan. All field procedures will be consistent with standard practices outlined in the National Handbook of Recommended Methods for Water Data Acquisition (U.S. Geological Survey, 1977) or other accepted and appropriate methods. Sampling procedures will include the collection of an appropriate number of quality control samples including field blanks, rinsate blanks, duplicate samples and standards.

3.3 Flow Measurements

Flow data will be collected to support: (1) engineering designs, and (2) evaluation of capture system effectiveness. Flow data to support engineering designs have been collected near water discharge monitoring points in each drainage. This flow data will continue to be collected. Following the construction of water management facilities, flows will be monitored at each discharge. Flows at storm water discharges and ambient monitoring sites will be estimated during collection of water quality samples. Flows for some mine drainage discharge stations will be monitored using permanently installed instruments.

The capture systems described in Section 2 are designed to provide effective capture of surface runoff and alluvial seepage. To evaluate the effectiveness of the capture systems, at least one effectiveness monitoring station will be established in each drainage. Each station will be located immediately downgradient of the capture facility in the drainage bottom. Where alluvial material is present, the effectiveness monitoring station would consist of a monitoring well or piezometer. Water levels in the well equal to or less than the elevation of the alluvial/bedrock interface would indicate successful seepage capture. In the case where there is no appreciable alluvial material, the effectiveness monitoring station would consist of a surface water flow measurement device. In this case, no measurable flow should occur above the bedrock surface. Additional site-specific details regarding effectiveness monitoring procedures and frequencies will be provided in the final Sampling and Analysis Plan.

3.4 Analytical Testing

In general, two types of water samples would be collected under this plan: (1) storm water discharge, and (2) mine drainage and ambient water. Each type will be analyzed for a specific suite of parameters. These parameters will be proposed in the final Sampling and Analysis Plan. The analytical lists will include selected metals, major ions, and other relevant water quality parameters. The parameters will be selected to monitor the effectiveness of BMPs, capture facilities, and treatment systems. These parameters will also permit a determination of compliance with interim and final effluent limits. Laboratory analyses will be performed in accordance with the methods in 40 CFR Part 136 or equivalent.

3.5 Determination of Compliance

The primary goal of water quality monitoring is to determine if compliance with interim and final effluent limits is achieved after implementation of water quality improvement facilities and practices. Compliance before and during implementation of the Phase I construction period will be based on adherence to the construction schedule and interim effluent limits. The Phase I construction period is defined as the initial construction plus the additional time required to monitor facility effectiveness. Upon satisfactory completion of all Phase I tasks, the Montana Department of Environmental Quality would issue an MPDES permit. The permit will stipulate interim and final effluent limits for established point-of-discharge locations.

The water quality improvement facilities and practices described in this Water Quality Management Plan are designed to meet potential MPDES effluent limits. Following completion of the Phase I constructions, there will be a period of effectiveness monitoring under interim water quality effluent limits. If water quality and capture effectiveness objectives are not being achieved, additional Phase II actions may be required. Any additional facilities to be constructed will be located downgradient of the Phase I facilities within the established "compliance zone." These "compliance zones" have been identified in the figures to indicate the drainage areas where water management facilities and monitoring sites will be located should Phase II construction be necessary. Ambient monitoring stations are to be located at the downgradient end of the compliance zones to establish a consistent reference point for evaluating water quality improvements.

Point source effluent monitoring data would be submitted to the DEQ by the 28th day of the month following the completed reporting period (calendar month). Ambient monitoring data would be submitted to the DEQ no later than 45 days after the completion of the previous calendar quarter. Annual summary reports and narratives may be submitted 90 days after completion of the calendar year.

4.0 IMPLEMENTATION SCHEDULE

Interim seepage capture and treatment measures plus runoff management practices are currently in effect at the existing mining operations to ensure that water quality in each drainage is stabilized or improved until the construction plans can be finalized. Many of these interim measures were constructed in 1995 in accordance with the Interim Administrative Compliance Order (Docket No. WQ-95-001) issued by the Montana DEQ.

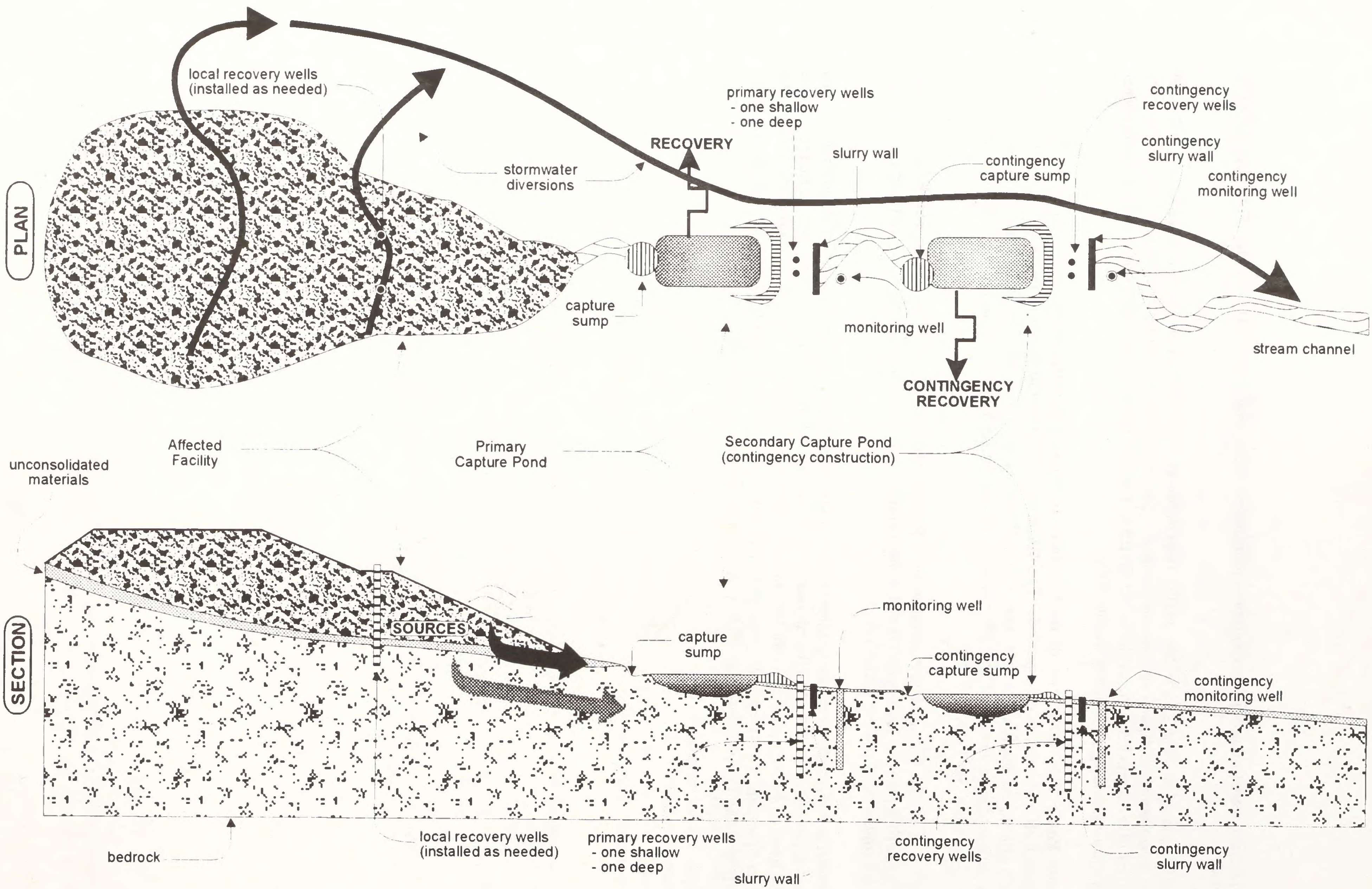
Additional interim water quality improvement requirements were issued previously by the BLM and DEQ in 1993 and 1994.

Actual construction of the Phase I water quality improvement facilities would require at least one full field season after acceptance of final engineering designs. Contingent upon obtaining the necessary regulatory approvals from other agencies such as the COE or EPA, Phase I construction would be initiated in drainages impacted by existing mining operations during 1996.

Any necessary Phase II constructions or modifications to Phase I facilities would be conducted following a suitable Phase I effectiveness review period. The BLM and DEQ would develop a Phase II implementation schedule with stipulated deadlines in the event Phase II actions are required. Any additional construction that may be necessary after a review of the effectiveness of the Phase I water management structures would be initiated by December 31, 1999.

Upon completion of the EIS and the issuance of a Record of Decision, ZMI would be required to submit certified engineering plans to BLM and DEQ for any capture and treatment systems that would be used at new mine facilities under the Preferred Alternative.

Under Alternative 7 this would require detailed plans for construction of seepage capture and treatment systems be submitted for the Goslin Flats leach pad and the new waste rock repository in Alder Spur drainage. These plans would have to be accepted as complete prior to initiating discharge. This means prior to altering the existing Alder Spur capture system with construction of the new waste rock facility; and prior to discharge (liner perforation) from the reclaimed Goslin Flats leach pad at the end of mine life.

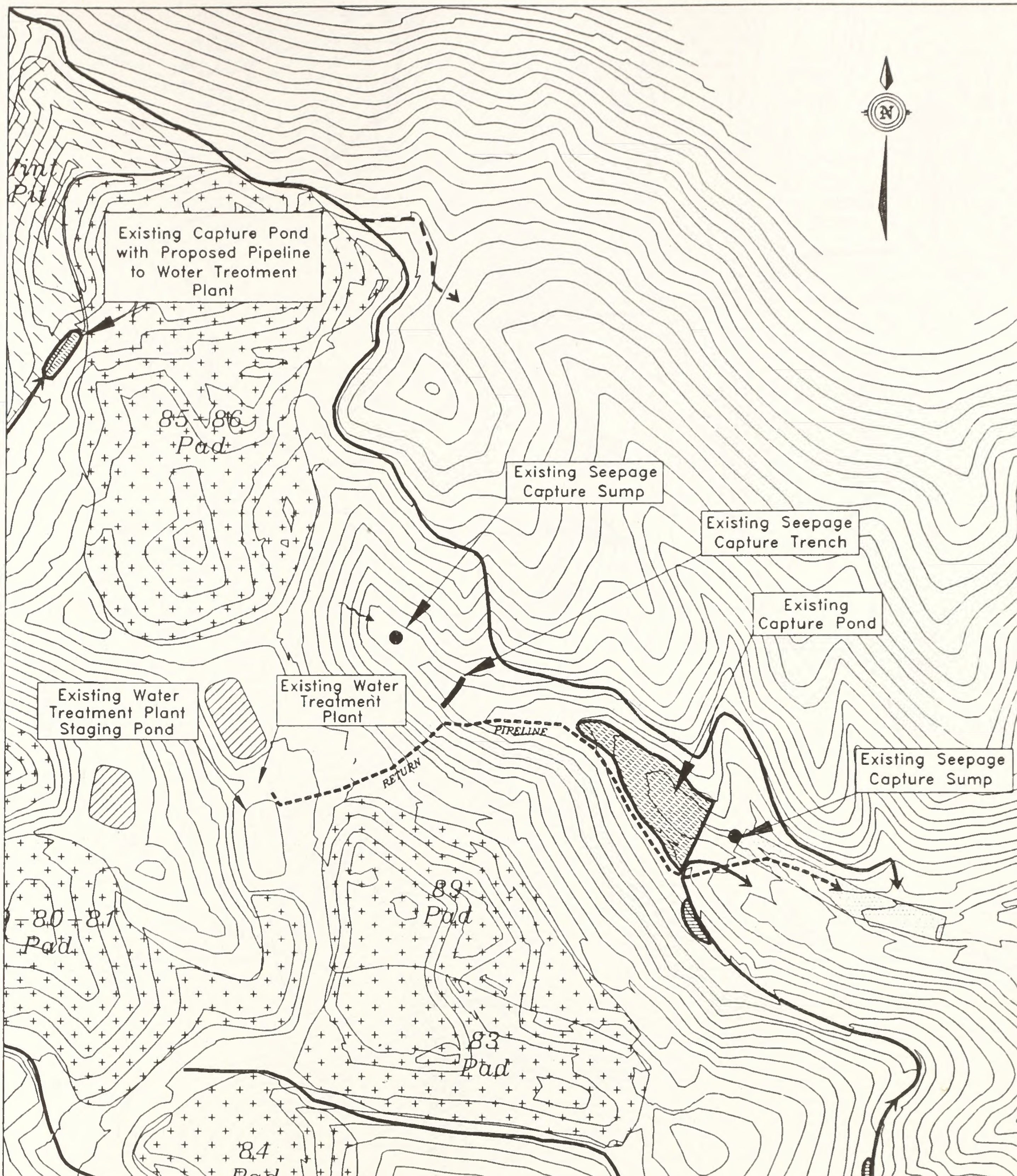


Schematic of Capture System

(not to scale)

FIG. A

Charles W Russell Ph D
10 August 1994



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basins
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

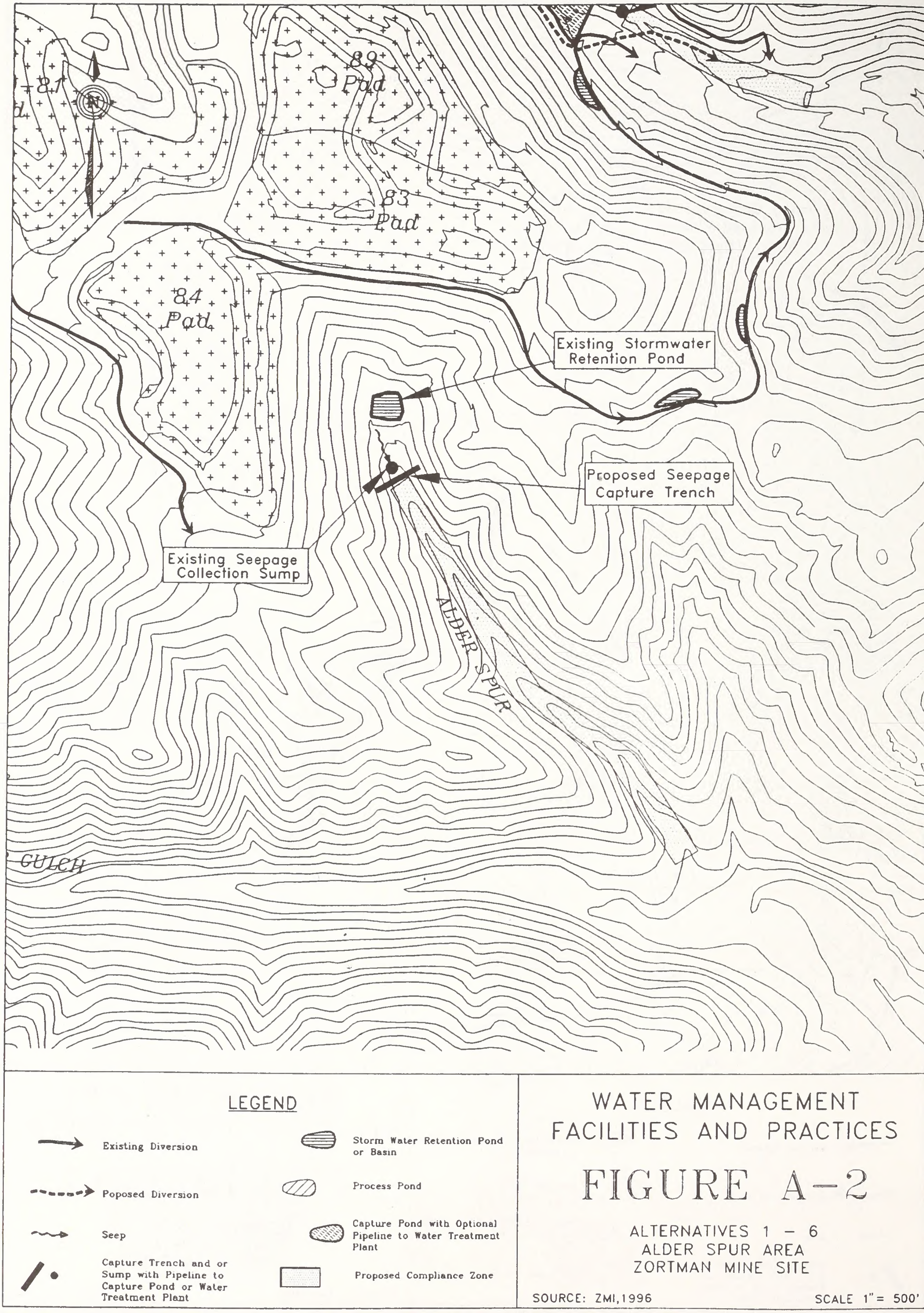
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-1

ALTERNATIVES 1 - 6
RUBY GULCH AREA
ZORTMAN MINE SITE

SOURCE: ZMI, 1996

SCALE 1" = 500'



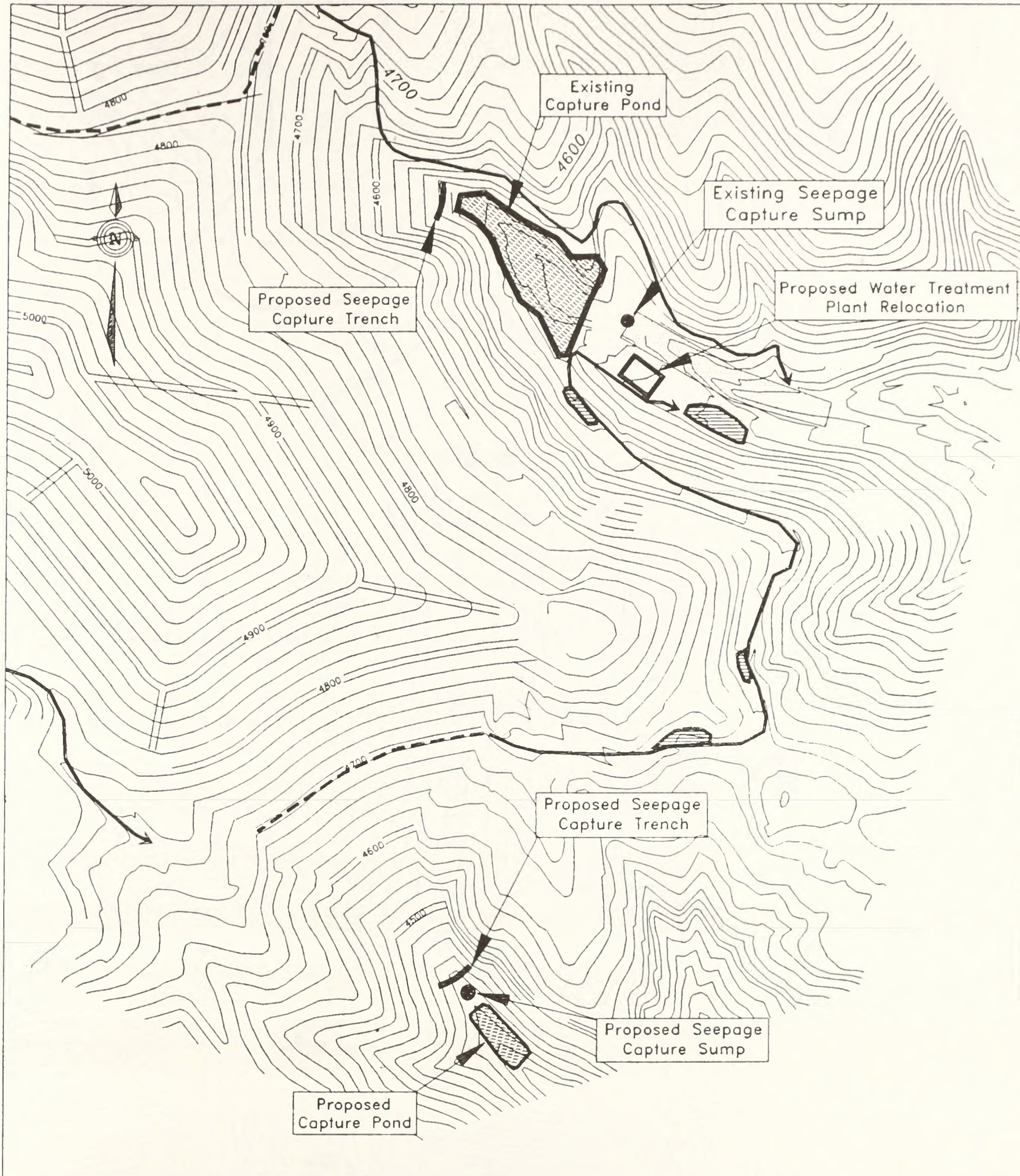
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A–2

ALTERNATIVES 1 – 6
ALDER SPUR AREA
ZORTMAN MINE SITE

SOURCE: ZMI, 1996

SCALE 1" = 500'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

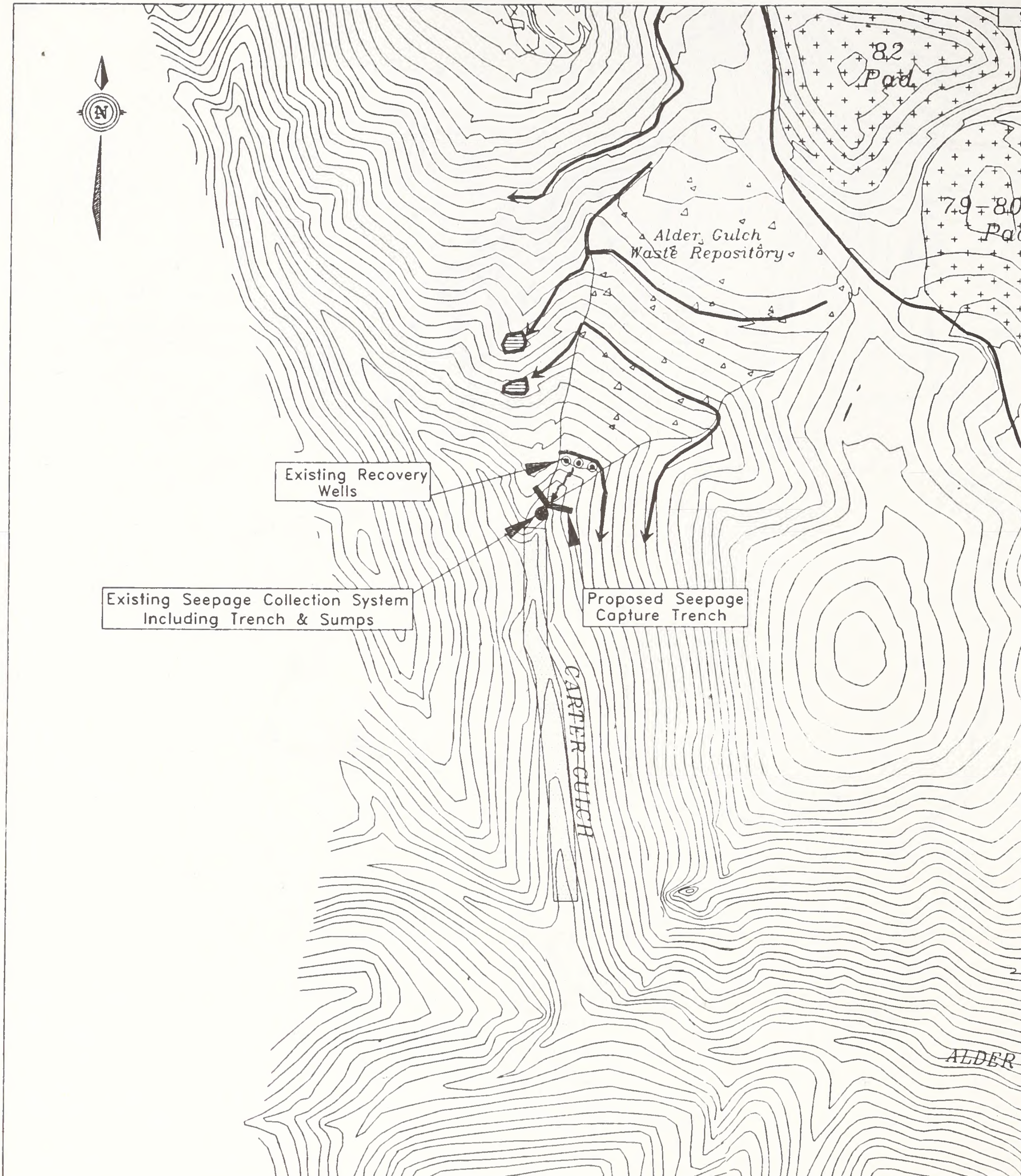
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-3

ALTERNATIVE 7
RUBY GULCH AND ALDER SPUR AREAS
ZORTMAN MINE SITE

SOURCE: ZMI,1996

SCALE 1" = 500'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

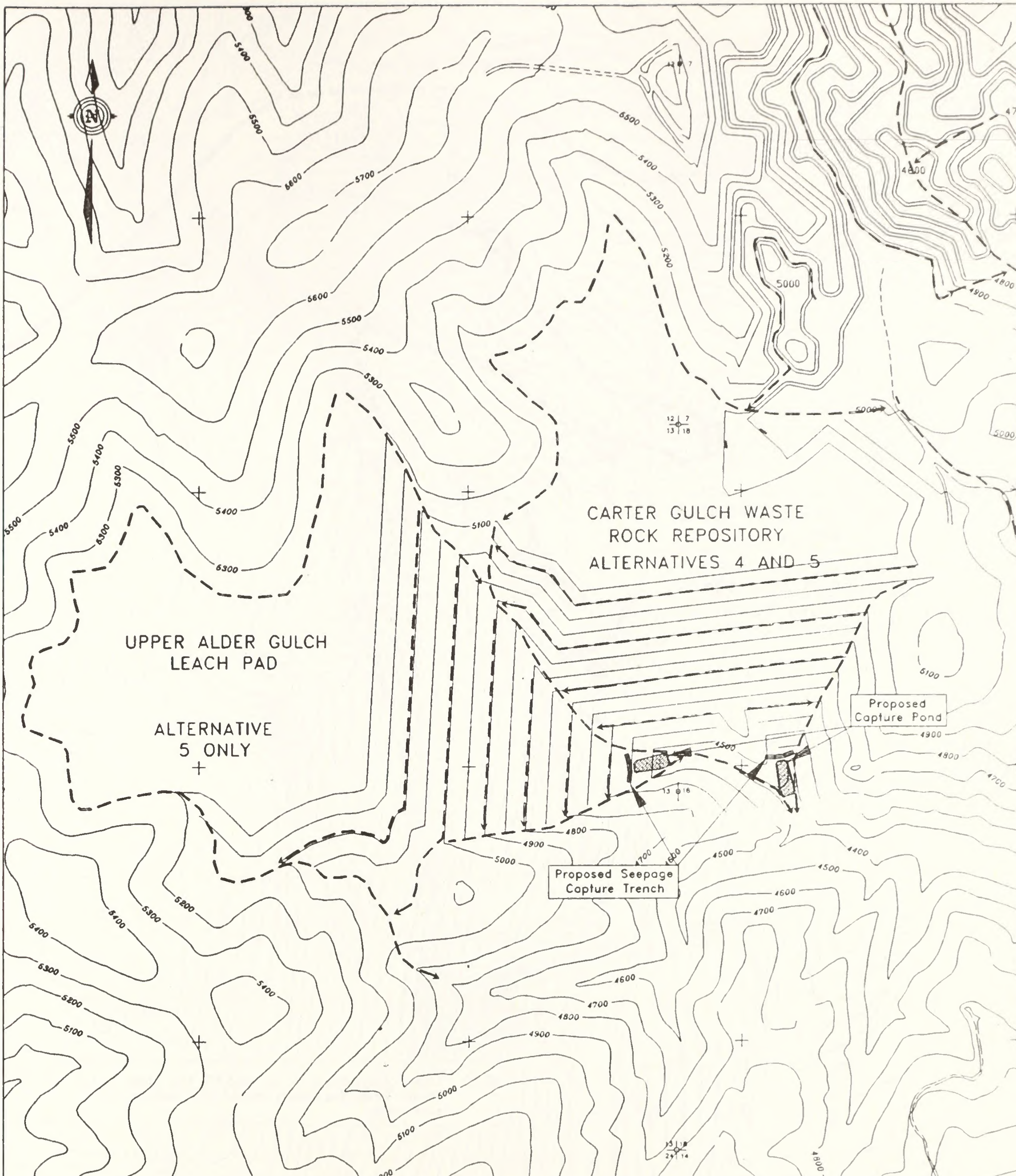
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-4

ALTERNATIVES 1 AND 2
CARTER GULCH AREA
ZORTMAN MINE SITE

SOURCE: ZMI, 1996

SCALE 1" = 500'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-5

ALTERNATIVES 4 AND 5
ALDER GULCH AREA
ZORTMAN MINE SITE

SOURCE: ZMI,1996

SCALE 1"=1000'

LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

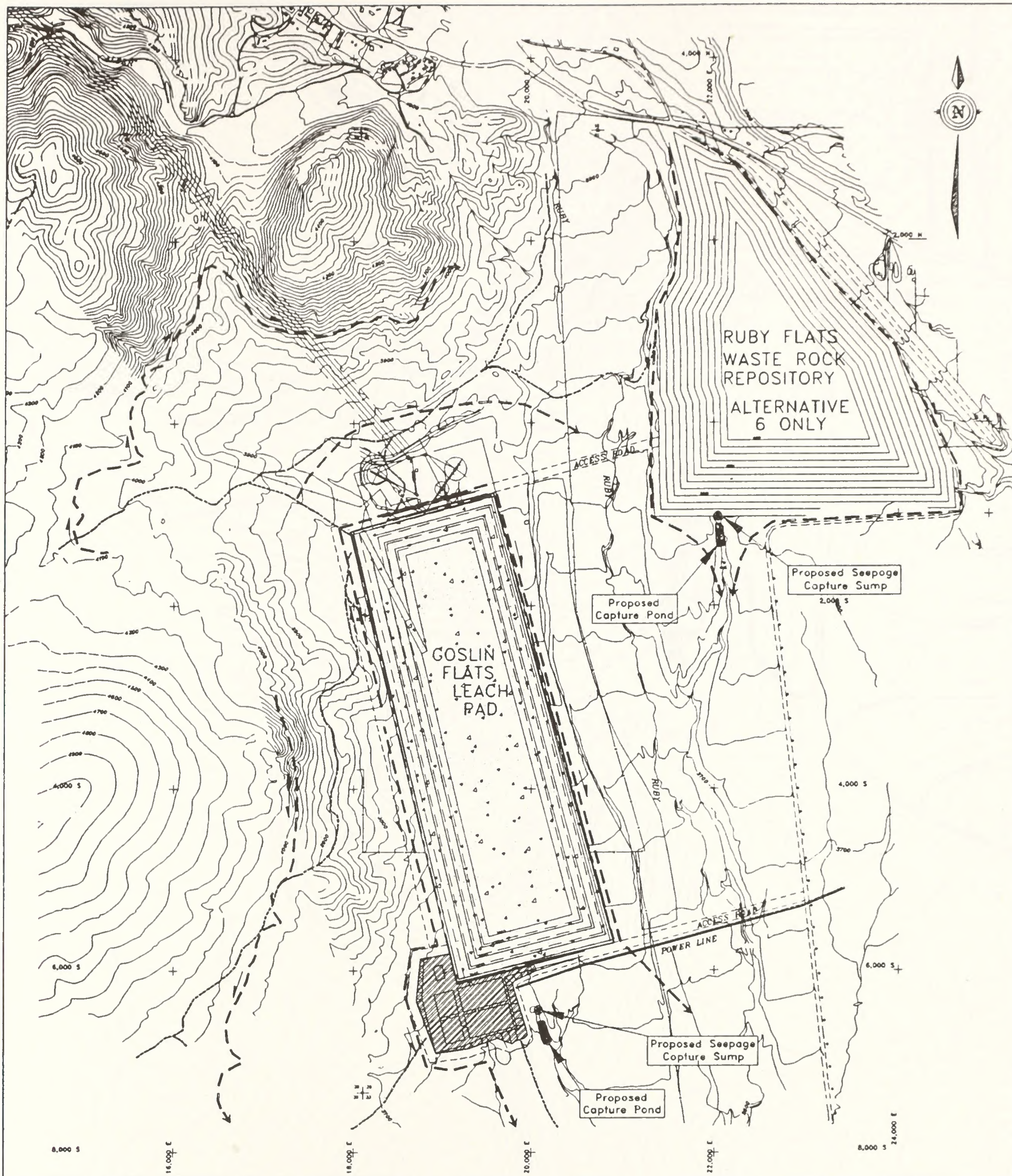
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-6

ALTERNATIVES 3, 6 AND 7
CARTER GULCH AREA
ZORTMAN MINE SITE

SOURCE: ZMI,1996

SCALE 1"=300'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

WATER MANAGEMENT
FACILITIES AND PRACTICES

FIGURE A-7

ALTERNATIVES 4, 6 AND 7
GOSLIN GULCH AREA
ZORTMAN MINE SITE

SOURCE: ZMI,1996

SCALE 1"=1500'

LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

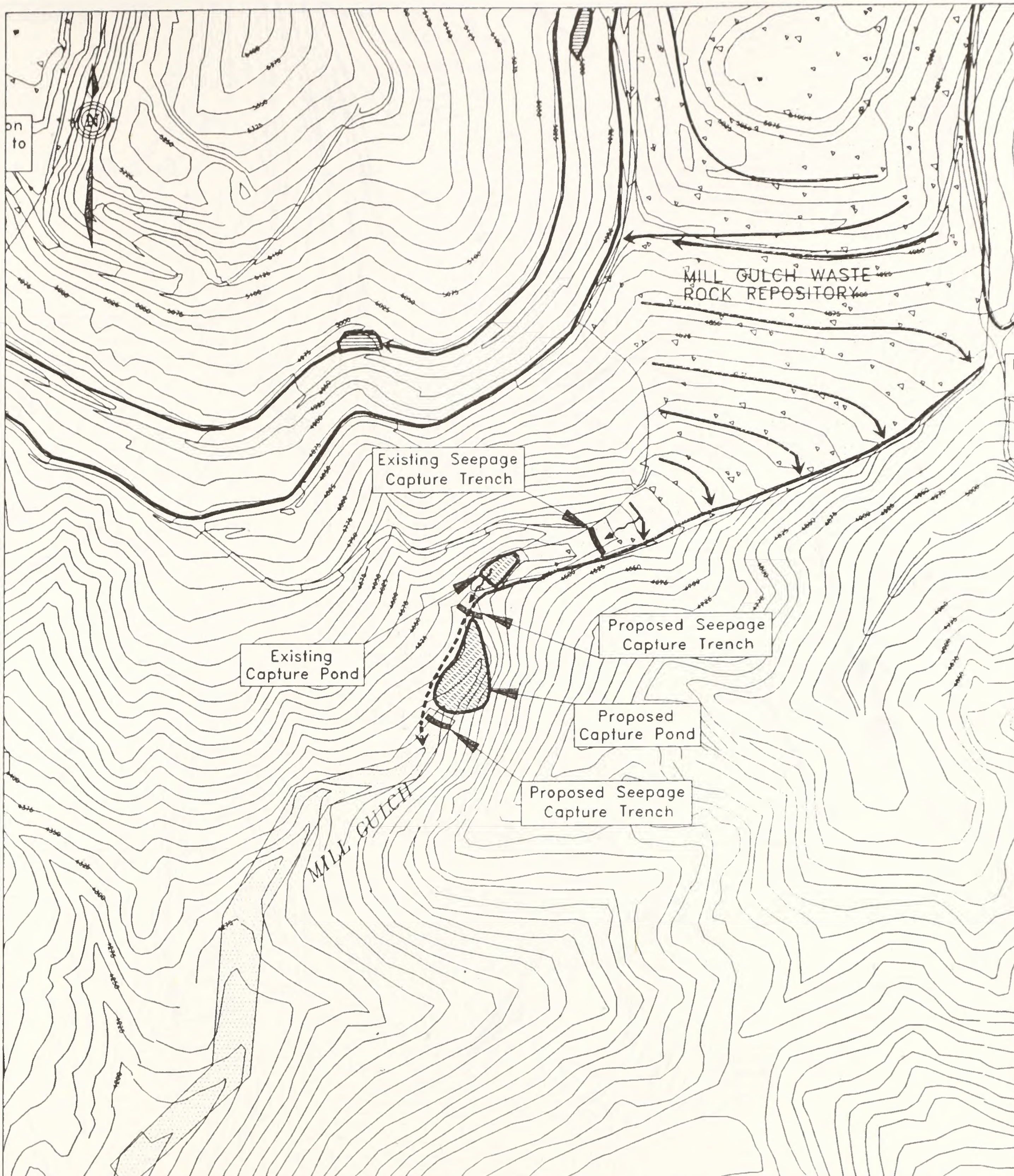
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-8

ALTERNATIVES 1 – 7
SULLIVAN PARK AREA
LANDUSKY MINE SITE

SOURCE: ZMI,1996

SCALE 1"= 500'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

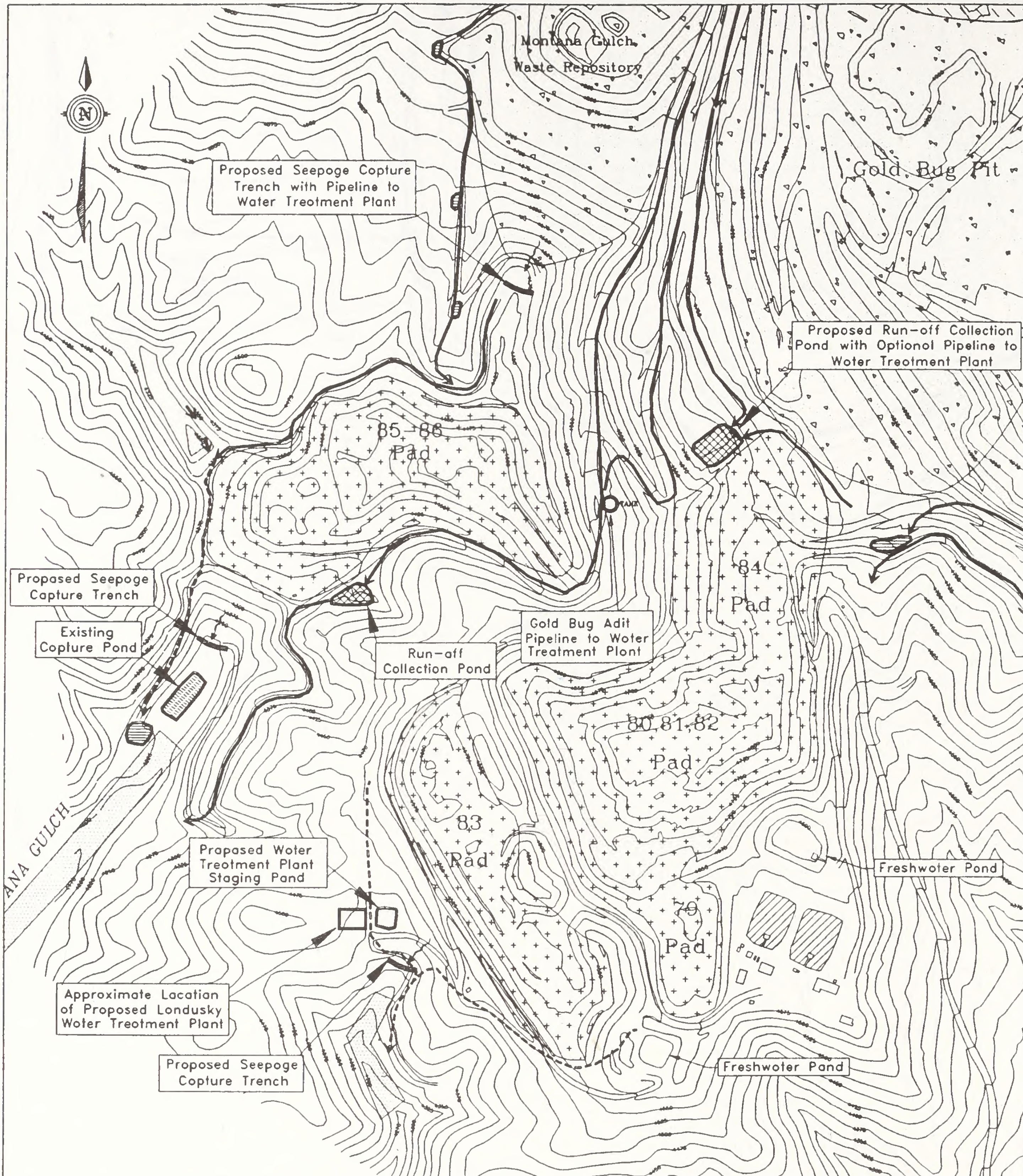
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-9

ALTERNATIVES 1 - 7
MILL GULCH AREA
LANDUSKY MINE SITE

SOURCE: ZMI, 1996

SCALE 1" = 500'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

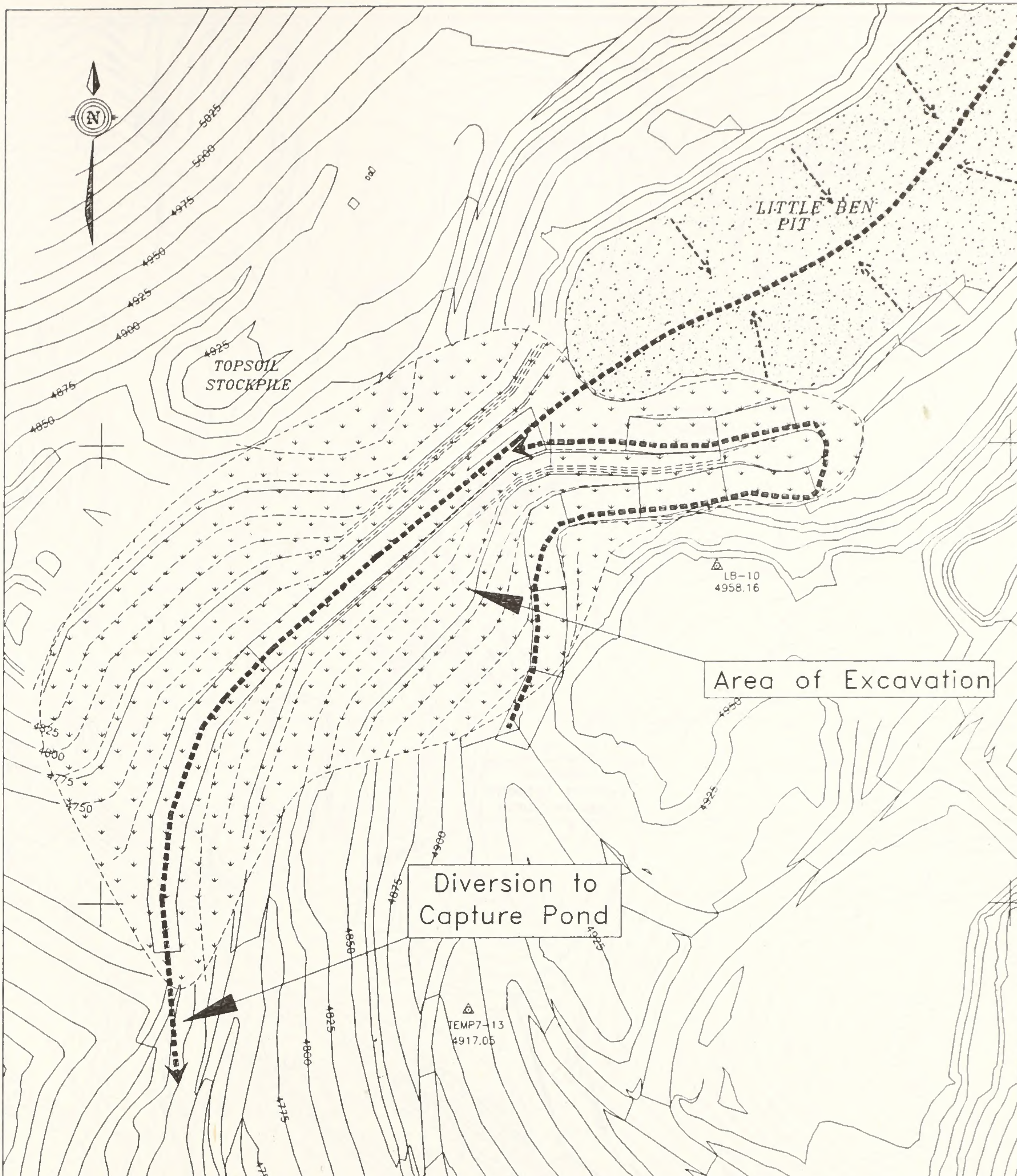
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-10

ALTERNATIVES 1 - 7
MONTANA GULCH AREA
LANDUSKY MINE SITE

SOURCE: ZMI,1996

SCALE 1"= 600'



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

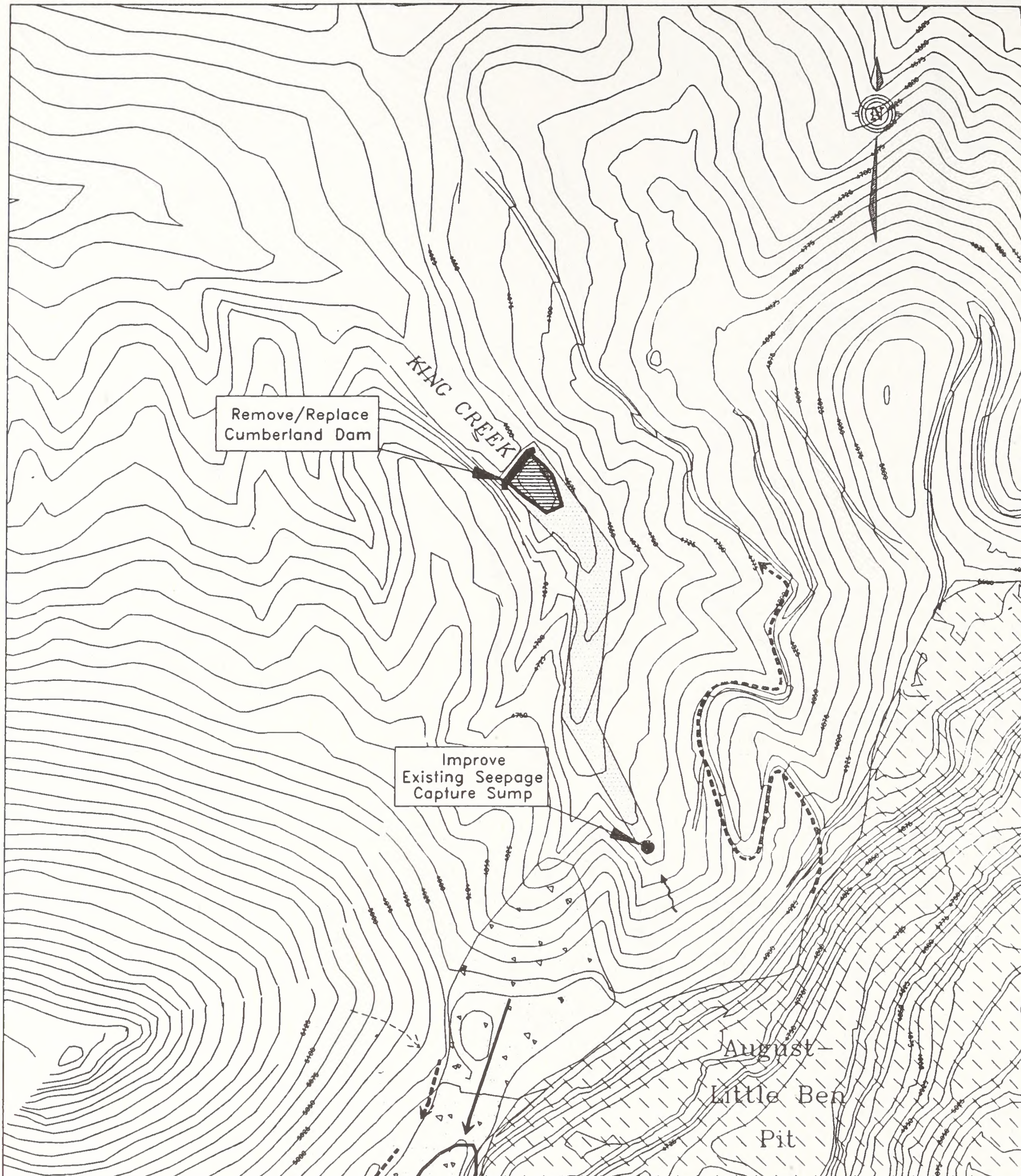
WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A–11

ALTERNATIVES 3, 6, AND 7
PIT DRAINAGE TO MONTANA GULCH
LANDUSKY MINE SITE

SOURCE: ZMI,1996

SCALE 1" = 300



LEGEND

- Existing Diversion
- Poposed Diversion
- Seep
- Capture Trench and or Sump with Pipeline to Capture Pond or Water Treatment Plant
- Storm Water Retention Pond or Basin
- Process Pond
- Capture Pond with Optional Pipeline to Water Treatment Plant
- Proposed Compliance Zone

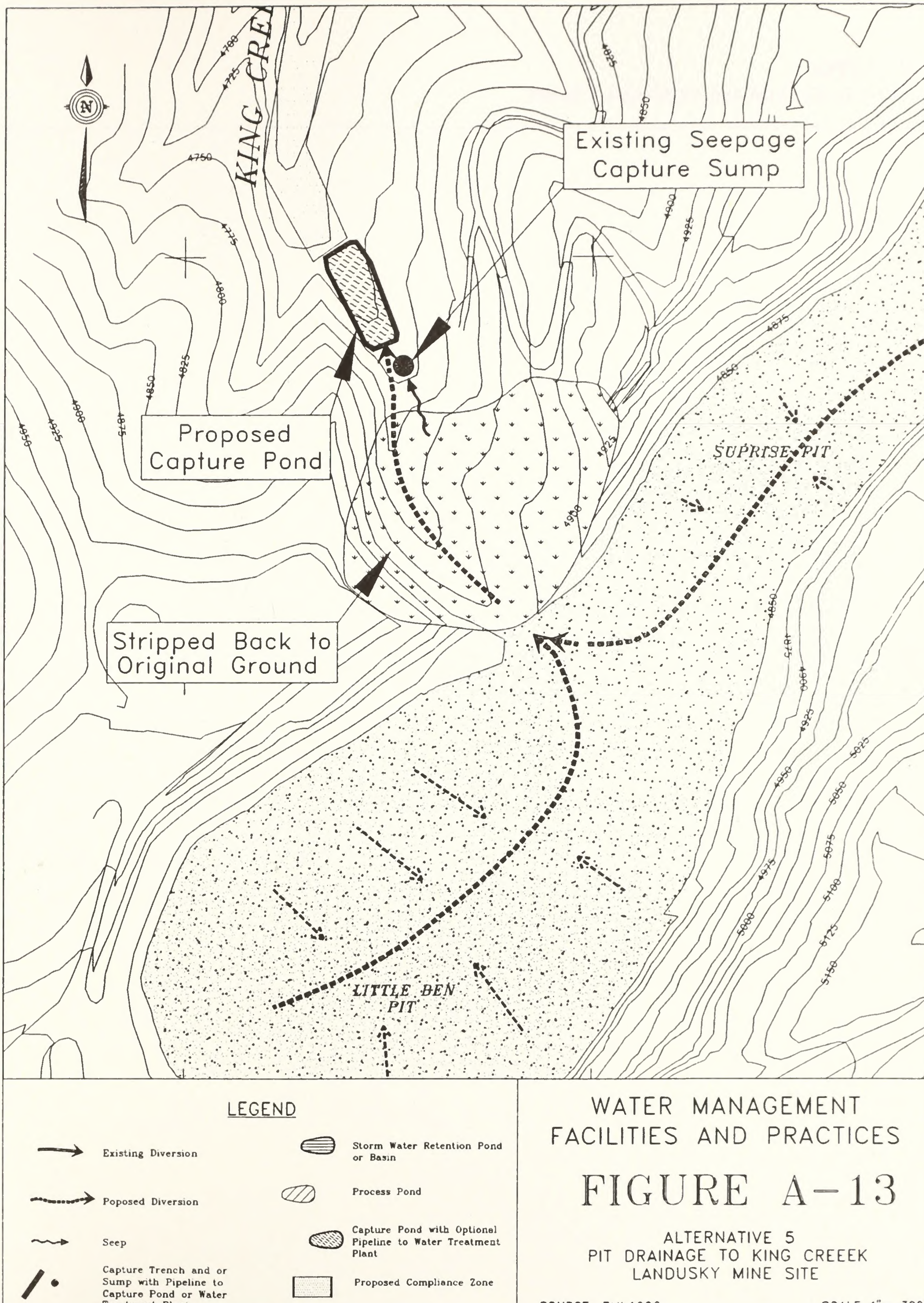
WATER MANAGEMENT
FACILITIES AND PRACTICES

FIGURE A-12

ALTERNATIVES 1 - 4, 6, AND 7
KING CREEK AREA
LANDUSKY MINE SITE

SOURCE: ZMI,1996

SCALE 1"= 500'



WATER MANAGEMENT FACILITIES AND PRACTICES

FIGURE A-13

ALTERNATIVE 5
PIT DRAINAGE TO KING CREEEK
LANDUSKY MINE SITE

SOURCE: ZMI,1996

SCALE 1"= 300'

APPENDIX B
DRAFT SECTION 404(b)(1) EVALUATION

APPENDIX B

DRAFT SECTION 404(b)(1) EVALUATION

Prepared by:
Department of Environmental Quality
and
U.S. Bureau of Land Management

Prepared for:
Zortman Mine and Landusky Mine Expansion and Reclamation Project

CONTENTS

LIST OF TABLES

DRAFT SECTION 404(b)(1) EVALUATION
Zortman Mine and Landusky Mine Expansion and Reclamation Project

This draft Section 404(b)(1) evaluation represents the Montana Department of Environmental Quality's and the U.S. Bureau of Land Management's (collectively referred to as the Agencies) assessment on how the preferred alternative (Alternative 7) complies with the requirements of the 404(b)(1) guidelines. A preliminary draft of this evaluation was included in the draft environmental impact statement (EIS). Comments from the public and government agencies (including the U.S. Army Corps of Engineers [COE] on the preliminary draft evaluation) were reviewed and appropriate revisions made to this draft Section 404(b)(1) evaluation. This draft evaluation has been prepared by the Agencies and reviewed by the COE; however, it is not intended to represent the final conclusions of the COE or its final 404(b)(1) evaluation.

1.0 SUBPART A - GENERAL INTRODUCTION

The 404(b)(1) Guidelines (40 Code of Federal Regulations [CFR] 230) are the substantive criteria used to evaluate discharges of dredged or fill material in waters of the U.S. under Section 404 of the Clean Water Act, and are applicable to all Section 404 permit decisions. Fundamental to these guidelines is the precept that dredged or fill material should not be discharged into an aquatic ecosystem unless it can be demonstrated that such discharges would not have unacceptable, adverse impacts either individually or in combination with known or probable impacts of other activities affecting the ecosystems of concern.

Subpart B of the guidelines outlines restrictions imposed on all discharges, the factual determinations required by the guidelines and specifications for a determination of compliance or noncompliance with the guidelines.

Section 230.10(a) states that no discharge of dredged or fill material shall be permitted, except as provided under Section 404(b)(2) of the Clean Water Act, if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

Section 203.10(b) establishes three conditions, applicable to inland waters, that must be satisfied to make a finding that a proposed discharge complies with the guidelines. No discharge of dredged or fill material shall be permitted if it:

1) Violates applicable state water quality standards;

2) Violates any applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act; or

3) Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat which is determined to be a critical habitat.

Section 230.10(c) provides that no discharge of dredged or fill material shall be permitted if it will cause or contribute to significant degradation of the waters of the U.S., except as provided under Section 404(b)(2). Effects contributing to significant degradation individually or collectively include significantly adverse effects of the pollutants on:

1) human health or welfare, including but not limited to effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites;

2) life stages of aquatic life and other wildlife dependent on aquatic ecosystems;

3) aquatic ecosystem diversity, productivity, and stability; or

4) recreational, aesthetic, and economic values.

Section 230.10(d) prohibits the discharge of dredged or fill material, except as provided under Section 404(b)(2) of the Clean Water Act, unless appropriate and practicable steps have been taken to minimize potential adverse effects of the discharge on the aquatic ecosystem.

Section 230.11 requires the permitting authority to determine in writing the potential short-term or long-term effect of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment in light of Subparts C to F. Determining the effects of each proposed discharge shall involve considerations of the following:

a) Physical substrate determinations;

b) Water circulation, fluctuation, and salinity determinations;

c) Suspended particulate and turbidity determinations;

d) Contaminant determinations;

e) Aquatic ecosystem and organism determinations;

f) Proposed disposal site determinations;

g) Determination of cumulative effects on the aquatic ecosystem; and

h) Determination of secondary effects on the aquatic ecosystem.

Subparts C through F list the potential impacts on the physical and chemical characteristics of the aquatic ecosystem, the potential impacts on the biological characteristics of the aquatic ecosystem, the potential impacts on special aquatic sites, and the potential effects on human use characteristics to be considered in making the factual determinations and the findings of compliance or noncompliance in Subpart B. Subpart G outlines evaluation and testing procedures conducted to obtain the information needed to reach the determinations in Subpart B. Subpart H lists actions to be undertaken to minimize the adverse effects of discharges of dredged or fill material.

This Section 404(b)(1) evaluation includes a description of the proposed discharge of fill material to be evaluated under Section 404 of the Clean Water Act as well as an analysis of the discharge according to the requirements of Subparts B through H. For this evaluation, primary effects are equated with direct impacts, and secondary effects are equated with indirect impacts. Construction-related impacts are considered direct. Indirect impacts can occur at some distance from the project site or can be associated with actions that occur after the project is operational. COE regulations (33 CFR 320.4a[2]i-iii) also require consideration of the relative extent of the public and private need, any unresolved conflicts in resource use, and the extent and permanence of the beneficial or detrimental effect of the proposed structure or work on the public and private uses to which the area is suited.

1.1 Project description – Zortman and Landusky Mines Expansion Project

Zortman Mining Inc. (ZMI) requests permission to place fill material in various wetland and non-wetland waters of the U.S. in conjunction with the ZMI mine expansion and reclamation project. ZMI currently has two active gold mines nearby: the Zortman Mine and the Landusky Mine. The two mines are located in the Little Rocky Mountains in southwestern Phillips County, Montana. The current mining projects were permitted by Montana Department of State Lands (DSL) in 1979 under operating permits No. 00095 (Landusky mine) and No. 00096 (Zortman mine). Between 1979 and 1991, ZMI received numerous amendments to these operating permits. The amendments are summarized in Tables 1-1 and 1-2 of the Final EIS. ZMI's current areas of operations include the Landusky permitted area of 1,287 acres, with 814 acres disturbed, and the Zortman permitted area of 961 acres, with 401 acres disturbed.

At the Zortman Mine, the expansion and reclamation project proposes to mine an additional 80 million tons of ore and 60 million tons of waste rock. At the projected mining rate of 21 to 28 million tons per year, the expansion would allow for an additional 5 to 8 years of mining. Under the preferred mine expansion alternative (Alternative 7), an additional 772 acres would be disturbed for a total disturbance of 1,170 acres at the Zortman mine. Under Alternatives 4, 5, 6, and 7, the Landusky mine expansion and reclamation project proposes to mine an additional 7.6 million tons of ore and 7 million tons of waste rock. No additional surface area would be disturbed directly by the expansion of the pit. However, additional acres would be disturbed at Landusky to provide for one or more limestone quarries, and other reclamation access and drainage construction activities. A summary of alternatives is in Chapter 2 of the EIS, Tables 2.2-1 through 2.2-3. Detailed discussions of the alternatives are presented in the Final EIS.

Under all the proposed alternatives ZMI would continue to use open-pit mining and heap leach mineral processing to extract gold and silver from ore. Table B-2 lists the primary facilities associated with the proposed mine expansion project that involve direct and indirect impacts to wetland and non-wetland waters of the United States. The Goslin Flats heap leach pad and ore handling area (as outlined in Alternatives 4 and 7) would cover approximately 290 acres located primarily along the lower portion of Goslin Gulch, an intermittent tributary to Ruby Creek. Geomorphically, the pad site is located on the first pediment stream terrace surface of Goslin Gulch. The proposed pad would be approximately 5,200 feet long and 1,800 feet wide and would have sufficient capacity to contain the present anticipated reserves of 80 million tons of ore. Ore would be stacked in 25-foot lifts to a maximum depth of about 200 feet. Prior to pad construction, the Goslin Flats location would be used to salvage about 1 million cubic yards of cover soil for use in reclaiming disturbed areas. Cover soil salvage volumes were based on salvaging up to 3 feet of soil over the 250-acre site.

The proposed overland conveyor system would connect the open pit operations to the heap leach facilities at Goslin Flats. The conveyor would be about 12,000 feet long with an elevation drop of about 1,000 feet. Construction of a maintenance road and fence, along some sections of the conveyor, would create an average 50-foot wide disturbance along the conveyor route.

Removing the existing Alder Gulch waste rock dump would involve relocating about 3.4 million tons of material from the current repository to the proposed Goslin Flats heap leach pad. The existing Alder Gulch waste rock is seeping poor-quality water from the toe of the dump; removing this material should reduce impacts to the drainage.

In 1991, a comprehensive delineation and inventory of wetland and non-wetland waters of the U.S. was prepared for ZMI by Western Technology and Engineering, Inc., with assistance by Hydrometrics, Inc. (ZMI 1995b). No comprehensive inventory of wetland and non-wetland waters of the U.S. was conducted prior to the 1991 inventory, which was completed as part of the delineation requirements for a Clean Water Act Section 404(b)(1) Permit Application to the COE. Results of the 1991 inventory were used to help assess the direct and indirect impacts to wetland and non-wetland waters of the U.S. associated with past, current, and proposed mining activities associated with on-going mining and the proposed ZMI mine expansion and reclamation project.

Potential acreage of wetland and non-wetland waters of the U.S. affected by direct placement of fill materials before 1991 has been estimated using a series of aerial photographs and topographic maps of the mines dating from December 17, 1981, to July 1994. Acreage was estimated based on chronologically scaled aerial photographs, reviews of available vegetation, hydrological data, soil inventories since 1977, and other assumptions based on best professional judgement. To be conservative, the estimates include potential acreage for non-wetland waters of the U.S. affected by historic disturbances. Before 1991, an estimated 3.73 acres of non-wetland waters of the U.S. (2.89 acres at Landusky and 0.84 acres at Zortman) were directly affected by activities at the Zortman and Landusky mines.

In addition to the directly affected acres, wetland and non-wetland waters of the U.S. have been indirectly impacted by existing mining mainly through increased sediments in surface runoff, acid rock drainage (ARD), leach pad leakage, and noise. The proposed mine expansion and reclamation project will most likely create additional indirect impacts, primarily through the same processes and through construction of water-capture facilities downstream of the waste rock and leach pad piles. Other indirect impacts have resulted from constructing diversion ditches around the waste rock and leach pad facilities and by the placement of rock blankets in some receiving streams. Calculated stream lengths were estimated based on delineations of the non-wetland waters of the U.S. as presented in the Section 404 Permit Application (ZMI 1995a). From 1979 to 1995, a total of 16.0 acres of indirect impacts have been identified by the COE. During the period 1990-1995, 14.6 acres (out of the 16.0 acres) have been identified as indirectly impacted (3.04 acres at Zortman and 11.56 acres at Landusky). The 14.6 acres are used in this evaluation and in the development of mitigation, based on a determination by the COE's regulatory authority to mitigate past impacts.

For the 1991 inventory, wetland and non-wetland waters of the U.S. were identified and delineated at the Zortman and Landusky mines based on technical criteria presented in both the 1987 wetland manual (Environmental Laboratory 1987) and 1989 wetland manual (Federal Interagency Committee for Wetlands Delineation [FICWD] 1989). Identification and delineation activities used both on- and off-site methods described in Part IV of the 1987 and 1989 wetland manuals. Most of the preliminary identifications were performed off site because detailed vegetation, soils, and hydrology baseline inventories were available. Most of the on-site survey work was conducted using the 1989 manual, because its use was considered most valid at the time of the field work. Supplemental information needed to delineate wetland areas include, on-site evaluations of wetland hydrology, hydric soils, and hydrophytic vegetation as well as measurements of hydrophytic zones along drainages. National Wetland Inventory (NWI) maps were not available for the project area.

Results of the wetland and non-wetland waters of the U.S inventory are presented on four individual large-format map sheets attached to the Section 404(b)(1) Permit Application (ZMI 1995a). The delineated non-wetland waters of the U.S. and narrow wetland areas are relatively small compared to the large mine permit area; as a result, the delineated areas are not readily visible on standard-format maps. Acreage for the wetland and non-wetland waters of the U.S. have been totaled only for the areas affected by the various mining alternatives. Acreage totals for each alternative are presented in Table B-1. Acreage by specific mine facilities is presented in Table B-2.

Wetland and non-wetland waters of the U.S. within the proposed mine project area were recognized as providing several important functions and values. An assessment of the functions and values of wetlands was conducted, based primarily on a modified approach of the Wetland Evaluation Technique (WET II) adapted for another mine site in Montana (EA Engineering, Science & Technology 1992). The social significance values (uniqueness, heritage, and recreation) were also evaluated using WET II (Adamus and others 1991). An assessment of non-wetland water functions and values was also conducted. Both assessments considered information gained during site visits, best professional judgement, and available scientific literature and project data. The most important functions of the wetlands and non-wetland waters of the U.S. at the project site include hydrologic support (groundwater discharge and recharge), floodflow alteration, sediment stabilization, and aquatic and wildlife diversity and abundance. Tables 3.4-2 and 3.4-3 in the Final EIS summarize existing wetland and non-wetland water functions and values for each drainage area.

ZMI has proposed wetland mitigation that would create about 2.69 acres of wetlands to compensate for (1) the direct loss of about 1.09 acres of wetlands (1.06 acres at Zortman and 0.03 acre at Landusky) and (2) the indirect loss of another 0.48 acre of wetlands at Zortman (ZMI 1995a). Of the total 1.57 (1.09 plus 0.48) acres, the 1.54 acres are related to the construction of the Goslin Flats heap leach pad and ore processing facility at Zortman. At Landusky, 0.03 acre will be lost as the result of constructing a water capture structure in Rock Creek.

Under the various Zortman action alternatives (Alternatives 4 through 7) an estimated 2.48 to 4.06 acres of non-wetland waters of the U.S. would be directly affected by placement of fill. An estimated 0.08 acres of non-wetland waters of the U.S. would be directly impacted under all Landusky expansion alternatives. Alternative 7, the preferred alternative, would directly impact a total of 3.64 acres (3.56 acres for Zortman and 0.08 acre for Landusky) of non-wetland waters of the U.S. and 1.09 acres (1.06 acres for Zortman and 0.03 acre for Landusky) of wetlands. As stated above, approximately 3.73 (0.84 acre for Zortman and 2.89 acres for Landusky) acres of waters of the U.S. have been filled by previous mining activities. For Alternative 7, an estimated 7.37 acres of waters of the U.S. (4.40 acres for Zortman and 2.97 acres for Landusky) will be directly affected by past and proposed mining activities.

Additional information on impacts and mitigation for waters of the U.S. and wetland resources are presented in Sections 2.0 and 4.0 of the Final EIS. Summaries of the acres of direct and indirect impacts to wetland and non-wetland waters of the U.S are presented in Tables 4.4-4a and 4.4-4b in the Final EIS. Proposed mining and reclamation plans for the proposed ZMI mine expansion and reclamation project are detailed in the Application for Amendment to Operating Permit No. 00096, Volume 5, submitted to the Montana DSL (ZMI 1993).

1.2 Description of filling activities associated with the ZMI mine project

Filling operations at the Zortman and Landusky mines have already affected 3.73 acres of non-wetland waters of the U.S. Alternative 7 would result in additional direct impact to 3.64 acres (3.56 acres for Zortman and 0.08 acres for Landusky) of non-wetland waters of the U.S. and up to 1.09 acres (1.06 for Zortman and 0.03 for Landusky) of wetlands.

Depending on the alternative selected, project activities could directly and indirectly affect as much as 31.34 acres of wetlands and non-wetland waters of the U.S. (see Table B-1).

Under Alternative 7, construction and operation of the proposed Goslin Flats heap leach pad, ore handling facility, and processing ponds will account for about 2.42 acres of the total 3.56 acres of directly affected non-wetland waters of the U.S. Compared to Alternative 4 (the alternative proposed by ZMI), Alternative 7 (the preferred alternative) would result in a reduction of 0.5 acre of direct filled non-wetland waters of the U.S. due to the elimination of the Alder Gulch waste rock repository and placement of most of the waste rock on top of existing facilities. Other proposed mine facilities that would require placement of fill materials in the remaining 1.13 acres of waters of the U.S. include construction of the waste rock repository, access roads, haul roads to Landusky and the limestone quarries, pipeline and powerlines, the conveyor corridor, and compliance structures (see Table B-2). In addition, the Goslin Flats heap leach pad would directly affect 1.06 acres of wetlands. For Landusky, about 0.03 acres would be directly affected by compliance structures placed in Rock Creek.

The type and quantity of fill materials that have been placed in existing non-wetland waters of the U.S. or that are proposed for placement in wetland and non-wetland waters of the U.S., are provided in Table 1-1 in both the Zortman and Landusky Section 404 Permit Applications (ZMI 1995a). At Goslin Flats, the wetland and non-wetland waters of the U.S. would be disturbed at the beginning of the expansion project and would receive fill material continuously throughout the 5- to 8-year life of the pad. As much as 0.87 million cubic yards (1.3 million tons) of ore may be placed directly on top of about 2.42 acres of non-wetland waters of the U.S. and 1.06 acres of wetlands, located under the proposed Goslin Flats heap leach pad area. Under Alternative 7, the remaining 1.22 acres of non-wetland waters of the U.S. proposed to receive fill materials in both Zortman (1.81 acres) and Landusky (0.08 acre) would receive a combined total of 855 cubic yards (1,282 tons).

Conventional earth-moving equipment, such as front-end loaders, dump trucks, bulldozers, and rubber-tired scrapers, would be used to place fill materials in all wetland and non-wetland waters of the U.S. except the Goslin Flats heap leach pad. A conveyor and stacker system would be used to place the ore and waste rock relocated from Alder Gulch on the Goslin Flats heap leach pad. The volumes, types, and modes of transportation for the fill materials at the Zortman and Landusky mines are identified by site in Tables A-1 of the Application for Department of the Army Permit (ZMI 1995a).

2.0 SUBPART B - COMPLIANCE WITH THE GUIDELINES

2.1 Section 230.10 - Restrictions on the discharge

2.1.1 Section 230.10(a): Practicable alternative analysis

Seven mining alternatives, described and analyzed in the EIS, were developed in response to the environmental issues and concerns outlined in Table 1-4 of the Final EIS. Section 2.0 of the Final EIS describes the development, evaluation, and selection of the project alternatives. Section 2.4 presents summary descriptions of the mine alternatives. Section 4.4 provides descriptive and numerical summaries of the direct and indirect impacts to both wetland and non-wetland waters of the U.S. for all mining alternatives. Tables 4.4-4a and 4.4-4b summarize the existing and proposed impacts at the Zortman and Landusky mines. Table B-1 of this Appendix summarize the affected acreage of wetland and non-wetland waters of the U.S. for each of the seven mining alternatives.

Because wetland and non-wetland waters of the U.S. will be affected by the proposed mine expansion, the EIS analysis must consider the protection and mitigation of these wetland and non-wetland waters of the U.S. The Section 404 program prohibits placement of fill material if there are practicable alternatives that are less damaging to the aquatic environment or if the placement of fill would result in significant degradation of waters of the U.S. Basic information needed to evaluate wetland and non-wetland waters of the U.S. affected by the proposed project include four categories: (1) characterization, (2) functional assessment, (3) impact assessment, and (4) mitigation. Mitigation requirements are based on the acreage, type, and functional quality of the existing and proposed wetland and non-wetland waters of the U.S. affected by the project. The mitigation plan is needed to evaluate efforts to avoid, minimize, and compensate for losses to wetland and non-wetland waters of the U.S. When compensation is required, additional information is usually necessary to evaluate which of the three types of compensation (creation, restoration, or enhancement) may be most applicable for the site.

Alternatives 1, 2, and 3 consist of the no-action alternative and two non-expansion alternatives. However, mine activities that have already been permitted, including ore leaching and rinsing, will continue. From 1977 to 1994, operations at the Zortman and Landusky mines have already placed fill in about 3.73 acres of non-wetland waters of the U.S. (2.89 acres at Landusky and 0.84 acres at Zortman). The primary differences among Alternatives 1, 2, and 3 relate to the mitigated reclamation procedures, specifically, the amount of slope reduction, backfilling, and reclamation cover required.

Alternative 4, which is proposed by ZMI, consists of expanded mine operations at both the Zortman and Landusky mines and implementation of modified reclamation plans. The following mine facilities and activities would directly and indirectly affect wetland and non-wetland waters of the U.S.: (1) Goslin Flats heap leach pad and ore handling area, (2) overland conveyor system, (3) relocation of the Alder Gulch waste rock repository, (4) construction of a new waste rock repository in Carter Gulch, and (5) construction of a new section of the Zortman to Landusky access road. This expansion alternative involves the direct placement of fill and would affect an estimated 4.14 acres of non-wetland waters of the U.S. (4.06 acres for Zortman and 0.08 acre for Landusky) and 1.09 acres of wetlands (1.06 acres for Zortman and 0.03 acre for Landusky).

Alternative 5 would allow expansion of both the Zortman and Landusky mines, but it would require major modifications to the expansion and reclamation plans. The major modification would relocate the Goslin Flats heap leach pad facility to an Upper Alder Gulch site to mitigate for visual, noise, and wildlife impacts. The conveyor system would not be needed. The Upper Alder Gulch heap leach pad would cover about 180 acres; however, a total area of about 308 acres would be affected, including the area enclosed by surface water diversion canals required to divert the natural flows around the leaching facility to Alder Gulch below. This expansion alternative would involve the direct placement of fill and would affect an estimated 2.56 acres of non-wetland waters of the U.S. (2.48 acres for Zortman and 0.08 acre for Landusky) and 0.05 acre of wetlands (0.02 acre for Zortman and 0.03 acre for Landusky).

Alternative 6 would allow expansion of both the Zortman and Landusky mines, but it would require a major modification by locating the waste rock facility on the Ruby Terrace just east of the proposed Goslin Flats heap leach pad. This alternative was developed partly because it would be easier to construct the repository on Ruby Terrace than in the Carter Gulch. In addition, the conveyor system could be used to transport both ore and waste rock. The Ruby Terrace waste rock repository would cover about 203 acres and would stand about 300 feet high when full. The Goslin Flats heap leach pad and ore handling area would cover about 290 acres and would be about 5,200 feet long; 1,800 feet wide; and 200 feet high. This expansion alternative would involve the direct placement of fill and would affect an estimated 3.34 acres of non-wetland waters of the U.S. (3.26 acres for Zortman and 0.08 acre for Landusky) and 1.09 acres of wetlands (1.06 acres for Zortman and 0.03 acre for Landusky).

Alternative 7 would allow expansion of both the Zortman and Landusky mines, but it would require a major modification by locating the Alder Gulch waste rock repository on top of the existing disturbance at the Zortman Pit Complex. This alternative was developed primarily to reduce the amount of land disturbance, reduce potential impacts to water resources, and enhance reclamation opportunities at existing facilities. Many of the reclamation and mitigation details for Alternative 7 are similar to or the same as those for Alternative 4 (the alternative proposed by ZMI). The conveyor system would be used to transport ore to the Goslin Flats ore handling and leach pad facility. This expansion alternative would also involve the direct placement of fill materials and would affect about 3.64 acres of non-wetland waters of the U.S. (3.56 acres for Zortman and 0.08 acre for Landusky) and 1.09 acres of wetlands (1.06 acres for Zortman and 0.03 acre for Landusky). Compared to Alternative 4, Alternative 7 would result in 0.5 fewer acres of filled non-wetland waters of the U.S. because the Alder Gulch waste rock repository is eliminated and most of the waste rock is placed on top of existing facilities.

Several other alternatives were evaluated based on engineering, environmental, and economic factors. These alternatives were developed and considered primarily regarding their potential for a waste rock storage facility and an ore heap leaching facility. Selection criteria used to identify potential waste rock and heap leach facilities included (1) sufficient capacity to hold 80 million cubic yards of material, (2) geotechnical conditions, and (3) minimization of seepage potential. Section 2.2 of the Final EIS provides detailed information on issues the agencies evaluated to develop alternative sites for these facilities. Section 2.2.6 and Table 2.2-1 of the Final EIS summarizes all alternatives considered and either eliminated or retained for further evaluation.

2.1.2 Section 230.10(b) - Discharge compliance with guidelines

The Section 404(b)(1) guidelines Section 230.10(b) require that no discharge shall be authorized if it:

1. Causes or contributes to any violation of applicable water quality standards.

2. Violates any applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act.

3. Jeopardizes the continued existence of species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended, or results in the increased likelihood of destruction or adverse modification of critical habitat under the ESA.

Placement of fill materials in wetland and non-wetland waters of the U.S. during the construction and operation of facilities associated with this mine expansion and reclamation project has been evaluated under the following:

State water quality standards. The Montana Department of Environmental Quality (DEQ) provides Section 401 certification pursuant to state rules (Administrative Rules of Montana [ARM] 16.20.1701 et seq.). The DEQ will review the proposed placement of fill material and if necessary will make a determination of violations of applicable state water quality standards. DEQ will not make its final ruling until ZMI submits a Water Management Plan for the Zortman and Landusky mines. The COE cannot complete its final 404(b)(1) evaluation until the Section 401 certification is completed. Any conditions of the 401 certification will be included as conditions of the Section 404 permit. A Section 401 certification does not constitute a relinquishment of DEQ's authority or any subsequent alterations or additions thereto, and it does not fulfill or waive any other local, state, or federal regulations.

Toxic effluent standard or prohibition. Documentation of the potential for ARD from fill materials resulting from this project is contained in the Final EIS. Determination of compliance with Section 307 of the Clean Water Act will be covered under the DEQ review. Section 307 requires that the project be reviewed for its potential to introduce toxic pollutants into waters of the U.S. As indicated above, water quality certification pursuant to Section 401 of the Clean Water Act will be required. All conditions identified in the Section 401 certification will be included as conditions if the 404(b)(1) evaluation results in a recommendation to issue a permit.

Threatened or endangered species. Impacts to threatened or endangered species are addressed in the Final EIS (Section 3.5.1.1) and in Section 4.1 of this evaluation. To comply with ESA requirements, a biological assessment was prepared to evaluate the potential effects on threatened and endangered species that may be present in the project area. The U.S. Fish and Wildlife Service (USFWS) reviewed the biological assessment and concurred with the determination that the proposed project would have no effect on threatened or endangered species (see Appendix C of the FEIS). ZMI must successfully meet the requirements of this section of the 404(b)(1) guidelines in order for the 404(b)(1) evaluation to result in a recommendation to issue a permit. The applicant realizes that failure to meet the requirements of this section will result in a recommendation of denial.

Findings related to water quality standards, toxic effluent standards and threatened and endangered species are discussed below.

Water quality findings A summary of the present water quality status is provided in Section 3.2.9 and Table 3.2-32 of the Final EIS. Major findings include the following:

1) Pre-1979 baseline data shows little or no degradation to water quality due to historical mining activity in most drainages. Baseline surface water data that exceeded current criteria were restricted to a few specific locations, primarily historical adit discharges.

2) On specific occasions, post-1979 surface water has exhibited elevated chemical constituent concentrations as far downstream as the towns of Zortman and Landusky. Parameters exceeding the available criteria are generally restricted to metals, which are leached out of the rock by ARD.

3) Capture and treatment or recirculation systems are currently operating in all impacted drainages at Zortman and Landusky and have demonstrated significant improvements in downstream water quality.

Toxic effluent findings The potential exists for toxic effluents, particularly from ARD, to be generated from materials placed in wetland and non-wetland waters of the U.S. This potential exists based on geochemical testing and the acid-generating character of the various rock types at the mines. The following detailed geochemical findings are provided in Section 3.2.2.9 of the Final EIS:

1) ARD is currently being generated from pit walls and floors, leach pad foundations, and waste rock piles at the Zortman and Landusky mines.

2) Geochemical testing has shown a direct relationship between sulfur content and net neutralizing potential (NNP). Total sulfur, NNP, and paste pH can be used as parameters to segregate potentially acid-generating wastes from non-acid-forming wastes.

3) Certain rock types, primarily breccia, monzonite, trachyte, quartzite, and felsic gneiss, have the potential to generate net acidity and have been excluded from use in construction, fill, underdrain, or reclamation purposes.

Threatened or endangered species findings Specific information on threatened or endangered species is discussed in Section 3.5.1.1 of the Final EIS. A listing of eighteen wildlife species of special concern that may potentially occur in the project area is provided in Table 3.5-1 of the Final EIS. Of these species, the bald eagle, peregrine falcon, and black-footed ferret are listed as endangered and the piping plover is listed as threatened. Other species, such as the ferruginous hawk, mountain plover, burrowing owl, loggerhead shrike, Baird's sparrow, Townsend's big-eared bat, northern long-eared myotis, long-legged myotis, and western small-footed myotis, are considered candidate species that may be suitable for listing, but sufficient data on a national level do not exist at this time.

Of particular interest are the stock ponds along Goslin Gulch and in the vicinity of Azure Cave that are considered bat habitat. The responsibility for wildlife habitat management in and around the Zortman mine rests with the Montana Department of Fish, Wildlife, and Parks (MDFWP); the U.S. Bureau of Land Management (BLM); and the USFWS.

2.1.3 Section 230.10(c) - Degradation of waters of the U.S.

Section 230.10(c) guidelines prohibit the discharge of dredge or fill material that will cause or contribute to significant degradation of U.S. waters. Findings of significant degradation must be based on factual determinations, evaluations, and testing. Section 230.10(c) provides that no discharge of dredged or fill material is permitted if it will cause or contribute to significant degradation of the waters of the U.S., except as provided under Section 404(b)(2). Effects contributing to significant degradation individually or collectively include significant adverse effects of pollutants on the following:

1) Human health or welfare, including but not limited to effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites

2) Life stages of aquatic life and other wildlife dependent on aquatic ecosystems

3) Aquatic ecosystem diversity, productivity, and stability

4) Recreational, aesthetic, and economic values

From 1977 to 1994, the Zortman and Landusky mines placed fill in about 3.73 acres of non-wetland waters of the U.S. (0.84 acre for Zortman and 2.89 acres for Landusky). No wetlands are believed to have been impacted from 1979 to the present, with the exception of possible sporadic disturbances from exploration activities (for example, minor sedimentation effects) (ZMI 1995b). Mitigation plans will be required for these previously disturbed non-wetland waters of the U.S. to address the overall degradation of waters of the U.S. associated with the Zortman and Landusky mines.

Adverse effects of the pollutants on human health, including effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites, would be considered as moderate because of the relatively small acreage involved and the lack of high value functions. With mitigation (see Appendix F), the direct effects would be reduced to less than significant. Alternative 7 would affect about 3.64 acres of non-wetland waters of the U.S. (3.56 acres for Zortman and 0.08 acre for Landusky) and 1.09 acres of wetlands (1.06 acres for Zortman and 0.03 acre for Landusky) through direct placement of fill materials. Most of the directly filled areas are associated with the Goslin Flats heap leach pad. Surface waters affected in this area are classified as C-3 and are suitable for bathing, swimming and recreation, growth and propagation of nonsalmonid fishes and associated aquatic life, waterfowl, and furbearers. The quality of these waters is marginal for drinking, culinary and food processing purposes, and agricultural and industrial water supply. Loss of two stock water ponds probably used by Azure Cave bats for watering is considered as a moderate impact based on the availability of other water in the area and the functional value of the Goslin Gulch drainage.

Adverse effects of the pollutants on aquatic life, other wildlife dependent on aquatic ecosystems, aquatic ecosystem diversity, productivity, and stability would also be considered as a moderate impact. Adverse effects would result from increased sediment inputs, leach pad leakage of cyanide and metals, possible groundwater and surface water changes due to diversions, loss of infiltration under the mine facilities (for example, the Goslin Flats heap leach pad), noise and other disturbances, and short-term loss of open water provided by the ponds.

Adverse effects of the pollutants on recreational, aesthetic, and economic values would be considered as a low impact. Adverse effects resulting from construction of the Goslin Flats heap leach pad may affect recreational users by increased traffic, visual, and noise disturbances. Construction and operation of the conveyor system may also affect recreational users and hunters by restricting access to Goslin Gulch and along the length of the conveyor.

2.1.4 Section 230.10(d) - Appropriate and practicable steps to minimize potential adverse impacts of the discharges on the aquatic ecosystem

The primary steps to minimize potential adverse impacts to wetland and non-wetland waters of the U.S. involve locating the mine features and facilities to maximize wetland avoidance. The two major facility components include the waste rock storage areas and the ore heap leaching facilities. Locations for these facilities were considered and evaluated based on engineering, environmental, and economic factors. Eight waste rock repository locations were considered: (1) Upper Ruby Gulch, (2) Lower Ruby Gulch, (3) total backfill of Zortman or Landusky pits, (4) partial backfill of Zortman or Landusky pits, (5) Goslin Flats, (6) Ruby Terrace, (7) Lodgepole Creek, and (8) Zortman Mine Complex. Six heap leach area locations were considered: (1) Ruby Gulch, (2) Upper Alder Gulch, (3) Placement of ore onto existing leach pads, (5) placement of ore into existing pits, and (6) Goslin Flats.

These facility locations were evaluated based partially on their ability to avoid impacts to wetland and non-wetland waters of the U.S. However, other environmental factors were also considered. The inclusive environmental evaluations considered potential impacts to air, water, and soil, with consideration of subsequent impacts to vegetation, wildlife, and human health. Alternatives 4, 5, 6, and 7, the four mine expansion action alternatives, would directly fill 2.56 (2.48 acres for Zortman and 0.08 acre for Landusky) to 4.14 acres (4.06 acres for Zortman and 0.08 acre for Landusky) of both wetland and non-wetland waters of the U.S. Alternative 7 is the preferred alternative because it would result in directly filling only 3.64 acres (3.56 acres for Zortman and 0.08 acre for Landusky) of wetland and non-wetland waters of the U.S. About 3.73 acres of non-wetland waters of the U.S. have previously been filled by mining activities. For Alternative 7, an estimated total of 7.37 acres of non-wetland waters of the U.S. will be directly filled with materials from past and proposed mining activities.

Facility locations were evaluated in Section 2.2 of the Final EIS. Facility locations that were considered acceptable and retained for analysis in the Final EIS generally received acceptable engineering and environment ratings. Facility locations were considered unacceptable if the engineering design was infeasible, they failed to be protective of the environment, or were not considered cost effective. The following issues were most significant when considering proposed facility locations:

(1) Water quality – possible additional adverse water quality impacts after the mine expansion and reclamation project is complete

(2) ARD – proposed mine expansion and reclamation project would develop sulfide ore and create possible additional adverse water quality impacts

(3) Goslin Flats heap leach pad – concerns about storage and potential leakage, visual impacts, access restrictions, effectiveness of heap neutralization prior to closure, heap stability, adequate solution storage and flood diversion, quality of construction, ARD potential, and hazards to wildlife

(4) Carter Gulch waste rock dump – concerns about waste characterization, waste handling, waste modification, ARD, dump stability, and reclamation and monitoring of dump performance.

Project impacts that would affect wetland and non-wetland waters of the U.S. are addressed in the following text, in accordance with the 404(b)(1) guidelines. Appropriate and practicable steps have been developed to minimize potential adverse impacts to wetland and non-wetland waters of the U.S. If Section 404 permit is approved and issued, these steps, including permit conditions and best management practices, will be incorporated into the Section 404 permit to ensure the project complies with these guidelines.

Wetland and Non-Wetland Waters of the U.S. Mitigation:

A mitigation plan for impacts to wetlands and non-wetland waters for Alternative 7 has been developed and is presented in Appendix F. The mitigation plan consists of four components: on-site water quality mitigation; Ruby Gulch tailing removal and stream restoration; on-site wetland mitigation projects; and off-site mitigation projects. Detailed descriptions of these four components and estimated acreage for each is contained in Appendix F. In total, about 40.04 acres of wetland and non-wetland mitigation have been developed to cover the past, present, and projected direct and indirect impacts.

Establishing the needed wetland hydrology would rely on flow barriers, dikes, dams, and clay liners to increase retention of surface runoff and the duration of soil saturation and inundation. Retention dikes and dams would have a maximum height of 6 feet. Each dike or dam would have a spillway designed to allow for high flows during runoff and severe precipitation. Clay liners with a hydraulic conductivity of 0.01 inches per hour would be used for the impoundments and on the upstream face of dikes to reduce water loss. Native clay materials would be available from ZMI's clay pits.

Hydric soils from the affected wetland areas would be salvaged and directly respread on the mitigation sites, where possible, to provide increased organic matter and a plant materials source. All disturbed areas within the mitigation sites would be broadcast-seeded with a wetland revegetation mixture, and containerized root stock, plugs, or rooted cuttings would be planted mechanically. The pond areas would be covered with an erosion control blanket up to the high water line. Reseeded areas above the high water line would be mulched or covered with an erosion control blanket.

Wetland mitigation will be initiated before substantial disturbance of the existing wetlands. This timing will allow for the direct haul of hydric soils salvaged from the affected wetlands, concurrent mitigation, and a greater selection of construction equipment. The primary wetland functions to be reestablished at the wetland mitigation sites would include reduced sediment transport, increased aquatic and wildlife habitat diversity and abundance, and attenuated peak flows.

2.2 Section 230.11 - Factual determinations

The potential adverse impacts of placing fill material on the physical, chemical, and biological components of the wetland and non-wetland waters of the U.S. ecosystems have been evaluated. Mitigation efforts to offset adverse impacts have also been considered for impacts to these wetland and non-wetland waters of the U.S. Determination of these impacts are discussed in the following subsections.

2.2.1 Section 230.11(a) Physical substrate determinations

Under Alternative 7, the proposed Goslin Flats heap leach pad, ore handling facility, and process ponds will account for 2.42 of the total 3.64 acres of directly affected wetland and non-wetland waters of the U.S. Other proposed mine facilities that would require placement of fill materials in the remaining 1.22 acres of waters of the U.S. include the construction of the waste rock repository, access roads, haul roads to Landusky and the limestone quarries, the pipeline and powerline, the conveyor corridor, and compliance structures; 1.06 acres of the affected wetland acres are associated with Goslin Flats facility and 0.03 acre are associated with a compliance structure in Rock Creek. Summaries of the total direct and indirect impacts to wetland and non-wetland waters of the U.S. are provided in Tables B-1 and B-2.

Before construction begins, soils under the Goslin Flats facility will be salvaged for use in reclaiming disturbed areas. An estimated 1 million cubic yards of cover soil can be salvaged based on an average depth of 3 feet over the 250-acre site. Hydric soils from beneath the Goslin Flats facility will be salvaged separately and will be used at nearby wetland mitigation sites. Soils from non-wetland waters may have limited salvage potential due to excessive coarse fragment content and steep slopes.

The physical and mineralogical composition of the waste rock and ore materials will vary but will be quite different than the substrate (parent) materials in Goslin Flats. Parent materials for the Goslin Flats soils are primarily of sedimentary origin, but they also include alluvial, colluvial, and remnant glacial till deposits. The lithologies of the waste rock and ore deposits are metamorphic and igneous, formed by the igneous intrusion. Detailed information on geology and soil resources is presented in Section 3.3 of the Final EIS.

Geochemical testing has been performed on hundreds of samples of ore, waste rock, spent ore, and other local rock types at both Zortman and Landusky. Tests indicate that most of the Zortman ore and waste materials have a negative NNP and therefore have the potential to generate acid. ZMI currently sorts waste rock materials with a total sulfur content less than 0.2 percent and defines this material as non-acid-generating waste. However, supplemental testing has shown these low total sulfur wastes have negative NNP and should not be considered truly non-acid-generating waste. Detailed results of waste rock and ore geochemical analyses are provided in Section 3.2.2 of the Final EIS.

2.2.2 Section 230.11(b) Water circulation, fluctuation and salinity determinations

As described later in this evaluation (see Section 4.4 below), water circulation and fluctuation would be altered in Goslin Gulch by capturing surface water in the 290-acre Goslin Flats heap leach pad and ore handling facility and the surface water diversion around the facility. The placement of waste rock fill materials in small narrow waters of U.S. tributaries below the Zortman pit complex will have only a limited affect on circulation and fluctuations of Alder Gulch and Ruby Gulch waters. Pre-mine surface water monitoring in Goslin Flats (since 1990) indicates that the waters have high sulfate concentrations, high total dissolved solids, and high (alkaline) pH. This type of water quality is commonly associated with continental and marine shale geology. Downstream of Goslin Flats, surface water quality is not expected to show discernable impacts from proposed mining activities.

Limited monitoring information is available to document changes in surface water flows due to mining activity. However, the excavation of the pits and diversion of surface water flow into these pits is expected to decrease flows in the northern streams to some degree. The U.S. Geological Survey (USGS) has established permanent monitoring stations in selected drainages, yielding continuous monitoring data as far back as 1987. In general, streams in the Little Rocky Mountains are ephemeral in their upper most reaches, becoming intermittent in their mid-reaches. Due to the presence of springs and shallow bedrock, some streams are perennial to intermittent in their mid-reaches. The streams become ephemeral again as they leave the Little Rocky Mountains and enter the plains. Additional information on surface water flows and quality is provided in Section 3.2 of the Final EIS.

2.2.3 Section 230.11(c) Suspended particulate/turbidity determinations

Placement of fill materials and associated construction activities in Goslin Flats and the small tributaries to the Alder and Ruby Gulch drainages would create a short-term increase in sedimentation in wetland and non-wetland waters of the U.S. Soil erosion and transport would occur primarily during construction activities and prior to waste rock reclamation and revegetation. Potential soil losses for all mine alternatives have been estimated using the revised

Universal Soil Loss Equation (RUSLE) and are presented in Appendix E of the Final EIS. Estimated short-term soil losses (over 1 to 3 years) for steeper slopes range from 0.8 to 1.2 tons per acre per year. Long-term soil losses (over 3 to 5 years) are estimated at 0.1 to 0.3 tons per acre per year. Inclusion of DEQ Section 401 permit conditions, as well as other conditions to control sedimentation and turbidity, as included in Appendix F - Attachment A of the FEIS will help minimize soil erosion and its potential negative impacts on aquatic organisms. Erosion control measures are described in ZMI's mine expansion permit application. Excess water discharged from the Montana Gulch mitigation wetland will be delivered to a diversion system to avoid erosion of Montana Gulch below the constructed dike. If rills or gullies form on graded slopes or channels, selective filling and erosion control procedures will be implemented. These procedures may include erosion control mats or nets, mulching, straw bales, and filter fences or slash filter windrows. In addition, mechanical practices, such as the use of mulching and erosion control blankets, surface water diversions to control runoff and sedimentation, and revegetation practices, will be incorporated to provide a stabilizing cover.

2.2.4 Section 230.11(d) Contaminant determinations

The proposed fill materials would potentially increase contaminant concentrations at the disposal site. The physical and mineralogical composition of the waste rock and ore materials vary but are quite different than the native soils in Goslin Flats. Detailed information on geology and soil resources is presented in Section 3.3 of the Final EIS. Detailed results of waste rock and ore geochemical analyses are provided in Section 3.2.2 of the Final EIS. Geochemical testing indicates that most of the Zortman ore and waste materials have the potential to generate acid. However, the acid-generating materials would be excluded from use for construction, fill, underdrain, or reclamation purposes (see Section 7.0 below).

2.2.5 Section 230.11(e) Aquatic ecosystem and organism determinations

The ZMI mine expansion and reclamation project will directly affect aquatic organisms by the placement of fill materials in 3.64 acres of non-wetland waters of the U.S. (3.56 acres for Zortman and 0.08 acre for Landusky) and 1.09 acres of wetlands (1.06 acres for Zortman and 0.03 acre for Landusky). Approximately 3.73 acres of non-wetland waters of the U.S. have previously been filled by mining activities. Under Alternative 7, in total, an estimated 7.37 acres of non-wetland waters of the U.S. and 1.09 acres of wetlands will be directly filled with materials by past and proposed mining activities.

Past mining activities have created indirect impacts to wetland and non-wetland waters of the U.S. at the Zortman and Landusky mines. Indirect impacts are primarily associated with increased soil erosion and inputs to receiving streams, decreased flows due to water diversions, and exposure to potential acid-generating materials. Most indirect impacts associated with Alternative 7 would occur mainly in the areas immediately below the waste rock piles and below the Goslin Flats heap leach and ore processing facility. The COE has identified 14.6 acres of non-wetland waters of the U.S. as being indirectly impacted by past mining (1990-1995) with subsequent reduced water quality. Indirect impacts to non-wetland waters of the U.S. for all mine alternatives are described in detail in Table 4.4-4b and Table 4.4-5 of the Final EIS.

Fisheries habitat in the project area is very limited. Drainages that will receive the main impacts from the mine expansion and reclamation project (Alder Gulch, Carter Gulch, Goslin Gulch, and Ruby Gulch) have intermittent flows and do not currently support fisheries.

Six species of bats have been documented as using Azure Cave as habitat. This cave may be the northernmost hibernaculum in the Pacific Northwest (Chester and others 1979). It supports hibernating bats because it provides stable temperature and humidity ranges and possibly a moderate airflow (Freeman 1984). The bats probably use the Goslin Flats stock ponds and surrounding wetlands for insect foraging and as water supply. The Upper Goslin Gulch mitigation measures are designed to offset impacts to the bats' habitat requirements.

Other components of the aquatic environment, particularly benthic plants and animals, would compete for existence in surrounding areas which contain similar habitat. Potential impacts are considered as moderate primarily because of the improved water quality expected from implementing the Water Quality Improvement Plan and the relatively high probability for reclamation success.

2.2.6 Section 230.11(f) Proposed disposal site determinations

As previously stated, the DEQ provides Section 401 certification pursuant to Section 401 of the Clean Water Act. The DEQ will review this placement of fill material and will make a determination for violations of applicable state water quality standards. Section 404 permits, issued by the COE, require Section 401 certification.

Under Alternative 7 the proposed Goslin Flats heap leach pad, ore handling facility, and process ponds will account for 2.42 of the total 3.64 acres of directly affected non-wetland waters of the U.S. (see Table B-2). Other proposed mine facilities that would require placement of fill materials in the remaining 1.22 acres of non-wetland waters of the U.S. include the construction of the waste rock repository, access roads, haul roads to Landusky and the limestone quarries, the pipeline and powerline, the conveyor corridor, and compliance structures; 1.06 acres of the affected wetland acres are associated with Goslin Flats facility, and 0.03 acre are associated with a water capture system in Rock Creek.

2.2.7 Section 230.11(g) Determination of cumulative impacts on the aquatic ecosystem

Section 4.4 of the Final EIS contains an analysis of cumulative impacts for wetland and non-wetland waters of the U.S. Cumulative impacts include all effects of the project resulting from past, present, and reasonably foreseeable activities. Cumulative impacts for the ZMI mine expansion and reclamation project include the following: (1) historic mining disturbances in Montana Gulch, Beaver Creek, Pony Gulch, and the Hawkeye Mine, plus mill tailings in King Creek, Alder Gulch, and Ruby Gulch; (2) impacts from 1977 through 1994, including the previously filled 3.73 acres of non-wetland waters of the U.S.; (3) impacts resulting from implementing the mine alternative; and (4) reasonable foreseeable future actions, including a 2-million ton Pony Gulch mine, expansion of the Goslin Flats heap leach pad, development of new limestone sources, and construction of passive water treatment systems.

The cumulative impacts from these past, present, and reasonably foreseeable activities would result in a total of 29.27 acres of disturbance to non-wetland waters of the U.S. and 1.57 acres of wetlands (see Tables 4.4-4a and 4.4-4b of the Final EIS and Table B-1 of this Appendix). Some additional non-wetland waters of the U.S. may be affected by indirect impacts not associated with a particular acreage figure. In addition, some cumulative beneficial impacts may occur from implementing the Water Quality Improvement Plan.

A land application disposal (LAD) area has been identified for use near the Goslin Flats facility. The LAD would be used in the event that emergency land application of solutions is required, as well as during closure activities. Effluents disposed of at the LAD area would be neutralized to have cyanide concentrations at or below 0.22 milligrams per liter (mg/L) (as determined by the weak-acid dissociable [WAD] cyanide analytical test). Disposal activities would not occur within 100 feet of the county road or within 200 feet of any drainages or wetlands. The LAD area is proposed for both sides of the tributary designated as the wetland mitigation site.

2.2.8 Section 230.11(h) Determination of secondary effects on the aquatic ecosystem

Secondary effects on the aquatic ecosystem from ZMI mine expansion and reclamation project activities will result in increased surface runoff and sedimentation from cleared areas and the face of the waste rock dumps; increased total suspended solids, total dissolved solids, and metal concentrations in water resources; and reduced surface water flows from the surface water capture by the Goslin Flats facility. This loss of habitat is considered a low adverse short-term effect assuming mitigation successfully replaces this aquatic habitat.

2.3 Section 230.12 Findings of compliance or noncompliance with the restrictions on discharge

Based on the data contained in the Final EIS, the determinations of the preceding section, and the remainder of this evaluation, placement of fill materials in wetland and non-wetland waters of the U.S. would comply with the requirements of the Section 404 guidelines. Fill materials would be placed in wetland and non-wetland waters of the U.S. at the Goslin Flats facility, waste rock repository, roads to Landusky and the limestone quarries, the pipeline and powerline, and the conveyor corridors. Compliance with the Section 404 guidelines is desired by ZMI. Compliance with Section 404 guidelines would include implementing appropriate and practicable permit conditions to minimize any adverse effects of the discharge to the aquatic ecosystem.

3.0 SUBPART C - POTENTIAL IMPACTS ON THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Potential impacts on the physical, chemical, and biological components of the aquatic environment resulting from filling operations have been evaluated for the ZMI project. In addition, mitigation efforts to offset adverse impacts and the mitigation ratios have not been determined. Additional mitigation may be considered in the final evaluation after detailed engineering designs and drawings have been reviewed and approved. Determinations of these impacts are discussed in the following subsections.

3.1 Section 230.20 Physical substrate determinations

The placement of ore and some waste rock at the Goslin Flats heap leach facility will ultimately create a 200-foot-high pad that covers about 250 acres in the Goslin Gulch drainage. Under Alternative 7, the proposed Goslin Flats heap leach pad, ore handling facility and process ponds will account for 2.42 of the total 3.64 acres of directly affected non-wetland waters of the U.S. Other proposed mine facilities that would require placement of fill materials in the remaining 1.22 acres of non-wetland waters of the U.S. include the construction of the waste rock repository, access roads, haul roads to Landusky and the limestone quarries, the pipeline and powerline, the conveyor corridor, and compliance structures (see Table B-2); 1.06 acres of the affected wetland acres are associated with Goslin Flats facility, and 0.03 acre are associated with a compliance structure in Rock Creek. Surface soil materials salvaged from the Goslin Flats facility will be used for reclamation purposes. Hydric soils from the Goslin Flats pad area will be salvaged for use at the wetland mitigation site. Site-specific soil information is presented in Section 3.3 of the Final EIS.

3.2 Section 230.21 Suspended particulates/turbidity

Construction activities will result in an increase in total suspended solids, total dissolved solids, and metals concentrations in surface waters flowing through the delineated wetlands. Erosion control measures are described in the ZMI mine expansion permit application and in Appendix F of the FEIS. These measures primarily involve mechanical practices, such as the use of mulching and erosion control blankets, surface water diversions to control runoff and sedimentation, and revegetation practices to provide a stabilizing cover. Fisheries habitat in the project area is very limited; intermittent flows do not support fisheries.

3.3 Section 230.22 Water clarity, nutrients, environmental characteristics and values (chemistry)

The placement of fill material in wetland and non-wetland waters of the U.S. will alter water characteristics. During construction activities, changes in light penetration and water clarity could be reduced in downgradient waters due to increases in suspended solids. Total dissolved solids concentrations may also increase. Compliance with DEQ's Section 401 permit conditions, as well as other conditions and restrictions, will minimize these impacts.

3.4 Section 230.23 Current patterns and water circulation

The placement of fill and the diversion of surface water at the Goslin Flats heap leach pad and ore processing facility will modify surface water patterns, particularly at the point of discharge below the facility. The more than 300-acre facility will also capture surface water that will become part of the process flows rather than the natural flows. Placing waste rock fill materials in the small narrow channels within the mining complex will entirely fill these drainages and disperse the natural flows through the fill materials. Engineering design and erosion control practices, as outlined in the Final EIS, ZMI's mine expansion permit application, and Section 2.2.3 of this appendix will be implemented as necessary to minimize impacts to these drainages.

3.5 Section 230.24 Normal water fluctuations

The placement of fill and the diversion of surface water at the Goslin Flats heap leach pad and ore processing facility may modify normal water fluctuations in the Goslin Gulch drainage by capturing surface water and reducing peak flows. Because the heap leach facility covers more than 300 acres, it would have a significant effect on this small drainage. Goslin Gulch contains at least three alluvial springs that account for about 5- to 10-gallon per minute flows for short reaches below their sources. Potential decreases in surface and shallow groundwater flows (particularly springs) may affect wetlands downgradient from the Goslin Flats facility. Vegetative species that are more tolerant of drier sites may replace species requiring moist site conditions along certain short reaches of Goslin Gulch.

Construction and placement of fill materials associated with the pipeline, powerline, conveyor, and access road corridors will modify normal water fluctuations in some small drainages by partially filling these drainages. Sound engineering and erosion control practices will help minimize the impacts of these activities.

3.6 Section 230.25 Salinity gradients

The ZMI mine expansion and reclamation project is not expected to have any effect on salinity gradients because the fill materials are nonsaline and the wetland and non-wetland waters affected have freshwater sources.

4.0 SUBPART D - POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

4.1 Section 230.30 Threatened and endangered species

Numerous wildlife studies have been conducted within the Zortman mining area (Farmer 1977; Scow 1978, 1979, 1983; WESTECH 1985, 1986, 1989), and reports have been prepared on the bats and other wildlife found in Azure Cave (Chester and others 1979; and Butts 1993). MDFWP, BLM, and USFWS are responsible for wildlife habitat management in and around the Zortman mine. Additional information on threatened and endangered species is presented in Section 3.5.1.1 of the Final EIS.

A list of wildlife species of concern that may occur on or near the project site is presented in Table 3.5-1 of the Final EIS. Of these species, four are listed as threatened or endangered: bald eagle, peregrine falcon, piping plover, and black-footed ferret. Ten other species are considered candidate species that may be suitable for listing, but sufficient data on a national level do not exist at this time: ferruginous hawk, mountain plover, burrowing owl, loggerhead shrike, Baird's sparrow, Townsend's big-eared bat, northern long-eared myotis, fringed myotis, long-legged myotis, and western small-footed myotis.

Mitigation efforts will be conducted for the loss of two stock ponds along Goslin Gulch that are close to Azure Cave. A field reconnaissance of potential water sources for bats and other wildlife in the vicinity of Azure Cave identified four other stock ponds within 2 miles of the cave (Grensten Pers. Comm. w/R. Beane, Dec. 11, 1995). In addition, most of the bat species known to hibernate at Azure Cave typically glean their prey from vegetation or forage within tree canopies and do not require open water for foraging. Nevertheless, these stock ponds are still considered to be habitat for the Azure Cave bat populations.

A biological assessment was prepared to evaluate the potential effects on threatened and endangered species that may be present in the project area. The USFWS reviewed the biological assessment and concurred with the determination that the proposed project would have no effect on threatened or endangered species (see Appendix C of the FEIS).

4.2 Section 230.31 Fish, crustaceans, mollusks, and other aquatic organisms in the aquatic food web

The small intermittent drainages in the Zortman and Landusky mine areas do not support many types or numbers of fish. Brook trout inhabit Beaver, Lodgepole, and Little Peoples Creeks and can be found in ponds along Rock Creek below the town of Landusky. Rainbow trout occur in Little Peoples Creek. Flows in other drainages in the project area, including Alder Gulch and Montana Gulch, are intermittent and do not support fish habitat. An MDFWP inventory of fish populations in reservoirs and perennial flowing streams below the Zortman and Landusky mines found populations of flat-headed minnows, long-nose dace, white sucker, northern redbelly dace, brook sickleback, northern pike, and perch. Indirect impacts of residual water quality and sedimentation on downstream biota would primarily result from acid rock runoff, with acid and metals being toxic to fish and invertebrates in the receiving waters or unfenced ponds. Table 4.4-5 of the Final EIS summarizes additional information on potential impacts to fish and macroinvertebrates in the project area drainages.

Under Alternative 7, placement of fill materials would not affect fish populations within the Zortman and Landusky mine areas. Capture and treatment or recirculation systems currently operating in all impacted drainages at Zortman and Landusky have demonstrated significant improvements in downstream water quality. Impacted drainages have exhibited elevated levels of sulfates, total dissolved solids, conductivity, and low pH on specific occasions, all of which was attributed to ARD. Additional surface water quality information is provided in Section 3.2.5.1 of the Final EIS.

4.3. Section 230.32 Other wildlife

The ZMI project would affect shrub and grassland habitat used by terrestrial wildlife species, such as pronghorn antelope, in the areas near the Goslin Flats heap leach pad and the ore handling facility. The 2.42 acres of non-wetland waters of the U.S. and 1.06 acres of wetland in the Goslin Flats area are probably used as a water supply for some terrestrial wildlife species. As mentioned above, the open water (stock ponds) along Goslin Gulch are considered bat habitat. As part of ZMI's proposed wetland mitigation, one seasonal impoundment covering an estimated 0.39 acre would be created in Upper Goslin Gulch to provide a source of water for wildlife, in particular big game species and bats.

The construction and operation of the conveyor belt system may disturb big game and upland game birds for the life of the mine. Recommended mitigation will include designed wildlife overpasses and underpasses along important corridors, such as gulches and draws.

As previously indicated, MDFWP, BLM, and USFWS are responsible for wildlife habitat management in and around the Zortman and Landusky mines. Additional information on wildlife and fisheries is presented in Sections 3.5 of the Final EIS.

5.0 SUBPART E - POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

As discussed previously, Alternative 7 would result in the placement of fill in wetland and non-wetland waters of the U.S. The physical, chemical, and biological integrity of the aquatic ecosystem would be modified as described in the Final EIS and the following subsections.

5.1 Section 230.40 Sanctuaries and refuges

No sanctuaries or wildlife refuges exist in the project area.

5.2 Section 230.41 Wetlands

For the Zortman mine area, about 1.06 acres of wetlands will be directly altered by fill materials from the Goslin Flats heap leach pad and ore processing facility. An estimated 0.48 acre of wetland would be indirectly impacted by construction and operation of this heap leach pad. At Landusky, 0.03 acre of wetland would be directly impacted during placement of a compliance structure in Rock Creek. Direct and indirect impacts to wetlands are discussed in more detail in Section 4.4 of the Final EIS. A summary of direct and indirect impacts to wetland is provided in Tables 4.4-4a, 4.4-4b, and 4.4-5 of the Final EIS.

About 2.69 acres of replacement wetlands have been developed as part of the on-site wetland mitigation plan to mitigate the loss of 1.09 acres of wetlands. An overall mitigation plan for impacts to wetlands and non-wetland waters of the U.S. for Alternative 7 has been developed and is presented in Appendix F. ZMI has identified possible on-site wetland mitigation areas and plans to create seasonal impoundments (ZMI 1995a). The wetland mitigation sites are located on a tributary to Ruby Creek and Upper Goslin Gulch, near the proposed filled wetlands.

5.3 Section 230.42 Mud flats

There are currently no mud flats at the project site.

5.4 Section 230.43 Vegetated shallows

There are currently no vegetated shallows at the project site.

5.5 Section 230.44 Coral reefs

There are no coral reefs associated with this project.

5.6 Section 230.45 Riffle and pool complexes

There are no riffle and pool complexes associated with this project.

6.0 SUBPART F - POTENTIAL EFFECT ON HUMAN USE CHARACTERISTICS

6.1 Section 230.50 Municipal and private water supplies

The project will not affect municipal or private water supplies. ZMI has stated that diversion and capture systems would be constructed to collect waters affected by the mine and to prevent deterioration of water quality in drainages not already contaminated. Captured seepage water would be pumped to the Zortman water treatment plant for treatment and release into Ruby Gulch.

6.2 Section 230.51 Recreational and commercial fisheries

Most streams in the vicinity of Zortman and Landusky mines are ephemeral and do not support fisheries. Recreational users do fish the lower sections of Rock Creek, south of the Little Rocky Mountains. Indirect impacts that which may be associated with water quality impacts to aquatic resources are considered low to insignificant. This ranking also reflects the positive impact expected from the success of the water balance cover and the Water Quality Improvement Plan (Appendix A).

6.3 Section 230.52 Water related recreation

Public lands in the vicinity of Zortman and Landusky mines provide some water-related recreation. Other types of recreation includes hiking, horseback riding, mountain biking, all-terrain vehicle use, wildlife and bird watching, caving, climbing, and hunting. Construction of the Goslin Flats heap leach pad may create affect recreational users through increased visual, noise, and traffic disturbance. Construction and operation of the conveyor system may also affect recreational users and hunters by the restriction of access to Goslin Gulch and along the length of the conveyor.

6.4 Section 230.53 Aesthetics

The project will have an impact on the visual resources (or viewshed) of the Little Rocky Mountains, particularly during construction and operation, and from some vantage points, after reclamation. The primary mine facilities that will affect aesthetics and visual resources are the Goslin Flats heap leach pad and the overland conveyor. Visual impacts from the Goslin Flats heap leach pad will include strong form and color contrasts created by the large, 200-foot-high pad facility. Night lighting at the Goslin Flats facility will also be visible for several miles. The overland conveyor system will pass through generally undisturbed forested areas, creating a linear feature in the landscape that will be visible from several roads in the area and from Saddle Butte and Old Scraggy Peak. Some impacts will be long term, such as landscape changes caused by the Goslin Flats heap leach pad. Most other impacts will be minimized through revegetation and reclamation activities after the ZMI project is complete.

6.5 Section 230.54 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves

No parks, national monuments, or other sites are located directed within the mine's project area. The Charles M. Russell National Wildlife Refuge is located about 15 miles south of the Zortman and Landusky mine sites. The Fort Belknap Indian Reservation is located about 2.5 miles north of the project area and includes the Pow Wow grounds. Nearly the entire Zortman mine is located in an area BLM has defined as an area of potential effect for cultural properties. Two groups of vision quest sites have been recommended as eligible for nomination to the National Register as Traditional Cultural Properties: the Eagle Child Mountain District and the Beaver Mountain Vision Quest Sites. Azure Cave, adjacent to the project area, has been designated an area of critical environmental concern by the BLM.

7.0 SUBPART G - EVALUATION AND TESTING

7.1 Section 230.60 General evaluation of dredged or fill material

Ore and some waste rock will be placed at the Goslin Flats heap leach facility and will ultimately create a 200-foot-high pad that covers about 250 acres. The leach pad liner system will consist of about 12 inches of compacted clay overlain by a 30-mil polyvinyl chloride (PVC) geomembrane. The facility will account for about 2.42 of the total 3.64 acres of directly filled non-wetland waters of the U.S. and 1.06 of the 1.09 acres of filled wetlands.

The Goslin Flats heap leach facility operations will include leaching ore stacked on the pad, collecting pregnant solution at the bottom of the pad, transferring the pregnant solution to ponds, extracting the metals, and storing the barren solution for reapplication. As designed, all processing solutions will be stored within the Goslin Flats heap leach facility, which includes storage within the heap, in sumps, behind dikes, and in the surface ponds. The pad will be designed to accommodate excess process solution that would accumulate during a 100-year, 24-hour storm (6.23 inch) with a pump shutdown of 36 hours.

The Goslin Flats heap leach pad facility will be constructed primarily with ore. However, some waste rock materials from the existing Alder Gulch waste rock dump will be relocated to the Goslin Flats facility. The physical and mineralogical composition of the waste rock and ore materials will vary. The waste rock and ore deposits are primarily metamorphic and igneous rocks formed by the igneous intrusion. Detailed information on geology and soil resources are presented in Section 3.1 of the Final EIS.

Fill materials associated with construction of the powerline, pipeline, and access roads and conveyor corridors would consist of natural borrow materials from cut and fill operations and nearby disturbances. Waste rock would be used to fill the small narrow channels within the mining complex. Numerous waste rock samples have been collected and analyzed to determine their acid-generating potential. Geochemical testing has shown that certain parameters can be used to segregate potentially acid-generating waste from non-acid-forming wastes. Certain rock types, namely breccia, monzonite, trachyte, quartzite, and felsic gneiss, have the potential to generate net acidity and have been excluded from use for construction, fill, underdrain, or reclamation purposes. Additional information on the acid-generating potential of the waste materials is provided in Section 3.2.2.4 of the Final EIS.

7.2 Section 230.61 Chemical, biological, and physical evaluation and testing

Chemical characteristics of ZMI's waste rock are presented in Section 3.1 of the Final EIS. Geochemical testing has been performed on hundreds of samples of ore, waste rock, spent ore, and other local rock types collected from both the Zortman and Landusky sites. Tests indicate that most of the Zortman ore and waste materials have a negative NNP and have the potential to generate acid. ZMI currently sorts waste rock materials with a total sulfur content less than 0.2 percent and defines this material as non-acid-generating waste. However, supplemental testing has shown that these low total sulfur wastes have negative NNP and should not be considered truly non-acid-generating waste.

ARD is generated from pit walls and waste rock piles at both the Zortman and Landusky mines. Data indicate that all of the major drainages show some degree of impact from mining-related activities. Geochemical analyses have indicated that ore and waste rock generated by the mine expansion and reclamation project will generate acid. Sorting waste rock based on its percent sulfur and NNP and then isolating it within the center of the repository will help minimize ARD from the new waste rock dumps.

8.0 SUBPART H - ACTIONS TO MINIMIZE ADVERSE EFFECTS

This evaluation addresses potential project impacts to wetland and non-wetland waters of the U.S., in accordance with Section 404(b)(1) guidelines. Appropriate and practicable steps to minimize potential adverse impacts on the aquatic ecosystem have been developed and are addressed in Section 2.1.4 of this evaluation and in the alternatives analyses in Section 4.0 of the Final EIS. Table B-1 summarizes how wetland and non-wetland waters of the U.S. will be affected by ZMI's mine expansion and reclamation project.

About 3.73 acres of non-wetland waters of the U.S. have previously been filled by ZMI mining activities. Alternatives 1, 2, and 3 would not fill any additional wetland and non-wetland waters of the U.S. Alternatives 4, 5, 6, and 7 would directly fill an estimated 2.56 to 4.14 acres of non-wetland waters of the U.S. and 1.09 acres of wetlands. Alternative 7, the preferred alternative, would result in direct impacts to 3.64 acres of non-wetland waters of the U.S. and 1.09 acres of wetlands. Combining past and potential mining disturbances, an estimated total of 7.37 total of acres of non-wetland waters of the U.S. and 1.09 acres of wetlands would be directly filled with materials under Alternative 7 (see Table B-1).

A mitigation plan for impacts to wetlands and non-wetland waters for Alternative 7 has been developed and is presented in Appendix F. The mitigation plan consists of four components: on-site water quality mitigation; Ruby Gulch tailing removal and stream restoration; on-site wetland mitigation projects; and off-site mitigation projects. Detailed descriptions of these four components and estimated acreage for each is contained in Appendix F. In total, about 40.04 acres of wetland and non-wetland mitigation have been developed to cover the past, present, and projected direct and indirect impacts.

8.1 Section 230.70 Actions concerning the location of the discharge

The primary action used to minimize impacts to wetland and non-wetland waters of the U.S. involves selecting the location for the waste rock storage area and the ore heap leaching facility. Eight waste rock repository locations and six heap leach area locations were considered. These facility locations were evaluated based partially on their ability to avoid affecting wetland and non-wetland waters of the U.S. However, other environmental factors, such as the potential impacts to air, water, and soil, and their subsequent impacts to the vegetation, wildlife, and human health were also considered as part of the overall environmental assessment.

8.2 Section 230.71 Actions concerning the material to be discharged

Limited actions are available to alter the physical or geochemical nature of the ore and waste rock materials placed in the waste rock dump and heap leach pad. To minimize problems associated with ARD, ZMI proposes to continue sorting the waste rock based on its sulfur content and NNP. Waste rock materials with a high sulfur content and high potential to generate ARD would be isolated in the center areas of the waste rock repository.

Water diversion and capture systems would be constructed to capture of mine-contaminated waters. The Water Quality Improvement Plan is provided in Appendix A of the Final EIS. This plan provides a basis for segregating various waters, particularly for identifying waters that could be managed with sediment and erosion control practices and waters that would require capture and treatment. The goal of the water capture and treatment plan is to achieve compliance with the Montana Water Quality Act as soon as possible and to improve downstream water quality; however, long-term water treatment may be necessary to achieve these goals.

8.3 Section 230.72 Actions controlling the material after discharge

ZMI proposes implementing a mine plan that includes reclamation of areas disturbed by past and proposed mine activities. The reclamation plan describes ZMI's proposed methods to recreate a land configuration compatible with the watershed, reestablish an appropriate vegetative cover, restore habitat for grazing livestock and wildlife, and reestablish the aesthetic environment.

Approximately 2.8 million cubic yards of non-acid-generating waste rock materials would be used for reclamation, primarily as a capillary break. After detoxifying the Goslin Flats heap leach pad, the slopes would be reduced to about a 2.5-to-1 slope (that is, 2.5 feet horizontal to 1 foot vertical). The uppermost surface of the pad would be left roughly contoured to create a variable skyline and some microhabitat areas. A water balance reclamation cover would be applied to all pad surfaces, and the areas would be revegetated with native prairie grasses, forbs, and shrubs. Reclamation activities for the other mining facilities, including the waste rock dumps, plant sites, and support facilities, are described in detail in ZMI permit application amendment (ZMI 1993).

8.4 Section 230.73 Actions affecting the method of dispersion

Under Alternative 7, fill materials would be placed in wetland and non-wetland waters of the U.S. using conventional mining equipment and a conveyor system. The Goslin Flats heap leach pad facility will be designed to contain the ore, waste rock, and process solutions and to prevent their dispersion or migration out of the heap leach facility. The leach pad liner system will consist of about 12 inches of compacted clay overlain by a 30-mil PVC geomembrane.

8.5 Section 230.74 Actions related to technology

The ore materials, relocated waste rock, and limestone used for reclamation would all be transported to the Goslin Flats facility using an overland conveyor system. The conveyor system would include dust suppression measures. ZMI is also considering some form of passive water treatment, possibly involving constructed wetlands. Using a water balance reclamation cover instead of a water barrier reclamation cover is also being considered to better limit downward migration of water into the waste zone and to be more effective on steeper slopes.

Hydric soils will be salvaged from the wetlands beneath the Goslin Flats heap leach pad facility and will be directly placed on the wetland mitigation sites to provide increased organic matter and a source for plant materials. A clay liner would be used to reduce deep percolation of water at the wetland mitigation sites.

8.6 Section 230.75 Actions affecting plant and animal populations

All plant populations at the Goslin Flats heap leach pad area will be lost, and animal populations will be displaced or lost as a result of construction activities. When complete, reclamation activities will replace some of the lost habitat and provide space for the reestablishment of some of the lost plant and animal populations. In addition, in the event a Section 404 permit is approved and issued, permit conditions and additional mitigation measures may be incorporated to ensure that the project complies with Section 230.10(d) of the guidelines.

A wetland and non-wetland waters of the U.S. mitigation plan has been developed to compensate for direct impacts (past and proposed) to wetland and non-wetland waters of the U.S. and to restore the functions of these aquatic resources (Appendix F). Mitigation for indirect impacts, particularly indirect impacts to the 14.6 acres of downstream non-wetland waters has also been developed.

8.7 Section 230.76 Actions affecting human use

The Goslin Flats heap leach pad facility site was selected because it appears to cause the least potential damage to the aquatic ecosystem of all the alternatives considered. Although the leach pad structure will have a permanent negative effect on the visual aesthetics of the area, reclamation activities during project completion as well as revegetation of the disturbed surfaces will minimize the overall visual impact. The completed project is not expected to increase human activities in the area that are incompatible with current use patterns. In addition, the placement of the fill is not expected to affect any public water supply intake.

ARD is now and will continue to be generated from pit walls and waste rock piles at the Zortman and Landusky mines. Data indicate that all of the major drainages show some degree of impact from mining-related activities. Geochemical analyses have indicated that ore and waste rock generated by the mine expansion and reclamation project will generate acid. Sorting the waste rock based on its percent sulfur and NNP and then isolating it within the center of the repository will help minimize ARD from the new waste rock dumps. If the COE recommends a permit, it may attach permit conditions requiring ZMI to develop a contingency operational plan for unanticipated increases in ARD.

8.8 Section 230.77 Other actions

The planned reclamation, including some slope reduction and revegetation of the disturbed surfaces for the Goslin Flats heap leach facility, will help minimize the adverse environmental impacts from this facility. The wetland and non-wetland mitigation proposed would offset some of the impacts caused by placing fill materials in Goslin Gulch and the other drainages within the mine sites.

9.0 PRELIMINARY CONCLUSIONS

The agencies have reviewed the proposed ZMI mine expansion and reclamation project against the Section 404(b)(1) guidelines and have concluded that the mining project will result in impacts to circulation and fluctuation patterns, substrate, suspended particulates and turbidity, water quality, and aquatic ecosystem functions. Several of these impacts will be permanent and long term, while others will occur primarily during the construction period and will be short term. Cumulative direct and indirect impacts for wetland and non-wetland waters of the U.S. are estimated to be 29.27 acres of disturbance to non-wetland waters of the U.S. and 1.57 acres of disturbance to wetlands (see Table B-1).

A mitigation plan for impacts to wetlands and non-wetland waters for Alternative 7 has been developed and is presented in Appendix F of the FEIS. The mitigation plan consists of four components: on-site water quality mitigation; Ruby Gulch tailing removal and stream restoration; on-site wetland mitigation projects; and off-site mitigation projects. Detailed descriptions of these four components and estimated acreage for each is contained in Appendix F. In total, about 40.04 acres of wetland and non-wetland mitigation have been developed to compensate for past, present, and projected direct and indirect impacts. Impacts after mitigation would not be significant.

During the COE review of the project, all the alternatives considered in the Final EIS will be reviewed and evaluated to determine if there is a least damaging practicable alternative that could be permitted. Before making a final permitting determination, the COE will also consider public interest issues, input from other state and federal agencies, and the proposed mitigation measures. At the earliest, a final Section 404 permit evaluation cannot be made by the COE until 30 days after the Final EIS is published.

TABLE B-1
SUMMARY OF TOTAL[a] DIRECT AND INDIRECT IMPACTS TO WATERS OF THE U.S.(ACRES)
ALTERNATIVES 1 THROUGH 7

Mining Alternative	Zortman				Landusky				Total Zortman and Landusky Impact Acres
	Wetland		Non-wetland		Wetland		Non-wetland		
	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	
Alt 1	0.00	0.00	1.24	3.04	0.03	0.00	2.97	11.56	18.84
Alt 2	0.00	0.00	1.24	3.04	0.03	0.00	2.97	11.56	18.84
Alt 3	0.00	1.54	1.24	3.44	0.03	0.00	2.97	11.56	20.78
Alt 4	1.06	0.48	4.90	10.34	0.03	0.00	2.97	11.56	31.34
Alt 5	0.02	0.24	3.32	3.44	0.03	0.00	2.97	11.56	21.58
Alt 6	1.06	4.07	4.10	11.74	0.03	0.00	2.97	11.56	35.53
Alt 7	1.06	0.48	4.40	10.34	0.03	0.00	2.97	11.56	30.84

[a] Total acres includes both existing and proposed impact acres. For a breakdown of specific existing and proposed impact acres, see Table 4.4-4a and Table 4.4-4b in the Final EIS.

TABLE B-2
PROPOSED FACILITY IMPACTS TO WATERS OF THE U.S.(ACRES)
ALTERNATIVE 7

Proposed Facility	**Waters of the U.S. (Acres)**			
	Wetland		**Non-wetland**	
	Direct	Indirect	Direct	Indirect
ZORTMAN				
Pit expansion	0.00	0.00	0.05	0.00
Carter Gulch waste rock repository expansion	0.00	0.00	0.94	0.00
Conveyor corridor	0.00	0.00	0.23	0.00
Access road to LS-1	0.00	0.00	0.02	0.00
Goslin Flats leach pad	0.82	0.43	2.01	0.00
Goslin Flats ore handling area	0.19	0.00	0.29	0.00
Goslin Flats plant site/processing ponds	0.00	0.00	0.10	0.00
Goslin Flats access roads	0.05	0.05	0.02	0.00
Compliance structures	0.00	0.00	0.40	0.00
TOTALS	1.06	0.48	4.06	0.00
LANDUSKY				
1987/1991 Leach pad extension	0.00	0.00	0.00	0.00
LAD support area	0.00	0.00	0.00	0.00
Reclamation access	0.00	0.00	0.00	0.00
Drainage construction	0.00	0.00	0.00	0.00
Quarry areas and access	0.00	0.00	0.00	0.00
Capture systems (Compliance structures)	0.03	0.00	0.08	0.00
TOTALS	0.03	0.00	0.08	0.00

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APPENDIX C
BIOLOGICAL ASSESSMENT

APPENDIX C

BIOLOGICAL ASSESSMENT
MINE LIFE EXTENSIONS AND REVISED RECLAMATION PLANS FOR THE ZORTMAN AND LANDUSKY MINES

1.0 INTRODUCTION

This biological assessment of threatened and endangered wildlife species evaluates impacts associated with mine expansion and reclamation proposals which are described in this Final Environmental Impact Statement (EIS). This biological assessment is in response to the requirements of section 7(c) of the Endangered Species Act (ESA).

The location of the mine expansions is in the Little Rocky Mountains of north central Montana (Figures 1-1 to 1-4 of the Final EIS). Zortman Mining, Inc. (ZMI) has two active gold mines in close proximity within the Little Rocky Mountains. The Zortman Mine is located in portions of Sections 7, 12, 17, and 18, Township 25N, Range 25E, Montana Principal Meridian (MPM). The Landusky Mine is west of the Zortman Mine in portions of Sections 14, 15, 22, and 23, Township 25N, Range 24E, MPM. Both are near the southern boundary of the Fort Belknap Indian Reservation in the southwest corner of Phillips County. The towns of Hays and Lodgepole are located in the southern portion of the Reservation, just to the north of the mountains. The town of Landusky is in the southwest portion of the Little Rocky Mountains about 0.5 miles south of the Landusky Mine. The town of Zortman is about 1 mile south of the Zortman Mine on the southern edge of the Little Rocky Mountains.

The present mining disturbance is 401 acres at the Zortman Mine and 814 acres at the Landusky Mine. The mine expansion activities would increase the areas of disturbance at the both Zortman and Landusky mines by varying amounts under each alternative as described in Chapter 2 of the Final EIS.

This Final EIS addresses impacts from the seven alternatives to both private and public lands. The Final EIS provides a comprehensive analysis of impacts to the public land and resources administered by BLM.

There are seven alternatives analyzed in the Final EIS. Alternative 1 is No Action; Alternative 2 is Mine Expansions Not Approved and Company Proposed Reclamation; Alternative 3 is Mine Expansions Not Approved and Mitigated Reclamation; Alternative 4 is the Company Proposed Expansions and Reclamation; Alternative 5 is Mitigated Expansion and Reclamation with Leach Pad located in Upper Alder Gulch rather than on Goslin Flats; Alternative 6 is the Mitigated Expansion and Reclamation with Waste Rock Repository located on Ruby Flats rather than in Carter Gulch; and Alternative 7 is Mitigated Expansion and Reclamation with Waste Rock Repository located on Existing Mine Facilities rather than in Carter Gulch.

2.0 AFFECTED SPECIES

According to a letter from the U. S. Fish and Wildlife Service (USFWS) dated December 8, 1992, the threatened and endangered (T&E) species listed on Table C-1 may be present in the project area. An updated list of threatened and endangered species was requested and received on October 28, 1994. There were no changes to the species listed on Table C-1.

A description of the occurrence of these species can be found in Section 3.5.1.1 Threatened and Endangered Species in the Final EIS. A summary of that information follows.

Bald eagles are fairly common migrants to eastern Montana. They occur throughout Phillips County following the fall and spring waterfowl migration. Wintering eagles have been observed primarily along major rivers (Milk and Missouri) where open water provides fish and/or waterfowl as food sources. However, bald eagle observations are rare in the Little Rocky Mountains. There are no known bald eagle nests or essential habitat in the Little Rocky Mountains and large open water bodies that could provide nearby nesting or foraging habitat do not exist.

Peregrine falcons have been an occasional spring and fall migrant to Phillips County. No historical nesting sites are known to occur in the Little Rocky Mountains. However, DeLap (1962) reported breeding peregrine falcons in the Little Rocky Mountains in 1962, but did not report the location of the nest. Potential nesting sites are present in the Little Rocky Mountains. Prairie falcons and golden eagles now occupy the potential peregrine falcon nesting sites in the Little Rocky Mountains.

Approximately, 200 black-tailed prairie dog towns occur in Phillips County. Most of these towns form a large complex ideal for a black-footed ferret reintroduction. This 7km Complex is known as the North Central Montana (NCM) Complex. The NCM complex has been identified by the Montana Department of Fish, Wildlife and Parks (MDFWP) and USFWS as Montana's best reintroduction area. This area ranks as one of the three best ferret reintroduction areas in the United States. Black-footed ferrets were re-introduced into Phillips County in the fall of 1994. The reintroduction occurred about 35 air miles southeast of the Little Rocky Mountains. The closest prairie dog town to the Little Rocky Mountains is over 10 miles away.

The piping plover was listed (January 10, 1986) as threatened in eastern Montana. No sightings have been made within the Little Rocky Mountains or on BLM administered land in the area. However, an intensive inventory has not been completed as yet on all BLM lands in Phillips County. This species could be a resident, occurring on lake shorelines or on gravel bars or sandy beaches along major rivers. Sightings and nesting of the piping plover has occurred at Fort Peck and Nelson Reservoirs within the area. No plovers were found during wildlife surveys associated with this project.

3.0 ISSUE ANALYSIS

This analysis discusses the Preferred Alternative identified in Chapter 2, Section 2.11 of the Final EIS. The summary is as follows: Alternative 7 would allow expansion of both the Zortman and Landusky mines but impose agency-developed mitigation on the expansion and reclamation activities. The major modification to ZMI's expansion plans would be at the Zortman Mine, where the proposed waste rock repository would be constructed on top of existing facilities at the mine. Based upon a preliminary design for a waste rock cap and pit contour at the Zortman Mine site, the agencies developed this alternative as a way to reduce the amount of surface disturbance associated with expanded mining activities, reduce the potential for impacts to water resources and enhance reclamation opportunities on existing facilities. This alternative would also reduce the amount of reclamation materials by concentrating disturbed areas. Water balance reclamation covers, as opposed to the barrier covers described in previous alternatives, would be used to promote revegetation and improve wildlife habitat. A significant modification at the Landusky Mine would include reclamation requirements to backfill the pits to a minimum elevation required to create a surface which would freely drain into Montana Gulch. Additional sources of backfill such as the 85/86 leach pad and the Montana Gulch waste rock dump may also be required to reach the desired Landusky Mine pit floor elevation. Other agency-developed mitigating measures designed to reduce or eliminate environmental impacts are incorporated into this alternative.

The *black-footed ferret* would not be impacted by the expansion of the mines under Alternative 7.

<u>Decision</u> - No Effect

<u>Rationale</u> - There is no habitat for the ferret within 10 miles of the mine site. Therefore, there would be no impact to the black-footed ferret. If a ferret would ever get to the mine site it would be out of its habitat and would be caught and relocated back into ferret habitat

The *bald eagle* would not be impacted by the expansion of the mines under Alternative 7.

<u>Decision</u> - No Effect

<u>Rationale</u> - There is no designated critical habitat for the bald eagle in the Little Rocky Mountains. Any open water associated with the mining that contains toxic concentrations of captured acid rock drainage (ARD) or cyanide process solutions associated with the leaching activities would be fenced and netted to protect birds from these solutions.

The *piping plover* would not be impacted by the expansion of the mines under Alternative 7.

<u>Decision</u> - No Effect

<u>Rationale</u> - There is no designated critical habitat for the piping plover in the Little Rocky Mountains. A plover was sited in a gravel pit in western Montana however, there is little or no gravel in or near these pits. Any open water associated with the mining that contains toxic concentrations of captured ARD or cyanide process solutions associated with the leaching activities would be fenced and netted to protect birds from these solutions.

The *peregrine falcon* would not be impacted by the expansion of the mines under Alternative 7.

Decision - No Effect

Rationale - The decision has been made to drop required mitigation for the peregrine falcon reintroduction study. The mitigation was to evaluate the highwall of the mine for possible hack site(s) (artificial nesting sites). The highwalls of the mine are still available for the natural establishment of peregrine falcons, but an evaluation (by BLM and FWS) will not be done. The falcon should be delisted by the time the mine closes (8-10 years) and the highwall will still be available for nesting without disturbance (mainly noise) from mining. The falcon population is increasing nationwide and falcons could naturally occupy sites in the Little Rocky Mountains by the time the mine closes.

4.0 CONSULTATION

The Bureau of Land Management consulted with the U.S. Fish and Wildlife Service concerning the biological assessment and "no effect" determinations. The FWS concurred with the determination of no adverse effect to the species identified, and notified BLM that formal consultation would not be required (U.S. DOI 1996). A copy of the determination and notification is attached to this Appendix.

TABLE C-1

THREATENED AND ENDANGERED SPECIES POTENTIALLY PRESENT IN PROJECT AREA

LISTED SPECIES	STATUS	EXPECTED OCCURRENCE
Bald Eagle *Haliaeetus leucocephalus*	Endangered	Year-round resident, winter resident, migrant
Peregrine falcon *Falco peregrinus*	Endangered	Summer resident, migrant
Black-footed ferret *Mustela nigripes*	Endangered	Potential resident in prairie dog (*Clomys*) towns
Piping plover *Charadrius melodus*	Threatened	Summer resident, nesting
PROPOSED SPECIES	**STATUS**	**EXPECTED OCCURRENCE**
None		

Source: U.S. Department of the Interior, Fish and Wildlife Service, December 8, 1992 and October 28, 1994

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLGICAL SERVICES
100 N PARK, SUITE 320
HELENA MT 59601

January 25, 1996

M.02 BLM Lewistown District (I)

MEMORANDUM

To: District Manager, Bureau of Land Management, Lewistown, MT

From: Field Supervisor, Montana Field Office, Helena, MT

Subject: Biological Assessment - Zortman and Landusky Mines Reclamation Plan Modifications and Mine Life Extensions

Thank you for your letter of January 9, requesting Fish and Wildlife Service (Service) review of the biological assessment for the proposed Zortman and Landusky Mines Reclamation Plan Modification and Mine Life Extensions.

The Service has reviewed the biological assessment and concurs with your determination the proposed project will have "no effect" on the endangered black-footed ferret (Mustela nigripes), or the threatened piping plover (Charadrius melodus) and bald eagle (Haliaeetus leucocephalus). While the Service believes their will be no adverse affect to the peregrine falcon (Falco perigrinus) from the proposed action we do not agree with the positive may affect conclusion reached in the biological assessment. Therefore, pursuant to S402.13 (a) of 50CFR, formal consultation is not required.

If, after public review and comment, the final project design is changed so as to have effects on threatened and endangered species other than those described in the August 1995 biological assessment and associated Draft Environmental Impact Statement, a revised assessment will need to be prepared. The Service will then issue a concurrence/nonconcurrence letter addressing the revised biological assessment.

We appreciate your efforts to ensure the conservation of these endangered species as a part of your responsibilities under the Endangered Species Act, as amended.

DMC

cc: Area Manager, Phillips Resource Area, Malta, MT
Suboffice Coordinator, USFWS, Ecological Services, Billings, MT

IMPORTANT NOTE:
ACTUAL PHOTO SIMULATIONS CAN BE FOUND IN
APPENDIX D OF THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT
ZORTMAN AND LANDUSKY MINES
Reclamation Plan Modifications and
Mine Life Extensions
August, 1995

DRAFT EIS PHOTO SIMULATIONS INDEX

Figure	Viewpoint	View Direction	View Distance (miles)	Location/Alternative Shown[1]
D-1	Hwy 191/Dry Fork Rd.	N	--	Existing Condition
D-2	Hwy 191/Dry Fork Rd.	N	5	Zortman/Alt. 4
D-3	Hwy 191/Dry Fork Rd.	N	5	Zortman/Alt. 6
D-4	Ricker Butte	WNW	--	Existing Condition
D-5	Ricker Butte	WNW	7.4	Zortman/Alt. 4
D-6	Ricker Butte	WNW	7.4	Zortman/Alt. 5
D-7	Ricker Butte	WNW	7.4	Zortman/Alt. 6
D-8	Beaver Mountain	S	--	Existing Condition
D-9	Beaver Mountain	S	4.2	Zortman/Alt. 6
D-10	Beaver Mountain	SSW	--	Existing Condition
D-11	Beaver Mountain	SSW	2.4	Zortman/Alt. 5
D-12	Old Scraggy Peak	S	--	Existing Condition
D-13	Old Scraggy Peak	S	3.2	Zortman/Alt. 4
D-14	Old Scraggy Peak	S	3.2	Zortman/Alt. 6
D-15	Old Scraggy Peak	W	--	Existing Condition
D-16	Old Scraggy Peak	W	1.6	Zortman/Alt. 4
D-17	Old Scraggy Peak	W	1.6	Zortman/Alt. 5
D-18	Old Scraggy Peak	W	1.6	Zortman/Alt. 7[2]
D-19	Old Scraggy Peak	W	1.6	Zortman/Alt. 7
D-20	Saddle Butte	N	--	Existing Condition
D-21	Saddle Butte	N	2.9	Zortman/Alt. 4
D-22	Saddle Butte	N	2.9	Zortman/Alt. 5
D-23	Saddle Butte	N	2.9	Zortman/Alt. 7[2]
D-24	Saddle Butte	N	2.9	Zortman/Alt. 7
D-25	Saddle Butte	E	--	Existing Condition
D-26	Saddle Butte	E	1	Zortman/Alt. 4[2]
D-27	Saddle Butte	E	1	Zortman/Alt. 4
D-28	Saddle Butte	E	1	Zortman/Alt. 6
D-29	Bear Gulch Road	W	--	Existing Condition
D-30	Bear Gulch Road	W	2.6	Zortman/Alt. 5
D-31	Bear Gulch Road	W	.2	Zortman/Alt. 6
D-32	Bear Gulch Road	SW	--	Existing Condition

DRAFT EIS PHOTO SIMULATIONS INDEX
(Concluded)

Figure	Viewpoint	View Direction	View Distance (miles)	Location/Alternative Shown[1]
D-33	Bear Gulch Road	SW	1	Zortman/Alt. 4
D-34	Bear Gulch Road	SW	.1	Zortman/Alt. 6
D-35	Thornhill Butte	N	--	Existing Condition
D-36	Thornhill Butte	N	5.1	Landusky/Alt. 4
D-37	Pow Wow Grounds	SSE	2.1	Existing Condition
D-38	Pow Wow Grounds	SSE	2.1	Landusky/Alt. 4
D-39	Hwy 66/Landusky turnoff	N	--	Existing Condition
D-40	Hwy 66/Landusky turnoff	N	4.5	Landusky/Alt. 4
D-41	Mission Peak	E	--	Existing Condition
D-42	Mission Peak	E	.3	Landusky/Alt. 4[2]
D-43	Mission Peak	E	.3	Landusky/Alt. 4

1 Photographic simulations show the various alternatives after final reclamation, unless noted otherwise.
2 Shows alternative during operations at full build-out.

APPENDIX E
PROGRAMMATIC AGREEMENT

PROGRAMMATIC AGREEMENT AMONG THE BUREAU OF LAND MANAGEMENT THE ADVISORY COUNCIL ON HISTORIC PRESERVATION AND THE MONTANA STATE HISTORIC PRESERVATION OFFICER REGARDING ZORTMAN AND LANDUSKY MINES PROPOSED RECLAMATION PLAN MODIFICATIONS AND MINE EXPANSION

WHEREAS, the Lewistown District Office of the Bureau of Land Management (BLM) has determined that the Zortman and Landusky Mines proposed reclamation plan modifications and Mine Expansion will have an effect on historic properties eligible for inclusion in the National Register of Historic Places, and has consulted with the Montana State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (Council) pursuant to Section 800.13 (36 CFR 800), of the regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f); and

WHEREAS, the historic properties that may be affected by the proposed undertaking include a traditional cultural properties (TCP) district, and historic and prehistoric sites located in the Little Rocky Mountains (LRM); and

WHEREAS, there has been mining in the LRM since the 19th century, and large scale surface mining activities since 1979 have resulted in existing physical, visual, and aural impacts; and

WHEREAS, the Fort Belknap Community Council has been consulted and chooses not to concur in this Programmatic Agreement (agreement); and

WHEREAS, Zortman Mining Incorporated has been consulted and invited to concur in this agreement; and

WHEREAS, site descriptions are presented in Appendix A and the definitions given in Appendix B are applicable throughout this agreement; and

WHEREAS, The BLM and the Montana Department of State Lands (DSL) are currently preparing an Environmental Impact Statement (EIS) examining potential impacts that would result from seven possible alternatives; and

WHEREAS, Appendix C is a summary of the Purpose and Need of the project and a brief description of the seven alternatives; and

WHEREAS, one of these seven alternatives will be selected as the Preferred Alternative and impacts to historic properties will vary according to the alternative selected; and

WHEREAS, Alternatives 1, 2, and 3 are reclamation alternatives, do not include additional mining beyond that already permitted, and would not result in additional impacts to historic properties;

WHEREAS, the BLM, the Montana SHPO, and the Council recognize that impacts to the Little Rockies Traditional Cultural Property District resulting from alternatives 4,5,6 and 7 cannot be fully mitigated in the view of Assiniboine and Gros Ventre Traditionalists of Fort Belknap;

NOW, THEREFORE, the BLM, the Montana SHPO, and the Council agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

BLM shall ensure that the following stipulations are carried out.

I. Treatment Plans

A. Treatment Plans will be prepared and implemented according to the Alternative selected in the Record of Decision (ROD) that will be issued by the BLM according to the requirements of the National Environmental Policy Act (NEPA). Treatment Plans will be required if Alternative 4, 5, 6, or 7 is selected and ZMI proceeds with the expansion project. Required Plans for each alternative are described in Stipulation III.

B. Treatment Plans shall be consistent with the Secretary of the Interior's Standards and Guidelines (48 FR 44716-44742), the Council's handbook <u>Treatment of Archaeological Properties: A Handbook</u>, guidelines included in <u>National Register Bulletin</u> 38, and any applicable regulations.

C. Where data recovery is determined by the BLM to be the most prudent and feasible treatment option, the research design proposed in the Treatment Plan shall specify, at a minimum:

1. the historic properties to be affected and the nature of those effects;

2. the research questions to be addressed through data recovery, with an explanation of their relevance and importance;

3. the fieldwork and analytical strategies to be employed, with an explanation of their relevance to the research questions;

4. proposed methods of addressing individual discovery situations;

5. methods to be used in data management and dissemination of data, including a schedule;

6. a proposed disposition of recovered materials, human remains, and records; and

7. a proposed schedule for the submission of progress reports to the BLM and the SHPO.

D. The National Park Service office of Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) shall be consulted to determine the appropriate level of documentation for historic structures and mining remains. The BLM shall ensure that all documentation is completed and accepted by HABS/HAER (National Park Service), and that copies of this documentation are made available to the SHPO.

E. The Treatment Plans for historical and archaeological sites shall be submitted by the BLM to the SHPO for review. Unless the SHPO objects within 30 calendar days after receipt of the Plan, the BLM shall ensure that it is implemented.

F. ZMI will be responsible for all costs associated with development and implementation of the Treatment Plans. Once the costs of the post-field work have been determined, ZMI shall post a surety bond to cover these costs. ZMI shall be provided an opportunity to review treatment plans and comment on their efficiency, reasonableness and practicality prior to final approval of the treatment plans. The bond shall be held until all reporting and other mitigative work has been completed according to Stipulations IV. D, E, and F. As treatment plans are implemented, the surety bond shall be proportionally decreased.

II. Professional Qualifications

A. The BLM shall ensure that all historic research carried out pursuant to this agreement is carried out by or under the direct supervision of a person or persons meeting at a minimum the <u>Secretary of the Interior's Professional Qualifications Standards</u> (48 FR 44738-9) for Historians; that all studies in architectural history are carried out by or under the direct supervision of a person or persons meeting at a minimum the same <u>Standards</u> for Architectural Historians; and that all archaeological studies are carried out by or under the direct supervision of a person or persons meeting at a minimum the same Standards for Archaeologists.

B. The BLM shall ensure that ethnographic/traditional cultural properties research carried out pursuant to this agreement is carried out by or under the direct supervision of a trained ethnographer that has demonstrated his/her expertise and experience with these types of resources in North America. Experience shall include Principal Investigator positions on at least one other project of this type.

III. Alternative Treatment Plans

A. Alternative 4

1. Treatment for the Little Rockies TCP will consist of provisions to provide for the preservation through recordation and study of the historic/traditional associations of these mountains. (See Appendix D for specifics of the Little Rockies TCP studies.)

a. If alternative 4,5,6 or 7 is selected by Record of Decision and ZMI proceeds with the expansion project, BLM shall advertise the availability of funding for the study of historic/traditional associations of the Little Rockies.

The BLM shall send a letter of invitation for proposals to the two universities, three private colleges and seven tribal colleges in Montana as well as provide an annual feature article to Montana media soliciting proposals.

Study proposals will be accepted each year by the Lewistown BLM from colleges, universities or other non-profit educational organizations, as well as groups and individuals.

ZMI will be provided a 20 day comment period on the proposals received.

BLM will consider ZMI's comments before making any awards.

b. These studies will be directed at the historic/traditional associations of the Little Rockies and may include the documentation of historic or traditionally important locations as well as the values associated with these places at either the general or specific level, through oral traditions and other sources. These studies may also include documentation of traditionally important medicines associated with the Little Rocky Mountains.

c. These studies will be directed at those historic associations located within the working boundaries of the Little Rockies TCP as described in Appendix A of this agreement, and owned or controlled by ZMI or the BLM.

d. BLM shall not accept proposals for the study of lands shown on Map 1 but not controlled by ZMI or the BLM unless they are accompanied by the written consent of the landowner(s).

e. ZMI shall provide the funds to conduct the studies which BLM determines to conform to the guidance in III.A.1.A. through III.A.1.D above, and which do not exceed the limit of ten thousand dollars ($10,000) per year for a period of five (5) years or a maximum of fifty thousand ($50,000), which ZMI agrees to make available for treatment of the Little Rockies TCP through the above described studies.

f. ZMI shall be allowed to review and make suggestions on proposals for studies for which ZMI is providing funding pursuant to this agreement.

2. The BLM shall ensure that ZMI develops and implements a Treatment Plan documenting the character of the Ruby Mill (24PH255). This Plan shall include HABS/HAER documentation of the site, prepared according to Stipulation I.D.

3. The BLM shall ensure that ZMI prepares and implements a Treatment Plan for the Alder Gulch Historic District. One site within the District (24PH2863, a lime kiln) would be directly impacted by construction of the conveyor system. The Plan, including data recovery and photographic documentation of the existing conditions in the District (including HABS/HAER recording), will be prepared according to the requirements of Stipulation I. Extensive data recovery in the form of archaeological excavations is not required. Excavation may be proposed as part of a plan to substantiate historical research, test

hypotheses, or to mitigate direct physical impacts to 24PH2863. A certain amount of excavations in workers housing or in trash dumps may be appropriate, depending on the research design contained in the Treatment Plan. It should be noted that sites that comprise the District are not all from the same time period. Additionally, the original purpose of some of the features is not known. The Plan should take this information into account.

a. The Treatment Plan will include preparation of interpretive signs for the Alder Gulch District. A minimum of three signs will constructed, incorporating results on the research done for the District. The signs will be no less than 2 square feet in size and of appropriate construction for outdoor durability.

b. The BLM shall ensure that reclamation measures include removal of the conveyor system upon mine closing.

4. The BLM shall ensure that ZMI prepares and implements a Treatment Plan addressing impacts to archaeological site 24PH2905, located in the land application area. The Plan shall be prepared in accordance with Stipulation I.

B. Alternative 5

1. Mitigation for the TCP District according to Stipulation III.A.1.

2. A Treatment Plan shall be prepared and implemented for the Ruby Mill according to Stipulation III.A.2.

C. Alternative 6

1. The BLM shall ensure that ZMI prepares and implements a Treatment Plan addressing impacts to archaeological sites 24PH2905 and 24PH3203. The Plan shall be prepared in accordance with Stipulation I.

2. A Treatment Plan shall be prepared and implemented for the Alder Gulch Historic District according to Stipulation III.A.3.

3. Mitigation for the TCP District according to Stipulation III.A.1.

4. A Treatment Plan shall be prepared and implemented for the Ruby Mill according to Stipulation III.A.2.

D. Alternative 7

1. A Treatment Plan shall be prepared for the Alder Gulch Historic District according to Stipulation III.A.2.

2. Mitigation for the TCP District according to Stipulation III.A.1.

3. A Treatment Plan shall be prepared for the Ruby Mill according to Stipulation III.A.2.

4. A Treatment Plan shall be prepared for site 24PH2905 according to Stipulation III.A.4.

IV. Schedule

A. If Alternative 1, 2, or 3 are selected in the ROD, no Treatment Plans will be required.

B. If Alternative 4, 5, 6, or 7 is selected in the ROD and ZMI proceeds with the expansion project, the BLM shall ensure that the appropriate Treatment Plans, according to Stipulation III. B, C, or D, are submitted to BLM within 90 days of signing of the ROD.

C. If Alternative 4, 5, 6, or 7 is selected in the ROD and ZMI proceeds with the expansion project, the BLM shall ensure that mitigation as described in Stipulation III.A.1 for the TCP District is ongoing for the duration of the expansion project or a period of five (5) years, which ever comes first.

D. If Alternative 4, 6, or 7 is selected in the ROD and ZMI proceeds with the expansion project, the BLM shall ensure that fieldwork for the treatment of the Alder Gulch Historic District shall be completed prior to disturbance of this historic district by construction of the conveyor system.

1. Notice of fieldwork completion will be provided to the BLM from ZMI along with a summary of the fieldwork completed in conformance with the Alder Gulch Historic District Treatment Plan.

2. Construction can begin in the Alder Gulch District within 15 days of BLM's receipt of the fieldwork summary, unless BLM objects to the fieldwork summary for non-conformance to the Treatment Plan.

3. If BLM determines from the fieldwork summary that the proposed treatment for the Alder Gulch District has not been carried out, BLM shall notify ZMI within 15 days of receipt of the summary of additional actions that are necessary to conform with the Treatment Plan.

4. A final report and the proposed wording and sign configurations shall be submitted within one year of completion of the fieldwork.

5. Construction of the conveyor system outside of the Alder Gulch Historic District is not restricted by provisions within this agreement.

E. Fieldwork for the Treatment Plan for site 24PH2905 shall be completed prior to use of the land application area. The final report shall be submitted within one year of completion of the fieldwork.

1. Notice of fieldwork completion will be provided to the BLM from ZMI along with a summary of the fieldwork completed in conformance with the Treatment Plan addressing impacts to archaeological site 24PH2905.

2. If BLM determines from the fieldwork summary that the proposed treatment for 24PH2905 has not been carried out, BLM shall notify ZMI within 15 days of receipt of the summary of additional actions that are necessary to conform with the Treatment Plan.

F. Fieldwork for the Treatment Plan for site 24PH3203 shall be completed prior to construction of the waste rock repository. The final reports shall be submitted within one year of completion of the fieldwork.

1. Notice of fieldwork completion will be provided to the BLM from ZMI along with a summary of the fieldwork completed in conformance with the Treatment Plan addressing impacts to archaeological site 24PH3203.

2. If BLM determines from the fieldwork summary that the proposed treatment for 24PH3203 has not been carried out, BLM shall notify ZMI within 15 days of receipt of the summary of additional actions that are necessary to conform with the Treatment Plan.

G. The Treatment Plan for the Ruby Mill shall be developed and implemented within one year of signing of the ROD. ZMI will provide the BLM and SHPO with the proposed Treatment Plan. If BLM determines that the Treatment Plan is inadequate, the BLM shall notify ZMI within 45 days of receipt of the Treatment Plan of changes necessary to make the Treatment Plan adequate.

V. Progress Reports

The BLM shall ensure that ZMI prepares annual progress reports detailing the status of Treatment Plans development and implementation. The reports will be submitted to the BLM and SHPO. The BLM shall submit a yearly report to the Council addressing work completed, work in progress, and a schedule of events for the upcoming year by April 1st of each year until all treatments are complete.

VI. Dispute Resolutions

Should the SHPO or ZMI object within 30 days to any Treatment Plans pursuant to this agreement, the BLM shall consult with the objecting party to resolve the objection. If the BLM determines that the objection cannot be resolved, the BLM shall request the further comments of the Council. The Council will provide comments to the BLM in response to such a request within 30 days. The BLM will take the Council's comments into consideration when deciding on the resolution of the dispute. The BLM's responsibility to carry out all actions under this agreement that are not the subject of the dispute will remain unchanged.

VII. Amendments

The BLM, SHPO or Council may request that this agreement be amended, whereupon the parties will consult in the same manner as this agreement was negotiated to consider such amendment. Concurring parties to this agreement shall be included in consultations on an amendment to this agreement.

VIII. Termination

Either the BLM or the Council may terminate this agreement for cause by providing 30 calendar days notice, in writing, to the other parties, provided that the parties will consult during the period prior to the termination to seek agreement or amendments or other actions that would avoid termination. In the event of a termination, the BLM will comply with 36 CFR 800.6(b) and 36 CFR 800.8(d) with regard to this undertaking.

IX. Failure to Carry Out Terms

Failure on the part of the BLM to carry out the terms of this agreement requires that the BLM again request the Council's comments. If the BLM cannot carry out the terms of this agreement, it shall not sanction any action, or make any irreversible commitment, that would foreclose the Council's consideration of alternatives to avoid or mitigate adverse effects, until such time as the commenting process has been completed.

X. Execution

Execution of this Programmatic Agreement and implementation of its terms evidence that the BLM has afforded the Council an opportunity to comment on the Zortman and Landusky Mines Proposed Reclamation Plan Modifications and Mine Expansions and its effects on historic properties, and that the BLM has taken into account the effects of the undertaking on historic properties.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: Cathryn B. Slater Date: 11-14-95
Chairman

BUREAU OF LAND MANAGEMENT

By: David L. Mari Date: 10/11/95
Lewistown District Manager David L. Mari

MONTANA STATE HISTORIC PRESERVATION OFFICER

By: [signature] Date: 10-23-95
Paul Putz, SHPO

Concur:

ZORTMAN MINING INCORPORATED

By: [signature] Date: 12 OCT 95
Rolin P. Erickson, Gen. Manager

SUB-APPENDIX A - SITE DESCRIPTIONS

Little Rocky Mountains Traditional Cultural Properties District

The BLM and SHPO have delineated a boundary around the Little Rocky Mountains which follows paved roads, for the most part (see attached map).

Alder Gulch Historic District

Twelve sites comprise the historic district and are listed below. A map delineating the District boundary is attached.

24PH2821	Adits	24PH2860	Mining Camp
24PH2822	Mining Camp	24PH2862	Alder Gulch Mill and Camp
24PH2823	Mining Camp	24PH2863	Alder Gulch Lime Kiln
24PH2824	Alder Gulch Dam	24PH2864	Pony Gulch Adit
24PH2825	Miner's Shack	24PH2865	Pole Gulch Mine
24PH2826	Adit	24PH2867	Adit

24PH255

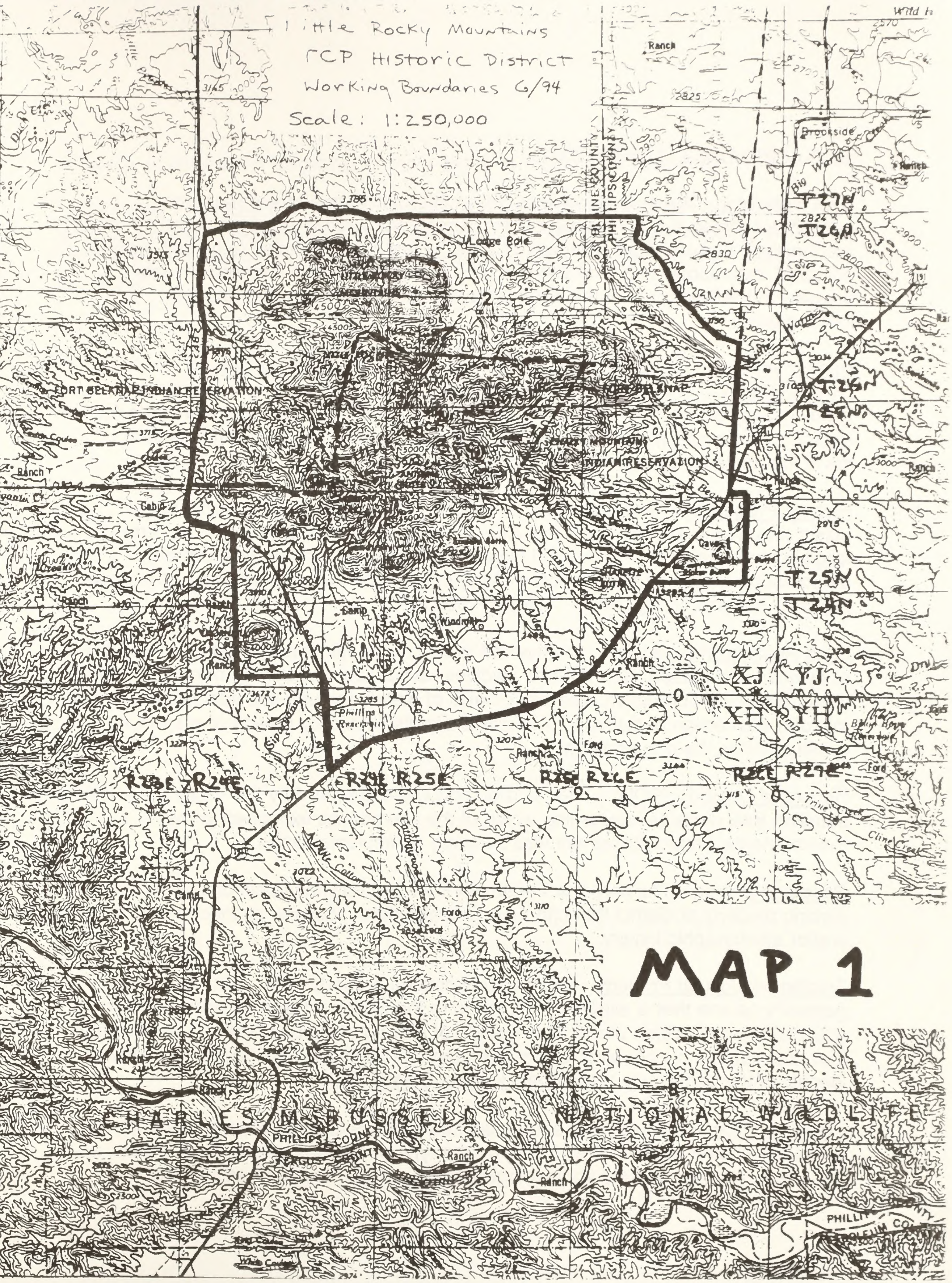
This is the Ruby Gulch Mill. Site 24PH255 was originally recorded in 1978 by Hogan and Fredlund (Cultural Resources Inventory: Zortman and Landusky Mining Tracts) as the Ruby Gulch Mine and Townsite. The mill was not included as it was outside the survey area. The townsite and mine have been destroyed by mining activities. The extant mill is the third one constructed for the Ruby mine; it was built in 1936.

24PH2905

This site was recorded by Rossillon in 1991 and described in Cultural Resource Inventory in the Little Rocky Mountains in and Adjacent to Pegasus Gold Corporation's Proposed Zortman Mine Expansion Project. The site consists of eleven rock rings on the east terrace of Ruby Creek. Lithic artifacts found in subsurface tests included tools, cores, debitage, and a projectile point fragment. A few small, unidentified bone fragments were also recorded.

24PH3203

This site was recorded by Munson in 1994 and described in Class III Cultural Resource Inventory of the Proposed Goslin Flat Waste Rock Repository. It is described as an oval-shaped cluster of heavily sodded-in cobbles. Tests revealed a layer of charcoal stained soil containing fragments of charcoal and calcined bone. The only artifact recovered from the tests was a possible pestle. The site may be the remains of a large hearth-type feature or a dwelling structure.


Little Rocky Mountains
TCP Historic District
Working Boundaries 6/94
Scale: 1:250,000
FORT BELKNAP INDIAN RESERVATION
INDIAN RESERVATION
Lodge Pole
Brookside
Ranch
T27N
T26N
T25N
T24N
XJ
YJ
XH
YH
R23E R24E
R24E R25E
R25E R26E
R26E R27E
PHILLIPS COUNTY
CHARLES M. RUSSELL NATIONAL WILDLIFE

MAP 1

SUB-APPENDIX B - DEFINITIONS

Data Recovery - The procedures that collect information to address research questions outlined in the Treatment Plan. These procedures usually include archaeological excavation, collection of artifacts and other samples (e.g., soil, pollen, charcoal, macrobotanical), and site mapping. Data recovery is followed by data analysis in the laboratory of the collected samples and a report detailing the investigations.

Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) - An office of the National Park Service that maintains records of buildings, structures, and engineering sites. The office also maintains standards for recording those site types; these procedures may include measured architectural drawings and scaled, large-format photography.

Historic Properties - "Any prehistoric or historic district, site, building structure, or object included in, or eligible for inclusion in the National Register. . . . The term 'eligible for inclusion in the National Register' includes both properties formally determined as such by the Secretary of the Interior and all other properties that meet National Register listing criteria." 36 CFR 800.2(e)

Land Application Area - Disposal method to neutralize effluents consisting of low levels of cyanide and metals. The method involves application by spraying of effluent onto a designated land application area for removal of metals through soil adsorption and soil microbe destruction of cyanide. The effluent is distributed by means of a sprinkler system laid on the ground surface.

Record of Decision (ROD) - The decision document prepared by the Federal agency detailing their decision concerning which of the alternatives examined in the Environmental Impact Statement was selected for implementation.

Research Design - The part of a Treatment Plan that outlines questions about a historic property or district that can be addressed data recovery, historic research, and/or ethnographic inquiry.

Traditional Cultural Property - "A traditional cultural property, then, can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community." National Register Bulletin 38, p. 1.

Treatment Plan - The plan that addresses how impacts to a (or several) historic property will be mitigated. Depending on the type of property and level of impact, a treatment plan may include archaeological excavations, historic or ethnographic research, HABS/HAER recording, or other forms of research or recording.

Undertaking - "A project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency including . . .those requiring a Federal permit, license, or approval. . ." National Historic Preservation Act, Section 301(7)(C).

SUB-APPENDIX C

ZORTMAN AND LANDUSKY MINES
PROPOSED RECLAMATION PLAN MODIFICATIONS
&
MINE-LIFE EXTENSIONS

The Bureau of Land Management (BLM) and the Montana Department of State Lands (DSL) have been evaluating proposals by Zortman Mining, Inc. (ZMI) for additional mining at both the Zortman Mine and the nearby Landusky Mine in Phillips County, Montana. Also under evaluation are proposals to modify the reclamation plans of existing mine facilities to address problems with acid rock drainage (ARD).

The agencies have conducted necessary scoping activities and are in the process of preparing an environmental impact statement on the mine expansions and corrective measures under requirements of the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA).

It has become apparent that the current approved reclamation plans are not adequate to limit or prevent the development of ARD from the present mine facilities. In early 1993 the agencies informed ZMI that the reclamation plans had to be modified to mitigate existing ARD and to ensure successful surface reclamation. ZMI has submitted proposed modifications to the current reclamation plans.

There is considerable interdependence between mine expansion activities and corrective measures to address the inadequacies of the existing reclamation plans. To consider these in a comprehensive fashion the scope of the EIS includes alternatives that address both these needs.

ALTERNATIVES SUMMARY

Seven alternatives (including the proposed action) have been developed. For ease of reading these are arranged from the simplest (No Action) to the most complex (Expanded Mining with Agency Imposed Mitigation).

Below is a summary of the seven alternatives. Attached to this summary document is a map to show various expansion alternatives.

Alternative 1: No Action, Existing Reclamation Plans, No Mine Expansions

Zortman Mining, Inc. (ZMI) would continue already permitted activities at both the Zortman and Landusky Mines.

There has been no mining at the Zortman Mine since 1990. Mine expansion plans would not be approved. Leaching and reclamation would continue as permitted.

At the Landusky Mine the permitted ore reserves would be mine out by the beginning of 1996. Mine expansion plans would not be approved.

Alternative 2: ZMI Proposed Modified Reclamation Plans, No Mine Expansions

ZMI would continue already permitted activities at both the Zortman and Landusky Mines. Mine expansion plans would not be approved. The existing reclamation plans for the mines would be revised as proposed by ZMI to mitigate the existing ARD problems. Company proposed revisions include low permeability capping of unreclaimed heaps and waste rock dumps, redesign of diversion structures, water treatment contingencies, and enhanced monitoring for evaluating reclamation effectiveness.

Alternative 3: Agency Mitigation Added to ZMI Proposed Modified Reclamation Plans, No Mine Expansions

This is the same as Alternative 2 described above. However, under this alternative the agencies would impose additional requirements on ZMI's proposed plans to insure reclamation success. These mitigating measures would include low permeability capping on all mine facilities, not just those that test positive for acid generating potential, slope reduction on mine waste units and development of limestone quarries in the Beaver Creek and the King Creek areas to be used for reclamation materials.

Alternative 4: ZMI Proposed Mine Expansions and Modified Reclamation Plans

This is ZMI's proposed Zortman Mine Expansion Plan contained in the application documents initially submitted to BLM and DSL on May 11, 1992 and revised through the completeness process until September of 1994. It also includes the smaller proposed expansion of the Landusky Mine detailed in the ZMI document of September, 1994. Enhanced reclamation measures for both operations are included in the proposals. These are collectively known as the Company Proposed Actions (CPA).

Approximately 600 additional acres would be disturbed. Major disturbances would be from construction of the leach pad, the waste rock depository, crusher, conveyor system, and processing facilities. Mining activities would expand and deepen the current pit areas. The proposed limestone quarry, shale pit expansion, Goslin Flats leach pad, Landusky powerline extension, and the conveyor would be outside the current mine permit boundaries.

The operation would enlarge the existing pits, combine run-of-mine oxide and crushed non-oxide ore, and transport the ore via a 12,000-foot overland conveyor to a cyanide heap leach facility located at Goslin Flats. Cyanide solution would be applied to the ore heap and the precious metal-enriched solution would be captured within the leach pad, and processed at an adjacent recovery facility.

At Landusky, mining of the South Pit would result in the disturbance of 20 additional acres (which were previously permitted).

Alternative 5: Mine Expansions and Modified Reclamation Plans With Agency Mitigation Added, New Leach Pad in Upper Alder Gulch

This alternative is the same as the CPA (Alternative 4) for both mine expansion and modification of reclamation plans; but with agency mitigation added to reduce or avoid potential environmental impacts.

The major change is that the Goslin Flat leach pad would be constructed in Upper Alder Gulch just west of the proposed waste rock dump. The conveyor system would not be constructed. Truck haulage would be used to transport both ore and waste rock from the mine to their respective facilities.

Alternative 6: Mine Expansions and Modified Reclamation Plans With Agency Mitigation Added, Zortman Waste Rock Disposal at Ruby Flats

This alternative is the same as the CPA (Alternative 4) for both mine expansion and modification of reclamation plans; but with agency mitigation added to reduce or avoid potential environmental impacts.

The major modification is that the Alder Gulch Waste Rock Repository would not be constructed. Instead waste rock would be disposed of at a new repository site on Ruby Flats, east of the proposed leach pad. The waste rock would be transported from the mine site by the conveyor to an off-load area near the leach pad. It would then be transported by truck to Ruby Flats Waste Rock Repository for disposal.

Alternative 7: Mine Expansions and Modified Reclamation Plans With Agency Mitigation Added, Zortman Waste Rock Disposal On Top of Existing Disturbances

This alternative is the same as the CPA (Alternative 4) for both mine expansion and modification of reclamation plans; but with agency mitigation added to reduce or avoid potential environmental impacts.

The major modification is that the Alder Gulch Waste Rock Repository would not be constructed. Instead waste rock would be disposed on top of and adjacent to existing disturbances at the Zortman Mine. This would mean placement of waste rock over the 79, 80/81, 82, 83, 84, and 89 leach pads and retaining dikes. This also includes the ridge where the old Ruby Mill is located. The existing Alder Gulch waste rock dump would still be removed and placed on the new leach pad at Goslin Flat.

Additional details on the proposed actions and alternatives are available from materials on file with either BLM or DSL.
If you have questions about the alternatives or wish to discuss them in greater detail, please contact Scott Haight (BLM) at 538-7461 or Jim Robinson (DSL) at 444-2074.

SUB-APPENDIX D
LITTLE ROCKIES TCP STUDIES

1. If alternative 4,5,6 or 7 is selected by Record of Decision and ZMI proceeds with the expansion project, BLM shall advertise the availability of funding for the study of historic/traditional associations of the Little Rockies.

Accepting Study Proposals

a. By January 1st of each year, the BLM shall send a letter of invitation for proposals to the two universities, three private colleges and seven tribal colleges in Montana as well as provide an annual feature article to Montana media soliciting proposals.

b. Study proposals will be accepted until January 31 of each year by the Lewistown BLM from colleges, universities or other non-profit educational organizations, as well as groups and individuals.

c. After January 31 of each year, ZMI will be provided a 20 calendar day comment period on the proposals received.

d. BLM will consider ZMI's comments each year before making a decision on the proposals.

Proposal Evaluation Criteria

2. The following criteria will be used in evaluating proposals.

2.1 Would the proposed study result in preserving important information which might otherwise be lost or forgotten?

2.2 Would the proposed study provide useful information for managing historic/traditional properties?

2.3 Would the study results be of interest to the public or to what degree would the public benefit from the proposed study?

2.4 Does the proposal indicate that the study has adequate organization to ensure success (realistic schedule and budget, trained personnel, realistic expectations)?

3. BLM may develop a scoring system to rank proposals if necessary, at its discretion.

4. BLM is not compelled to accept any proposal.

5. BLM may contact study applicants to request additional information, discuss or

refine a proposal before making a final determination on the awards for that year.

Awards

6. By March 31 of each year, BLM will select the successful proposal(s).

6.1 No more than two (2) studies will be funded in any calendar year.

6.2. Previously successful applicants will not be considered for additional awards until all products from previous awards have been submitted and accepted.

Payments

7. If alternative 4,5,6 or 7 is selected by Record of Decision and ZMI proceeds with the expansion project, ZMI shall provide the funds to conduct the studies which BLM determines to be appropriate through the above process.

7.1 ZMI shall provide funding not to exceed ten thousand dollars ($10,000) per year for a period of five (5) years or a maximum of fifty thousand ($50,000).

7.2 Payment for studies shall be directly from ZMI to the successful applicant.

7.3 BLM will work with ZMI and successful applicants to establish an appropriate delivery and payment schedule but will not otherwise be involved in payments.

Submitting a Proposal

8.1 Proposals must be submitted in two (2) copies by January 31 of the proposed funding year.

8.2 Proposals will not be accepted before December 15 of the year preceding the proposed funding year.

8.2 Proposals are to be mailed to: Attn. Archaeologist
BLM - Lewistown District Office
Airport Road, P.O. Box 1160
Lewistown, MT 59457-1160

Applicant Qualifications

9.1 Study proposals will be accepted from colleges, universities or other non-profit educational organizations, as well as groups and individuals.

9.2 Applicants must include evidence that all research will be carried out by or under the direct supervision of a person or persons meeting the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9) for Historians or under the direct supervision of a person or persons meeting at a minimum the same Standards for Archaeologists, as appropriate.

9.3 All ethnographic/traditional cultural properties research carried out pursuant to this agreement shall be carried out by or under the direct supervision of a trained ethnographer that has demonstrated his/her expertise and experience with these types of resources in North America. Experience shall include Principal Investigator positions on at least one other project of the type being proposed.

AQUATIC ECOSYSTEM MITIGATION PLAN
FOR IMPLEMENTATION OF ALTERNATIVE 7
ZORTMAN-LANDUSKY MINES EXTENSION PROJECT

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APPENDIX F

AQUATIC ECOSYSTEM MITIGATION PLAN FOR IMPLEMENTATION OF ALTERNATIVE 7 ZORTMAN-LANDUSKY MINES EXTENSION PROJECT

SUMMARY

The purpose of the Aquatic Ecosystem Mitigation Plan (Mitigation Plan) is to describe the mitigation procedures for past and proposed impacts to wetland and non-wetland waters of the United States that have or would occur at the Zortman and Landusky Mines in northcentral Montana, assuming implementation of Alternative 7, the preferred alternative, as described in the Final Environmental Impact Statement (FEIS). This Mitigation Plan has been designed to provide compensatory mitigation for unavoidable adverse impacts to waters of the U.S., including wetlands and non-wetland waters associated with past activities and proposed expansion of the Zortman and Landusky Mines. The plan includes information on expansion project location, the elements of the proposed project, the responsible parties, jurisdictional areas to be impacted, descriptions of the basic mitigation components, reporting protocol, and contingency measures.

I. PROJECT DESCRIPTION

The following sections provide information on the location of the project, a summary of the past and proposed mining activities, and a brief description of the affected waters of the United States.

A. PROJECT LOCATION

Zortman Mining, Inc. (ZMI) since 1979 has had two active gold and silver mines in close proximity in the Little Rocky Mountains of north central Montana. The Zortman Mine is located in Sections 7, 17, and 18, Township 25N, Range 25E, Montana Principal Meridian (MPM); while the Landusky Mine is west of the Zortman Mine in Sections 14, 15, 22, and 23, Township 25N, Range 24E, MPM. Both mines are near the southern boundary of the Fort Belknap Indian Reservation in the southwest corner of Phillips County (Figure F-1). The towns of Hays and Lodgepole are located in the southern portion of the Reservation, just to the north of the mountains. The town of Landusky is in the southwest portion of the Little Rocky Mountains, about 0.5 mile south of the Landusky Mine. The town of Zortman is about 1 mile south of the Zortman Mine, on the southern edge of the Little Rocky Mountains. More specific locations of the mines and their facilities are shown on Figure F-2.

B. BRIEF SUMMARY OF OVERALL PROJECT

1. Project Description

Gold and silver mining has occurred over the past century in the area of the Zortman and Landusky Mines. Zortman Mining, Inc. (ZMI) has been actively operating the two mines since 1979 under approved State Operating Permits. Subsequent revisions to the operating and/or reclamation plans have been approved through amendments to the permits allowing increases in the disturbance areas. Some of these activities include expansion of pits, pads, and dumps; and construction of an access road up Ruby Gulch. Currently, ZMI holds approved Federal Plans of Operations MTM-77778 and MTM-77779, and State Operating Permits No. 00096 and 00095 for mining and reclamation activities at the Zortman Mine and Landusky Mine, respectively.

The total new disturbance for the proposed agency-mitigated mine expansions and reclamation activities at both the Zortman and Landusky mines would encompass 772 acres. These proposed activities are described as Alternative 7 in the FEIS, and are summarized in the following sections. Of this total, about 82 acres of public land managed by the Bureau of Land Management (BLM) would be disturbed. Currently, approximately 594 acres of BLM land are disturbed by existing mining activities. Figure F-2 shows the approximate location of the existing and proposed facility locations.

Zortman Mine. At the Zortman Mine, the current permit area encloses 961 acres of land, of which 401 acres are currently disturbed. ZMI submitted a new application with the Lewistown District BLM and the Montana Department of State Lands (DSL) seeking approval to expand mining and reclamation activities. Existing mine pits would be widened and deepened, and a new waste rock repository would be constructed on top of existing facilities at the mine site. A conveyor system to transport ore would extend from the mine process area southeast approximately 11,000 feet to a new cyanide heap leach pad in Goslin Flats. Open-pit mining methods would continue to be used to remove gold, as well as silver oxide and sulfide ores. Approximately, 20,000 to 40,000 tons of ore would be processed per day, 350 days per year. These processing activities are expected to yield 100,000 ounces of gold and 300,000 ounces of silver annually.

Landusky Mine. At the Landusky Mine, the current permit area encloses 1,287 acres and approximately 814 acres of disturbance. An additional 7.6 million tons of ore and 7 million tons of waste rock would be mined as part of the overall mining and reclamation plan. ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore. The mined material would come from the August and South Gold Bug pits. The quantity of ore to be mined under this application would constitute slightly less than one year of additional mining at the facility. No additional workers are anticipated to be hired under this expansion proposal. About 42,000 total tons of material would be mined per day at Landusky during that year. During this one year of operations, about 50,000 ounces of gold and 150,000 ounces of silver are expected to be produced.

Purpose and Need. The underlying project purpose from a public interest perspective is to supply the public with needed gold and silver by mining in an environmentally sound manner. Approval of ZMI's applications for permit modifications at the Zortman and Landusky mines would allow continued extraction (mining), beneficiation (heap leaching), and recovery of gold, silver, and other metals from the two mines for a period of 5 to 8 more years. ZMI has cited the mines' beneficial economic impact on tax revenues and the communities near both mines. The mine expansions would continue to employ approximately 260 persons through project construction and mine operation, as the existing operations phase out. An additional 5 to 25 persons would be employed during the approximate 10-year post-operations reclamation period.

The agencies' (BLM and DEQ) purpose and need for this action is to address two basic issues: (1) mineral development needs; and (2) environmental protection needs. In the first matter, the lands in the project area are either private lands or public lands open to mineral development and the operator has properly filed for approval of mineral development activity under relevant state and federal laws and regulations. Secondly, the agencies have determined that existing operation and reclamation plans are not adequate to prevent unacceptable impacts from acid rock drainage. It is anticipated that the mitigation measures described in this document would achieve regulatory compliance.

The U.S. Army Corps of Engineers (COE) has determined that an individual Section 404 permit is necessary to implement the proposed expansion and reclamation activities. To date, the COE has issued a permit for construction of one impoundment in Ruby Gulch designed to catch drainage from upper Ruby Gulch to enable treatment of such waters. Before a COE permit can be issued for the Zortman/Landusky expansion proposal that involves a discharge of dredged or fill material into jurisdictional waters, the COE must determine that the project will be in compliance with the 404(b)(1) guidelines, that the project will be found to be "in the public interest," and that 401 water quality certification is obtained.

2. Affected Waters of the U.S.

Waters and wetlands that have been and/or will be affected by the previous and proposed mining activity are briefly described below. Additional details are provided in Section I.D. below. Descriptions of low, moderate, and high functional values are taken from Tables 3.4-2 and 3.4-3 of the FEIS and are based on professional judgement and wetland assessment methodology, as described in Section 3.4 of the FEIS.

Ruby Gulch is an intermittent stream with generally low functions and values for physical, chemical, biological, and human uses, which has been affected by previous mining activities. Approximately 3.04 acres were indirectly affected, and 0.58 acres directly affected by past activities. An additional 0.81 acres would be directly affected, and 3.96 acres of indirect impacts would occur downstream in Ruby Creek and its tributaries.

Alder Gulch is also an intermittent stream system with moderate (pre-1979) to low functions and values for physical, chemical, biological, and human use characteristics. No previous impacts have been identified, and 0.20 acres are expected to be impacted by the proposed project.

Alder Spur is an upper tributary of Alder Gulch with perennial characteristics and low values for physical, chemical, biological, and human use characteristics. Water quality degradation from previous activities affected 0.11 acres, and proposed actions are expected to affect an additional 0.14 acres.

Carter Gulch is also an upper tributary of Alder Gulch with perennial characteristics and low values for physical, chemical, biological, and human use characteristics. Water quality degradation from previous activities directly affected 0.12 acres, and proposed actions would have additional direct adverse effects on 0.07 acres and indirect effects on 0.22 acres in Antoine Spur, a tributary of Carter Gulch.

Goslin Gulch is an intermittent stream with generally low values for physical, chemical, biological, and human use characteristics. Water quality degradation from previous activities has not been identified, and 2.28 acres of additional direct impacts would result from proposed actions. An additional 3.12 acres of indirect impacts would occur in the two drainages that lead to Ruby Gulch. Existing wetlands in Goslin Gulch and Goslin Flats are given an overall low rating for functions and values, with a high rating for the hydrologic support function and moderate ratings for floodflow alteration, sediment stabilization and water purification. The proposed action would directly affect 1.06 acres of wetlands in Goslin Gulch and tributaries, and indirectly affect 0.48 acres of wetlands in Goslin Flats.

Tributaries to Lodgepole Creek include both intermittent and perennial reaches, with an overall rating of moderate in terms of functions and values. Physical, chemical, and special aquatic site characteristics are rated moderate and biological and human use characteristics rated low. There is no fishery in the headwaters section of the creek, but lower reaches support brook trout. Disturbance to 0.03 acres occurred from previous activities, and an additional 0.06 acres of unavoidable impacts would result from the proposed project.

Montana Gulch includes intermittent and perennial reaches, and was rated overall as moderate (low end) in terms of functions and values prior to 1979. Physical, chemical, and biological characteristics are rated low; special aquatic sites and human use characteristics are rated moderate. There is no fishery present. Previous disturbance directly affected 0.75 acres, and no additional adverse impacts would occur from the proposed project.

Rock Creek and its tributaries comprise an intermittent stream system with low to moderate values (depending on stream reach) for physical, chemical, biological, special aquatic site, and human use characteristics. Previous mining activity has indirectly affected a total of 10.70 acres and directly affected 0.34 in this drainage, and 0.02 acres of additional direct impacts would result from the proposed project.

Mill Gulch is an intermittent system rated as having low values overall and for physical, chemical, biological, special aquatic site, and human use characteristics. Past mining activity directly affected 1.18 acres and an additional 0.03 acres of direct impacts would occur.

King Creek is a system with intermittent flows upstream and perennial flows lower down, which has an overall rating of moderate for functions and values, with individual moderate ratings for biological, special aquatic site, and human use characteristics and low values for physical and chemical characteristics. Previous activity directly affected 0.35 acres in the upper section and indirectly affected 0.86 acres below Water Quality Monitoring Station L-5. An additional 0.03 acres of direct impacts would occur under this alternative.

Other North End drainages (South Bighorn Tributary A, on the northern side of the Landusky Mine and Swift Gulch) are mostly intermittent headwaters of South Big Horn Creek; these were rated overall as moderate+, with moderate individual ratings for physical, chemical, biological, and special aquatic site characteristics. Human use characteristics were rated low. Past activity directly affected 0.21 acres of nonwetland waters and no additional impacts would occur.

The South End drainage (on the southern side of the Landusky Mine) consists of an intermittent stream that enters Rock Creek just downstream of Mill Creek. Functions and values are low. Past activity directly affected 0.06 acres of nonwetland waters and no additional impacts would occur.

C. RESPONSIBLE PARTIES

The applicant's name, telephone number and address are:

Zortman Mining, Inc.
P.O. Box 313
Zortman, Montana 59546
(406) 673-3252

The person to be contacted regarding this mitigation plan is Kevin Ryan, General Manager, Zortman Mining, Inc.

D. JURISDICTIONAL AREAS IMPACTED

This section provides a description of the wetlands and non-wetland waters of the U.S. which exist on the study area and which have been and/or would be affected by the proposed project. Conditions in each area are described for a series of time periods, including pre-1979, 1979-1990, and 1990-1995. More complete descriptions of existing conditions are provided in the FEIS in Tables 3.4-2 and 3.4-3. Maps showing the locations of these waters and wetlands are provided in Figures F-2 and F-3. Table F-1 summarizes direct and indirect impact acreage by drainage for both wetlands and non-wetland waters.

Ruby Gulch

Ruby Gulch is divided for purposes of the rest of this discussion into two reaches, one above, and one below the town of Zortman.

<u>Ruby Gulch above the town of Zortman</u>: Above the town of Zortman, Ruby Gulch is an intermittent stream system that has a long history of adverse effects from mining activity. This reach was rated overall as low (low end) in terms of functions and values for non-wetland waters for pre-1979 conditions as low-/impaired for 1979-1990, and as low after 1990.

Prior to 1979, tailings deposition and consequent channel modifications severely disrupted flow and channel integrity, resulting in a low- rating for physical characteristics. Chemical characteristics were also rated low owing to elevated TDS and SO_4. Biological characteristics were rated low because there is no fishery and aquatic habitat is absent from much of this stream section. Whether wetlands were present in this reach is unknown. Human use characteristics were rated moderate.

Between 1979 and 1990, water quality declined from sediment and chemicals from mining operations, reducing the rating for physical, chemical, and human use characteristics to low-/impaired. A new deep well was developed for water supply to the town of Zortman. Biological characteristics were similar to pre-1979 conditions.

Between 1994 and 1995, construction and operation of the water treatment system has improved water quality although sediment input still occurs, giving an improved rating of low for physical and chemical characteristics. Biological characteristics did not change. Human use characteristics improved slightly to low and continuing water quality improvement occurs.

Wetlands exist only in small quantities, in high gradient side tributaries to Ruby Gulch, in the floodplain area, and support forest and shrub vegetation. No fishery exists but limited macroinvertebrate communities exist. The overall functions and values rating for these wetlands is low. Two functions, floodflow alteration and aquatic diversity/abundance, were rated moderate and one, hydrologic support, was rated high.

<u>Ruby Gulch below the town of Zortman</u>: Prior to 1979, overall functions and values for this segment of Ruby Gulch were rated as low due to impacts resulting from historic (pre-1979) mining. Physical characteristics were rated low because of the degradation above the town of Zortman and diversion of Alder Gulch confluence may have decreased flow in Ruby Gulch. The intermittent flow in this lower reach was likely sustained by springs. Biological characteristics were rated low as there was no known fishery but some wildlife use of water. Data on the presence of special aquatic sites in the

form of wetlands are lacking. Human use characteristics was rated low+ as the surface water and springs provided water for livestock and groundwater rights were used for livestock.

During 1979-1990, the overall rating was also low. Sediment and chemical pollution caused the rating for physical and chemical characteristics to fall to low-. Biological aspects were similar to pre-1979 conditions. Special aquatic sites were given a low rating because wetland site #9 in Ruby Tributary A was established and partially sustained by a stockwater well. Human use characteristics remained low+ although there may have been a slight decline owing to runoff and water quality changes.

In 1990-1995, the overall rating remained low. The Ruby Gulch treatment system improved water chemistry, although sediment flushes may still occur. The ratings for physical and chemical characteristics as well as biological, special aquatic sites, and human use characteristics did not change.

Wetlands in Ruby Gulch below the town of Zortman are negligible in quantity and given an overall rating of low for functions and values. Only one function, hydrologic support, was given a high rating. The upstream channel alterations reduce values. One spring-fed perennial wetland is present in a side tributary and stock watering is recognized as a beneficial use.

Summary of Impacts to Ruby Gulch: Pre-1995 impacts to nonwetland waters in Ruby Gulch directly affected 0.58 acres and indirectly affected 3.04 acres. Direct effects on a total of 0.81 acres of nonwetland waters and indirect effects to 3.96 acres of nonwetland waters are expected from this Alternative. The functional values affected include physical, chemical, biological, and human use characteristics which are all rated as being low since pre-1979 conditions.

Alder Gulch

Alder Gulch is also divided into segments above and below the town of Zortman.

Alder Gulch above the town of Zortman: Prior to 1979, the functions and values of this segment are given an overall moderate (low end) rating. Channel integrity was generally intact although affected by previous mining and physical characteristics and rated low+. Chemical characteristics are also rated low+ and no evidence of acid mine drainage was found in limited sampling. Biological characteristics were moderate owing to a lack of known fishery. Wildlife use is known and aquatic habitat is thought to have been present in most of this segment. Special aquatic sites (wetlands) are rated low, and low quality riffle-pool complexes probably occurred in upper Alder Gulch. Human use characteristics are rated medium because of water use, springs and seeps, and water right uses for mining and livestock.

Between 1979 and 1990, the overall rating for functions and values declined to low (low end)/impaired. Physical and chemical characteristics were rated low-/impaired as a result of deteriorating water quality and sedimentation. Biological characteristics were rated as also declining to low as a result of the pollution, and macroinvertebrate communities were indicative of poor water quality. Ratings for special aquatic sites and human use did not change from pre-1979 levels.

In 1990-1995, the overall rating remained low-/impaired as a result of continuing declines in water quality, which were only partly remediated by actions in 1992. Biological characteristics and special aquatic site ratings did not change. Human use characteristics were rated as declining to low-/impaired as a result of acid rock drainage seepage through facilities.

Wetlands in Alder Gulch above the town of Zortman were given an overall rating of low for functions and values. Four functions were rated as medium. Floodflow alteration was provided by two small wetlands with large receiving areas and a constructed pond. Sediment stabilization from periodic natural erosion events in headwaters areas. Water purification functions were provided by an atypically wide wetland which is thought to receive bank overflow during peak runoff events. Wildlife diversity/abundance function is provided by the habitat diversity and interspersion of these wetlands within the surrounding landscape.

Alder Gulch below the town of Zortman: This system is given a pre-1979 overall rating of low (low end). The channel modifications and diversion at the confluence with Ruby Gulch affected channel integrity and result in a rating of low- for physical and chemical characteristics. Biological characteristics are rated low- as a result of a lack of fishery, low wildlife use, and absence of aquatic habitat from most of this section. Special aquatic site extent during this time period is unknown. Human use characteristics are also rated low- owing to no known water rights.

In 1979-1990, the overall functions and values were given a low (low end) rating and conditions were similar to pre-1979 for the same four functions described above. In 1990-1995, conditions were also similar to pre-1979 for all functions.

No wetlands are known to exist in this segment of the stream.

Summary of Impacts to Alder Gulch: No specific acreages of impacts pre-1995 were identified. The proposed alternative would directly affect 0.20 acres of nonwetland waters which were rated as having low functions and values overall and individually for physical and chemical characteristics, biological characteristics, and special aquatic sites. Human use was rated moderate. No indirect effects from the proposed alternative have been identified.

Alder Spur

Alder Spur is a headwater tributary of Alder Gulch. Prior to 1979, functions and values were rated overall as moderate (low end). Physical, chemical and special aquatic site characteristics were rated as low and biological characteristics rated as moderate from wildlife use. Low quality riffle-pool complexes probably occurred there. Human use characteristics were rated moderate as water was used by surface and groundwater rights used by mining.

In 1979-1990, the headwaters of Alder Spur were filled and deteriorating water quality and sedimentation led to a decline to low-/impaired overall for functions and values. Biological characteristics declined as a result of water quality and sediment impacts. Special aquatic sites and human use did not change.

During 1990-1995, water quality continued to decline and the overall functions/values rating remained low-/impaired. The functions did not change with the exception of human use characteristics, which declined to a low-/impaired rating owing to acid rock drainage seepage through waste material.

Impacts to Alder Spur prior to 1995 were a total of 0.11 acres of direct loss of nonwetland waters from the filling of the headwaters. The functions affected by this loss are rated as low to low- for physical, chemical, and biological characteristics and special aquatic sites, and were low to moderate for human uses. An additional 0.14 acres of nonwetland waters with similar functions and values would be impacted by Alternative 7.

Carter Gulch

Carter Gulch is a headwater tributary of Alder Gulch. Functions and values were rated overall as moderate (low end) and similar to those of Alder Spur.

During 1979-1990, encroachment from the Alder Gulch waste rock dump and declining water quality also led to a decline to low-/impaired for overall functions and values, similar to the situation in Alder Spur.

In the 1990-1995 time period, overall values were rated low-/impaired. The ratings were similar to those for Alder Spur.

Impacts to Carter Gulch prior to 1995 were a total of 0.12 acres of direct loss of nonwetland waters from the filling of the headwaters. The functions affected by this loss are rated as low to low- for physical, chemical, and biological characteristics and special aquatic sites, and were low to moderate for human uses. An additional 0.07 acres of non-wetland waters with similar functions and values would be impacted by Alternative 7.

Goslin Gulch and Goslin Flats

Prior to 1979, functions and values were rated overall as low. It is assumed that since no mining activities have been located in this drainage, water quality conditions are indicative of undisturbed conditions. Physical and chemical characteristics were rated low, although the channel is well defined in the upper reaches and poorly defined below. Flows are ephemeral to intermittent. Three constructed stock ponds are present and store some water. Pre-1979 water quality information is lacking. Biological characteristics were also rated low as there is no fishery and aquatic habitat is lacking except near the ponds; waterfowl may use these ponds as well as bats from nearby Azure Cave and other local wildlife. Wetlands probably were present at springs, seeps, and along the channel leading to a low rating for special aquatic sites. Human use was rated low also owing to limited use by livestock and from use of water rights.

Between 1979 and 1990, functions were individually and overall similar to those pre-1979 and were rated low.

In the 1990 to 1995 period, functions remained low collectively and individually as described above.

Wetlands in Goslin Flats exist near springs and seeps, along the channel, and vegetative cover is mostly intact except for areas trampled by livestock near the ponds. These wetlands are rated overall as low in terms of functions and values. Four functional categories were rated above low: hydrologic support was rated as high from the spring/seep wetlands, floodflow alteration was moderate from the stockponds providing some detention/storage, sediment stabilization and water purification functions were rated moderate from the vegetative cover present.

There have been no pre-1995 mining impacts identified, and existing functions and values of nonwetland waters were rated low, including overall as well as chemical, physical, biological, special aquatic, and human use characteristics. Wetlands functions and values were also rated overall as low, with the hydrologic support function rated as high, and floodflow alteration and sediment stabilization rated medium. Alternative 7 would directly remove 2.28 acres of nonwetland waters, and 1.06 acres of wetlands, including the stockponds used as water by wildlife. In addition, this alternative would indirectly affect an additional 3.12 acres of nonwetland waters and 0.48 acres of wetlands.

Lodgepole Creek

Lodgepole Creek is one of the few systems given an overall moderate rating for functions/values in the pre-1979 time period. This system includes intermittent and upper perennial systems fed by springs and seeps. Physical and chemical characteristics are rated moderate+, and no mining activities took place in this drainage. Biological characteristics are rated moderate owing to wildlife use, the lack of a fishery and probable presence of aquatic habitat. Brook trout exist lower down in the system. Special aquatic sites are rated moderate and include small local wetlands at springs and seeps and low to moderate quality pool-riffle areas. Human use is rated low+ owing to limited use as a portion of the watershed supplying water to the Ft. Belknap Reservation.

During 1979-1990, the overall rating declined to moderate- as a result of mining activities. Flow characteristics were affected by Ross and Ruby Pits, activity in Glory Hole Creek and Lodgepole Tributary D. An observed nitrate increase may be related to blasting or fertilization, other water quality parameters indicate no other mining impacts. Biological characteristics, special aquatic sites and human use characteristics did not change from pre-1979 levels.

Functions and values in the 1990 to 1995 period remained the same as the 1979-1990 period. Studies conducted in the area found diverse macroinvertebrate populations, approximately 1 acre of wetland, and no change in water quality.

Wetlands in this drainage were rated overall as moderate, with more functional values in the high and moderate range than the drainages previously described. Hydrologic support received a high rating from the presence of perennial wetlands. Floodflow alteration was rated moderate as a result of the presence of wetlands in the floodplain which included forested and shrub vegetation. Wildlife diversity and abundance was rated moderate owing to habitat diversity. Aquatic diversity/abundance was rated moderate from habitat dispersion, plant species richness, and intact macroinvertebrate communities. Uniqueness/heritage was rated high owing to a lack of disturbance at existing wetlands. Water purification was rated moderate from the abundance of wetlands and emergent types.

Previous disturbance affected 0.03 acres of nonwetland waters in Lodgepole Creek, which was rated overall as moderate+ for functions and values. Individual functions and values for physical and chemical characteristics were rated as moderate+, special aquatic sites were rated as moderate, biological and human use characteristics were rated low. An additional 0.06 acres of nonwetland waters would be affected by the proposed project.

Montana Gulch

Montana Gulch is a system that includes perennial and intermittent segments and some areas of existing riparian and wetland vegetation. Prior to 1979, Montana Gulch was given an overall functions/values rating of moderate. Physical and chemical characteristics were rated moderate as a result of discharge from the Gold Bug Adit which included minor pollution and flow augmentation. Biological characteristics were rated moderate low owing to wildlife use and the lack of a fishery (although there is a non-salmonid fishery lower down off the study area). Special aquatic sites were rated at moderate as riparian wetlands were present and riffles and pools occur in perennial segments. Human use was rated moderate and include agricultural diversion and mining water right use, and domestic drinking water.

In the 1979-1990 period, conditions declined and the overall rating declined to low. Periodic increases in chemical pollution from mine activities occurred, although treatment facilities were constructed in 1984. Most of the impacts were above the confluence with Rock Creek. Part of the channel was filled by waste rock and a leach pad affected flows and sediment levels. These combined to cause a reduction in the rating for physical and chemical characteristics to low-/impaired. Biological characteristics declined to low- and special aquatic sites declined to low- from pre-1979 ratings as a result of pollution. Human use characteristics were similar to pre-1979 but reduced to moderate- owing to evidence of mining effects on water quality in alluvial and bedrock aquifers.

During 1990-1995, the overall rating was low (high end) and individual functions/values ratings did not change.

Wetlands in Montana Gulch were given an overall functions and values rating of moderate-. Four functions were given ratings of high or moderate. Hydrologic support was rated high from the presence of perennial wetlands. Floodflow alteration was rated moderate from the presence of wide wetlands in the floodplain. Sediment stabilization was also rated moderate from the presence of wetlands vegetation. Wildlife diversity and abundance was also rated moderate owing to moderate habitat diversity.

Prior to 1995, 0.75 acres of nonwetland waters were directly affected by mining. The functions and values of these waters were rated as moderate overall, prior to 1979. Physical, chemical, special aquatic sites, and human use were rated as moderate and biological characteristics were rated low. No additional impacts would occur under Alternative 7.

Rock Creek Tributaries

Rock Creek is a narrow, high gradient stream with ephemeral to intermittent flows, no fishery, and limited wetlands. Prior to 1979, the overall functions/values rating was low. Physical and chemical characteristics were rated low+ and no indications of mining impacts were evident. Biological characteristics were also rated low owing to little wildlife use and the lack of a fishery. Special aquatic sites were rated low because wetlands were limited in extent and values. Human use characteristics were also rated low because uses included limited domestic drinking water use from the lower portion of the creek.

The overall and individual functions and values were low and similar during 1979 to 1990. Studies found relatively diverse macroinvertebrate communities. Minor negative impacts occurred to surface and ground water.

During 1990 to 1995, the overall rating declined to low-. Physical and chemical characteristics were affected by leach pad discharges, nitrates, and filling of Sullivan Gulch headwaters. Biological and special aquatic site characteristics remained low and similar to pre-1979 conditions. Human use characteristics declined to low- as a result of surface and ground water quality declines.

Wetlands functions and values were rated as low overall. Hydrologic support was rated high from the presence of perennial wetlands. Floodflow alteration was rated moderate from the presence of wide wetlands in the floodplain. Sediment stabilization was also rated moderate from the presence of wetlands vegetation. Wildlife diversity and abundance was also rated moderate owing to moderate habitat diversity.

Lower Rock Creek

This segment is an intermittent stream with moderate gradient and developed floodplain and diverse plant communities including a well-developed riparian zone. Pre-1979 values were rated as moderate. No adverse water quality effects were indicated and physical/chemical characteristics were rated moderate. Biological characteristics were also given a moderate rating as a result of wildlife use, vegetative diversity, evidence of beaver use, and presence of a non-salmonid fishery downstream off of the study area. The presence of riparian vegetation led to a rating of low+ for special aquatic sites. A broad range of human uses also resulted in a moderate rating for this function; these uses included agriculture, some recreation, and domestic drinking water.

During 1979-1990 and 1990-1995, overall and individual ratings for functions did not change.

Lower Rock Creek wetlands were given an overall rating of low (high end) for functions/values. Sediment stabilization was rated moderate and water purification high as a result of the wetlands present. Aquatic diversity/abundance was given a moderate rating from downstream, off-site fishery resources.

Pre-1995 impacts in the Rock Creek system were diverse. In Rock Creek tributaries, 0.34 acres of nonwetland waters were directly impacted by mining. Overall functions of the impact area were rated low and included individual values for physical, chemical, biological, special aquatic site, and human use characteristics. Indirect impacts prior to 1995 included 10.70 acres of nonwetland waters which were rated as low in upper sections and moderate lower down overall and for physical, chemical, biological, special aquatic site, and human use characteristics. Additional impacts from Alternative 7 would include direct impacts to 0.02 acres of Rock Creek Tributaries and 0.03 acres of wetlands. The wetlands are given an overall low rating in terms of functions and values, but hydrologic support was rated high, and floodflow alteration, sediment stabilization, and wildlife diversity/abundance were rated moderate.

Mill Gulch

Mill Gulch is an intermittent system on a steep gradient, with some spring input and no evidence of water quality impacts from mining. There is no fishery resource, limited wetlands, and limited human uses. Prior to 1979, overall, physical, chemical, biological, special aquatic site, and human use characteristics were rated as low. Water use by mining is the only human use characteristics.

During 1979-1990, mining impacts from construction, operations, and related filling of upper Mill Gulch with a leach pad and waste rock dump caused declines in overall and physical and chemical characteristics to low-/impaired. Biological characteristics did not change and sampling found relatively diverse macroinvertebrate populations. Effects on wetlands was unknown. Human use characteristics declined to a rating of low- from ground and surface water quality degradation.

In the 1990-1995 period, the overall rating improved to a rating of low (low end). Water treatment/capture systems have caused improvement in physical and chemical characteristics to low-, and human use characteristics improved to a low rating from ground water quality improvement. Biological and special aquatic site characteristics did not change.

Pre-1995 impacts to Mill Gulch included direct effects to 1.8 acres of nonwetland waters which had low functions and values overall and individually for physical, chemical, biological, special aquatic site, and human use characteristics. The proposed project would directly affect an additional 0.03 acres of nonwetland waters.

King Creek

King Creek is a narrow, high gradient, intermittent stream with associated wetlands. Prior to 1979, the overall rating for functions and values was moderate. Physical and chemical characteristics were given a low+ rating from the effects of a historic adit and tailings deposition. Based on the habitat and probable beaver and other wildlife use, biological characteristics were rated moderate. Special aquatic sites are given a rating of moderate from the wetlands present and their contiguity with offsite riparian floodplain wetlands. Human use characteristics were rated moderate and limited recreational and tribal uses were identified.

During 1979 to 1990, the overall rating declined to moderate-. Physical and chemical characteristics declined from low to low- as a result of sedimentation and hydrologic impacts from pits. Biological characteristics did not change and studies indicated general wildlife use. Special aquatic sites were rated moderate, a slight decline from pre-1979 conditions may have occurred as a result of water quality and hydrologic effects but data are lacking. Human use characteristics declined to moderate- as a result of mining impacts to surface and ground water quality.

In the 1990 to 1995 period, the overall rating was moderate. Physical and chemical characteristics improved to moderate as a result of tailings removal and channel stabilization. Hydrologic effects are ongoing. Biological characteristics and special aquatic site, ratings were unchanged, the human use rating improved to moderate.

The wetlands of the King Creek system are rated overall as moderate (high end) in terms of functions and values. Hydrologic support was rated high as a result of the perennial wetlands created by springs and seeps. Floodflow alteration and water purification were rated high as a result of the presence of vegetated wetlands in the floodplain. Sediment stabilization was rated moderate as a result of the wetlands. Wildlife diversity/abundance was rated moderate as a result of studies and habitat diversity and aquatic diversity/abundance rated moderate owing to the presence of permanently flooded aquatic bed habitat and three wetland types. Uniqueness/heritage/recreation functions were also rated high owing to recreational and traditional cultural practices.

Impacts to King Creek prior to 1995 include direct impacts to 0.35 acres of nonwetland waters, and indirect impacts to 0.86 acres below Station L-5. The functions and values of King Creek were rated as moderate+ prior to 1979, and included individual ratings of low for physical and chemical characteristics, moderate for biological characteristics, and moderate+ for special aquatic sites and human use. An additional 0.03 acres of nonwetland waters would be affected by Alternative 7.

South End Drainage

The South End Drainage consists of a single small unnamed intermittent stream which enters Rock Creek between Mill Creek and the town of Landusky. Pre-mining functions and values are not described but assumed to be low. A total of 0.06 acres of non-wetland waters were affected by previous mining and no additional disturbance would occur from this Alternative.

Previous mining activity directly affected 0.06 acres of nonwetland waters with low functional values and no additional impacts are anticipated. No wetland impacts occurred in the past and none would occur under this alternative.

North End Drainages (South Bighorn Tributary A and Swift Gulch)

The North End Drainages consist of the headwaters area of South Big Horn Tributary A and Swift Gulch. Functions and values prior to 1979 were rated overall as moderate+, with moderate ratings given to physical, chemical, biological, and special aquatic site characteristics. These areas are high gradient channels with a few perennial reaches and a cobbleboulder substrate. There is no known fishery. There are continuous wetlands present in some reaches. Limited human uses including water supply for wildlife and the Fort Belknap Indian Reservation.

During 1979-1990 the overall rating for functions and values declined to moderate, mainly as a result of a decline in physical and chemical characteristics from drainage from the Landusky mine and hydrologic effects of Queen Rose and Little Ben pits. Biological and human use characteristics remained the same. The rating for special aquatic sites was increased to moderate+ as a result of natural restoration occurring in previously disturbed areas.

During 1990-1995 the overall rating remained moderate and the individual functions described above did not change.

Mining activity prior to 1995 directly affected 0.21 acres of nonwetland waters rated as moderate overall and for physical, chemical, biological, and special aquatic site characteristics in terms of functions and values. Wetlands were not affected by previous mining and no wetland impacts would occur from this alternative.

II. SUMMARY OF IMPACTS AND MITIGATION GOALS

This section provides a summary table of the acreages of direct and indirect impacts to wetlands and nonwetland waters that have been described in detail above. Goals for replacing lost functions and values are disclosed.

Year Range	Direct Impacts (ac)	Indirect Impacts (ac)	Subtotal of Impacts (ac)	Mitigation Ratio	Mitigation Total (ac)
1979-1989	2.6	*	2.6	1.5:1	3.9
1990-1995	1.1	14.6	15.7	1.5:1	23.55
1996-2003	4.8	7.8	12.6	1:1	12.6
Totals	8.5	22.4	30.9	--	40.05

* From 1979 to 1995 a total of 16 acres of indirect impacts have been identified. During the period 1990 to 1995, 14.6 acres (out of the 16.0 acres identified for the entire period of large-scale mining) are identified as indirectly impacted. The 14.6 acres are used in the calculation of indirect impacts based on a determination of the Corps of Engineers regulatory authority to mitigate past impacts.

The mitigation goal for impacts that would occur as a result of proposed expansion activities is therefore 12.6 acres of wetlands and/or nonwetland waters. Past (1979-present) impacts have a 1.5:1 mitigation ratio and a goal of 27.45 acres of wetlands and/or non-wetland waters.

In all cases, the overall goal is replacement of the lost functions and values of the impacted wetlands and waters in the long-term. Based on the functions and values lost, the compensatory mitigation for wetlands should create or enhance, at minimum, the following functions and values (see Table 3.4-2 of the FEIS; Goslin Gulch wetlands):

- overall, low values
- hydrologic support, high value

- floodflow alteration, moderate value
- sediment stabilization, moderate value
- water purification, moderate
- other functions, low

The compensatory mitigation for nonwetland waters, based on the above, should create or enhance the following functions and values, at minimum (see Table 3.4-3 of the FEIS; numerous drainages affected by past and proposed activities as described in Section III):

- overall, low to moderate
- physical and chemical characteristics, low to moderate
- biological characteristics, low to moderate
- human use characteristics, low to moderate
- special aquatic sites, low to moderate
- other functions, low

More specifically, the primary goals for the mitigation should include the following:

- Provide water quality benefits from sediment and pollution control
- Enhance riparian habitat development to provide water quality and biological benefits
- Enhance flows where possible
- Create pond-wetland complexes for water quality, hydrologic, special aquatic site, wildlife and stockwater human use benefits

Details of the success criteria and schedules established to measure if these goals are being met are discussed separately for each mitigation component in Section IV.

III. SUMMARY OF MITIGATION COMPONENTS

During development of the proposed mine expansion project at the Zortman and Landusky Mines, an effort was made by ZMI to first avoid, then minimize, then mitigate for impacts to waters of the U.S. Consideration was given in the design and location of project facilities to avoid direct and indirect impacts to wetland and non-wetland waters. This consideration, however, was constrained by design and operational limitations imposed by topographical constraints, location of the ore body, and the need to construct capture systems for the Water Quality Improvement Plan at existing wetland sites. The final design and location minimizes unavoidable impacts to on-site and off-site wetlands, wetland values, and non-wetland waters of the U.S. in the project area.

Best Management Practices (BMP's) are proposed to minimize impacts to the wetlands and non-wetland waters that could not be initially avoided. ZMI would follow COE and DEQ-recommended BMP's during construction and operation phases of the expansion project. BMPs which may be used include those described in the "Montana Sediment and Erosion Control Manual" (Montana DHES 1993). BMP's required by COE regulations and COE Special Conditions for 404 permits are listed in Attachment A to this Mitigation Plan. Their implementation would primarily serve to minimize indirect impacts caused by erosion and siltation (i.e., sedimentation).

Following avoidance and minimization efforts, ZMI would lastly provide mitigation for the remaining unavoidable adverse impacts to wetlands and non-wetland waters. The preferred mitigation would be on-site, in-kind; then on-site, out-of-kind; then off-site, in-kind; then off-site, out-of-kind. Based on the assessment of acres needed for mitigation, potential sites were investigated. Several on-site, in-kind projects were identified and developed as mitigation. These include wetland creation projects in Ruby Gulch, Goslin Gulch, and Montana Gulch drainages, as well as restoration of Ruby Gulch above the town of Zortman. The Water Quality Improvement Plan (Appendix A of the FEIS) measures would also provide on-site mitigation for past and proposed indirect impacts.

Additional investigation was conducted to find more on-site, in-kind mitigation options. However, based on the limited number of mountain drainages that required remediation (beyond that required under the Water Quality Improvement Plan), insufficient acreages were unavailable to meet the replacement requirement. The Ruby Gulch tailings removal and stream channel restoration project was the only drainage that would provide suitable on-site, in-kind mitigation. All other drainages adjacent to the mines have been or would be remediated through implementation of the Water Quality Improvement Plan and the 1993 tailings removal project in King Creek on the Landusky side. Alder Gulch was investigated, but rejected because it was determined to provide insignificant potential mitigation acreages and because ZMI has valid placer and lode claims in Alder Gulch with potential for development. Also, investigations by BLM resource specialists indicated problems with maintaining sufficient water in Alder Gulch to implement the required mitigation. Because of the limited opportunities for on-site, in-kind mitigation for impacted non-wetland waters of the U.S., it was necessary to look for suitable mitigation projects in the general area of the Zortman and Landusky mines. Discussions were held with the Montana Department of Fish, Wildlife and Parks Department, the Natural Resources Conservation Service (NRSC), and the BLM. The BLM identified four potential sites; the other agencies did not have any sites or opportunities in the area. Therefore, off-site mitigation projects in the form of reservoir and wetland construction were included in the plan. As south Phillips County is a prime nesting and reproduction area for waterfowl, it was determined that habitat enhancement offered the best opportunity for off-site, out-of-kind mitigation.

Based on the above investigations, a Mitigation Plan for impacts to wetlands and non-wetland waters for Alternative 7 was developed that consisted of the following four components. These are briefly introduced below and described in detail in Section IV.

A. ON-SITE WATER QUALITY MITIGATION

Mitigation plans for addressing indirect impacts to waters of the U.S., due to water quality degradation, are contained in Appendix A, the Water Quality Improvement Plan, of this Final EIS. These plans include construction of water management, water capture and water treatment facilities and are not repeated here. Appendix A describes how these measures would be implemented under the various EIS alternatives.

B. RUBY GULCH TAILING REMOVAL AND STREAM RESTORATION

The Ruby Gulch Tailing Project is on-site, in-kind mitigation for non-wetland Waters of the U.S. Upper Ruby Gulch above the town of Zortman is covered by tailings deposited by the historic mill near the head of Ruby drainage in the Little Rocky Mountains. It is a relatively steep mountain watershed with steep side slopes. Historic tailings will be removed from the drainage and a channel restoration project will be implemented. Although the tailings were not deposited by ZMI, restoration of this stream channel would provide 2.6 acres of mitigation for impacts to non-wetland Waters of the U.S.

C. ON-SITE WETLAND MITIGATION PROJECTS

The Wetland Mitigation Project is on-site, in-kind mitigation for wetland waters of the U.S. Two stock ponds and associated wetlands will be covered by the Goslin Flat leach pad. To offset those impacts, three mitigation projects would be constructed prior to construction and mining activities: (1) a series of wetlands and non-vegetated waters (1.79 acres) in a lower tributary of Ruby Creek; (2) a single wetland/non-wetland water (0.39 acres) in Upper Goslin Gulch adjacent to Azure Cave; and (3) a wetland/non-vegetated water (0.51 acre) in the western tributary of Montana Gulch. The construction of wetlands will replace the functions and values of the stockponds, including their use as a watering source for bats and big game. Total wetland mitigation would be 2.69 acres (minus 0.13 acres of existing non-wetland waters that would be replaced by the impoundments and dams).

D. OFF-SITE MITIGATION PROJECTS

Two watershed/reservoir development projects would be constructed on BLM property in south Phillips County as off-site, out-of-kind mitigation for indirect impacts to waters of the United States, since, other than the Upper Ruby Gulch channel restoration project described earlier, there are no other suitable on-site, in-kind mitigation projects in the drainages of the Little Rocky Mountains. The projects would be the Cowboy Retention Reservoir, with 45 acre-feet of storage and the Hump Retention Dam, with 67.1 acre-feet of storage. Both projects are a compacted earthfill retention reservoir to stop headcut, reduce erosion, store sediment and provide water for wildlife and livestock. The Cowboy project would provide 6.85 acres of mitigation, and the Hump project would provide 12.74 acres of mitigation, for a total of 19.59 acres (minus 0.15 acres of non-wetland waters, if jurisdictional, that would be replaced by the impoundments and the dams).

IV. DESCRIPTION OF MITIGATION COMPONENTS

A. COMPONENT 1: ON-SITE WATER QUALITY MITIGATION

Mitigation plans for addressing indirect impacts to waters of the U.S., due to water quality degradation, are contained in Appendix A, the Water Quality Improvement Plan, of this Final EIS. These plans include construction of water management, water capture and water treatment facilities and are not repeated here. Appendix A describes how these measures would be implemented under the various EIS alternatives to:

- reduction or elimination of long-term seepage through diversion of run-on water, isolation of waste rock, and use of surface reclamation
- segregation of good from poor quality water
- reduction of erosion and sediment production using BMPs
- capture and treatment of surface water and alluvial seepage from mine drainage and seeps

This plan will provide 16 acres of mitigation (per Corps of Engineers estimates).

1. Location Description

Water capture and treatment facilities would be located within the Zortman and Landusky mine area on affected drainages. General locations of these facilities are shown on Figures F-4 and F-5. More detailed location/plan maps for the individual structures can be found in Appendix A of the FEIS on Figures A-1 through A-13.

2. Ownership Status

The water quality improvement facilities would be located on public lands managed by the BLM and on private lands controlled by ZMI. ZMI will be responsible for maintaining the on-site water quality improvement structures. ZMI will assure access to permitting agencies for monitoring and inspection.

3. Present and Proposed Uses of Mitigation Areas

Currently, the present use of the general mitigation area is mining. An existing water treatment plant is located at the Zortman Mine which treats captured water from Ruby Gulch, Alder Spur and Carter Gulch. An objective of the Water Quality Improvement Plan is to improve water quality at the following drainages in the mining area:

Zortman Mine Area	Landusky Mine Area
Ruby Gulch	Sullivan Gulch
Alder Spur	Mill Gulch
Carter Gulch	Montana Gulch
	King Creek

The proposed use of the mitigation area is to continue mining for at least ten years, and to implement the Water Quality Improvement Plan to improve and maintain water quality in the effected drainages. Another water treatment plant would be constructed at the Landusky Mine in the Montana Gulch area. Details on specific facilities that would be constructed can be found in Appendix A.

4. Present and Proposed Uses of Adjacent Areas

The areas adjacent to the drainages are currently used for mining activities, and will continue to the drainages are currently used for mining activities, and will continue as such for at least ten years.

5. Schedule for Implementation and Completion

A phased approach would be used to implement the water quality improvement plan as described in Appendix A of the FEIS. Phase I includes constructing and implementing drainage-specific water management facilities and practices. Construction of the Phase I improvement facilities would require at least one full field season after acceptance of final engineering designs. Contingent upon obtaining the necessary regulatory approvals, Phase I construction would be initiated in drainages impacted by existing mining operations during 1996.

If compliance with MPDES effluent limits is not achieved, Phase II would be implemented in the relevant drainage. In Phase II, the source of the deficiency would be identified, and the existing water management facilities and practices would be modified, or additional facilities would be constructed accordingly to achieve the water quality objectives. Any necessary Phase II constructions or modifications would be conducted following a suitable Phase I effectiveness review period.

5. General Planning and Engineering Requirements

The generalized plan for improving water quality is to:

- segregate good quality water (unclassified and storm water zones) from poor quality water (mine drainage zones and seeps);
- reduce surface water runoff, erosion and sediment production in storm water management zones by applying Best Management Practices (BMPs);
- apply BMPs in mine drainage water management zones to reduce sedimentation in capture systems;
- capture surface water and alluvial seepage from mine drainage water management zones and seeps and treat this water to meet interim and final effluent limits; and
- reduce or eliminate long-term water quality impacts from mine drainage areas through source control and reclamation.

Diversion ditches are used at the Zortman and Landusky mine sites to segregate storm water and unclassified runoff from mine drainage zones and seeps. The diversion ditches intercept runoff water from undisturbed (unclassified) or reclaimed (storm water) slopes before it has an opportunity to come into contact with areas disturbed by mining activities (mine drainage zones). These ditches then route the good quality water to discharge points downstream of mine drainage capture facilities.

Best Management Practices (BMPs), including revegetation, soil stabilization matting, sediment retention basins, dikes, drains, silt fences, check dams, level spreaders, and discharge dispersion structures, are used by ZMI to control erosion and sediment production from storm water and mine drainage water management zones. BMPs, such as soil caps, geotextiles and geomembranes are used to reduce the infiltration of precipitation in areas which could contribute to mine drainage seeps.

To meet the objectives of this plan, poor quality water from both mine drainage runoff and alluvial seepage flow would be captured and treated prior to discharge. Capture systems vary depending on site-specific conditions, and may include one or more of the following:

- lined capture ponds,
- recovery wells,
- seepage capture trenches, and
- seepage capture sumps.

All captured mine drainage will be treated at the existing Zortman Water Treatment Plant or the proposed Landusky Water Treatment Plant. The Zortman Water Treatment Plant uses lime to precipitate metal hydroxides and to reduce acidity. Other treatment processes may be instituted at future dates, if it is demonstrated that future discharges do not meet final water quality effluent limits.

Refer to Section 2.11.1.7 and Appendix A of the FEIS for additional details on the water management plans.

7. Success Criteria

Water quality improvement and maintenance will be measured through compliance with applicable federal and state water quality standards.

8. Monitoring Methods

The existing operational water monitoring program would continue during the expansion and reclamation of the Zortman and Landusky mines. (Refer to Section 2.8.3.1 and 2.11.3.1 of the FEIS for details.) In addition, more intensive monitoring of water quality and quantity would be conducted in conjunction with implementing the Water Quality Improvement Plan and complying with a MPDES permit. The surface water and groundwater quality and flow monitoring program would be performed to:

- determine the effectiveness of capture and treatment facilities
- determine the effectiveness of BMPs
- document compliance with interim and final MPDES permit effluent limits
- monitor improvements in ambient water quality.

Appendix A and Section 2.11.3 of the FEIS contain details on the monitoring program.

B. COMPONENT 2: RUBY GULCH TAILING REMOVAL AND STREAM RESTORATION

This component would remove tailings deposited by an old mill near the head of the drainage. This type of mitigation is on-site and in-kind and would provide 2.6 acres of mitigation for impacts to non-wetland waters. Since this tailings-covered area currently does not provide any wetland or non-wetland waters and therefore no functional values, all of the benefits accruing from this would be viewed as mitigation credit.

1. **Location Description:** Ruby Gulch is a south flowing drainage in the Little Rocky Mountains that runs from the Zortman mine complex through the town of Zortman. Ruby Gulch is covered by tailings deposited by the historic Ruby Gulch mill near the head of the drainage. The tailings were in excess of 50 feet thick near the upper end by the Ruby Gulch capture pond, while on the downstream end near the town of Zortman they are on the order of 5 to 25 feet thick. The tailings are non-toxic and consist of mixtures of sand and gravel up to approximately 1/2 inch. The tailings are often vegetated where not subjected to erosion and mature trees are common. Ruby Gulch is a relatively steep mountain watershed with steep side slopes. The creek is intermittent and generally flows through the tailings, not on top of them. The tailings do not represent an acid generating source, but are quite mobile and subject to erosion from severe thunderstorm events. The mitigation project

would consist of removal of tailings between the existing captures ponds below the Zortman 85/86 leachpads to just north of the town of Zortman (see Figure F-6).

2. **Ownership status:** The portion of the Ruby Gulch tailings to be removed and the stream channel to be restored is on public land managed by the BLM. Access to the area will be via the town of Zortman to an existing county road adjacent to Ruby Gulch. ZMI would be responsible for maintaining the Ruby Gulch restoration area until it is reclaimed and bond is released by the DEQ and BLM.

3. **Present and Proposed Uses of Mitigation Areas:** Currently, Ruby Gulch is used for access to the Zortman mine complex by ZMI. Public access is not provided through Ruby Gulch. Other uses of Ruby Gulch is excavation of the tailings for road construction purposes. After mitigation is complete in Ruby Gulch, access would be via the county road adjacent to the drainage bottom.

4. **Present and Proposed Uses of Adjacent Area:** The area adjacent to Ruby Gulch may be used for woodcutting and some recreational uses, although it is limited by the steep terrain and heavy timber growth. Mining occurs in the upper end of Ruby Gulch, as well as leach pad and waste rock repository construction. No changes are proposed for use in adjacent areas.

5. **Schedule for Implementation and Completion:** Removal of Ruby Gulch tailings would begin after the project was approved. A portion of the tailings would be used as liner cover for the Goslin Flat leach pad in Year 1 and also for reclamation in Years 2 and 3. However the majority of tailings would not be used until final reclamation of the Zortman waste rock cap and open pit took place, between Years 6 to 8. Stream restoration would be completed after tailings removal, in Years 7 to 9 after project approval.

6. **General Planning and Engineering Requirements**

After removal of Ruby Gulch tailings, stream channel restoration would be undertaken. The objective of stream restoration is to create a geomorphically stable channel and improve aquatic habitat.

Channel pattern and channel parameters from similar nearby channels would be mimicked, and the channel will be designed to accommodate calculated flows, sediment load, and gradient. A likely candidate for a study channel is Bear Gulch, the first major drainage to the northeast, which appears to be similar in size, overall gradient, and geology. The study channel would be surveyed and the following data gathered:

- Valley floor gradient
- Channel gradient
- Channel width, depth, shape and form (cross-sections)
- Flood plain width
- Entrenchment
- Grain size distribution in channel bottoms and terraces
- Sinuosity
- General conditions, i.e., vegetation, erosion and sedimentation, and materials available for reclamation purposes.

After the data is gathered, a channel will be designed in Ruby Gulch using this information and adapting it for use on Ruby Gulch. A reclamation plan would be developed with design channel gradient, design channel geometry, design channel substrate, a design transition zone at the downstream end of the reclaimed zone and a revegetation plan. After the final reclamation plan was developed, it would be submitted to the agencies for approval.

7. **Success Criteria**

This proposed project will be designed on the basis of information gathered at a nearby study natural channel which is similar in size, overall gradient, and geology. This nearby channel can thus be used as a reference area against which the success of this project can be quantitatively evaluated.

Goal 1: To restore a geomorphically stable stream channel to this area currently filled with tailings.

Success Criterion A: To recreate a valley floor and channel gradient, sinuosity, width, depth, shape, and form (cross-sections), flooded plain with substrate and transition zone channel similar to the design as documented by as-built surveys and photographs.

Success Criterion B: To recreate a channel which after 3 years is not experiencing bank erosion, as measured by surveys and photographs in years 2, 3, 5, 7, and 10.

Success Criterion C: To recreate a channel substrate of size and composition similar to the reference stream, and which is not experiencing visible buildup of sediments or erosion, as measured by photographs surveys in years 2, 3, 5, 7, and 10.

Success Criterion D: To create, if possible, localized riffle-pool or "stair-stepping" reaches which are also stable geomorphically, as measured by surveys in years 2, 3, 5, 7, and 10.

Goal 2: To restore riparian and streamside wetland vegetation.

Success Criterion A: Establish total vegetative cover at the mitigation site no less than 20 percent lower than existing cover and proportion of native herbaceous species at similar reference impoundments by year 5, as measured by ocular estimates of canopy cover at plots surveyed annually and photographed. The variance of the mitigation site data shall be within 20 percent of the variance of the reference area, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion B: Achieve woody plant stem density no less than 20 percent lower than existing density at similar reference impoundments by year 5, as measured by stem counts within plots surveyed annually and photographed. The variance of stem density at the mitigation site shall be within 20 percent of the reference data, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Goal 3: To restore wildlife habitat values.

Success Criterion A: To provide habitat for a total of at least 10 species of native birds, mammals reptiles, and amphibians by year 5, as measured by annual surveys.

8. **Monitoring Plan**

Hydrology

Flows would be monitored in terms of seasonal duration and quantity at the reference stream and at the newly constructed stream in Ruby Gulch by bimonthly observations during the months of the anticipated wet season. Flow quantity would be measured by installation of a staff gauge.

Morphology

An as-built survey would be conducted after construction was completed, and compared to the design drawings. In subsequent years, e.g., years 1, 2, 3, 5, 7 and 10, the length of the stream would be walked and channel configuration changes and areas of erosion noted on the as-built drawing and photographs. Monitoring of channel substrate would consist of ocular estimates of substrate size and composition at least 10 permanently marked sites along the constructed stream and reference area. Photographs at each sampling site would be provided. If riffle-pool reaches are found to be feasible and constructed, permanent observation points would also be established and visually monitored and photographed at least once each during the wet and dry season of each year. Visual inspection of the transition reach and mapping and photographs should take place at least three times per year.

Vegetation

Vegetation will be monitored annually by qualified personnel for at least 3 years using U.S. Forest Service (1987) Ecodata methods at a series of randomly selected plots established along the restored stream and at the reference stream to be selected with agency input. A total of at least 20 permanent plots will be established at the newly constructed stream, and an additional 20 plots will be established at the reference stream. Surveys will be scheduled during the summer when vegetation development is at a maximum (probably June of most years).

Wildlife

A single, permanently marked ground transect shall be established that parallels the restored stream. A wildlife ecologist capable of identifying native birds and mammals, bird songs and calls, and tracks shall survey the transect at least once per year between 1/2 hour before sunrise and 3 hours after sunrise in June. Surveys shall only be conducted in mornings without precipitation and only light winds (the weather conditions when bird activity is greatest). All wildlife species observed (or best possible identification) within 100 feet of the edge of the created wetlands shall be recorded.

C. COMPONENT 3: WETLAND MITIGATION PROJECTS

This component is designed to create a series of wetland and nonwetland water impoundment complexes by constructing a series of impoundments at three locations: along a tributary to Ruby Creek, in upper Goslin Gulch, and in Montana Gulch. These three project together would provide 2.69 acres of on-site, in-kind compensatory mitigation for anticipated wetland and non-wetland water impacts. Existing functions and values of the tributary of Ruby Creek, and segment of upper Goslin Gulch, and Montana Gulch for wetland and non-wetland waters are rated as low overall and for chemical, physical, and biological characteristics and moderate for human uses which include wildlife, livestock, and water right uses. Specific goals and success criteria are listed below for these projects.

1. **Location Description:** The Upper Goslin Gulch wetland mitigation project is located in the lower portion of the southern Little Rocky Mountains in a well vegetated drainage (see Figure F-7). The soil is composed of loams, silty loams and silty clay loams with low coarse fragment content. The area currently does not contain wetlands due to a relatively steep topographical gradient.

   The Ruby Creek tributary wetland mitigation project is located on the plains approximately one-half mile from the base of the Little Rocky Mountains (see Figure F-8). The area is in a channel that feeds into Ruby Creek. The area is used by livestock, and therefore vegetation is well-grazed. The tributary does not currently contain wetlands due to coarse soils and a coulee bottom gradient of sufficient steepness to allow the area to drain.

   The western Montana Gulch wetland is located in upper drainage of Montana Gulch near the headwaters (see Figure F-9). It is typical of other drainages in the Little Rocky Mountains, with a steep gradient and steep side slopes.

2. **Ownership Status:** The Upper Goslin Gulch wetland mitigation project is located on BLM ground and can currently be accessed via an unimproved road leading from private ground owned by ZMI. After the Goslin Flat leach pad is constructed, access would be routed around the leach pad, but the current access road located on BLM ground would not change.

   The Ruby Creek tributary wetland mitigation project is located on private ground owned by ZMI and is immediately adjacent to the county road, Seven Mile Road. Access would be via Seven Mile Road.

   The western Montana Gulch wetland project is located on BLM ground adjacent to private ground owned by ZMI and also the Fort Belknap Indian Reservation. Access is via roads constructed in Montana Gulch leading from ground controlled by ZMI.

3. **Present and Proposed Uses of Mitigation Areas:** The Upper Goslin Gulch wetland mitigation project area is relatively unused except possibly by wildlife for browse and shelter and access to Azure Cave. Azure Cave is located approximately one-half mile away, and it is anticipated the Upper Goslin Gulch mitigation site would be used for water by the bats roosting in the cave. It would also be used by big game animals for water in place of the stockponds that would be covered in Goslin Flat.

   The Ruby Creek tributary wetland mitigation project area is used primarily for cattle grazing. Seven Mile Road and an overhead power line run adjacent to the tributary. Proposed uses would include use of the water by big game animals in place of the stockponds that would be covered in Goslin Flat. No changes to Seven Mile Road or the power line would occur.

The western Montana Gulch wetland mitigation project area is relatively unused. It is not readily accessible for hiking or recreation and does not provide significant forage for animals. Construction of the wetlands would provide a water source for animals.

All three drainages currently are non-wetland waters of the U.S., and the mitigation projects would replace 0.13 acres of existing non-wetland waters with the proposed impoundments and dams. This acreage would be subtracted from the mitigation acreage provided by this plan.

4. **Present and Proposed Uses of Adjacent Areas:** Present uses of areas adjacent to all the wetland mitigation projects are similar to the mitigation area. Proposed uses of the area adjacent to the Upper Goslin Gulch and Ruby Tributary wetland mitigation areas would be construction of a leach pad, a process solution pond area and a carbon plant, carbon strip plant and refinery for processing of gold ore.

All three drainages currently are non-wetland waters of the U.S., and the mitigation projects would replace 0.13 acres of existing non-wetland waters with the proposed impoundments and dams. This acreage would be subtracted from the total mitigation acreage provided by this plan.

5. **Schedule for Implementation and Completion:** Wetland mitigation for Upper Goslin Gulch and Ruby Creek tributary would coincide with construction of the Goslin Flat heap leach facility. This will allow: 1) direct haul of hydric soils salvaged from affected wetlands; 2) concurrent mitigation; and 3) greater selection of construction equipment. The wetland projects would be completed prior to cover of the stockponds by fill.

Wetland mitigation for Montana Gulch would be implemented and constructed the first summer after permit approval.

6. **General Planning and Engineering Requirements**

A) Ruby Tributary and Upper Gosling Gulch Wetland Mitigation Sites

Specific climatic and hydrologic factors were evaluated in the design of wetland mitigation areas supplied with surficial water. These included:

- average monthly precipitation and evaporation
- potential evapotranspiration
- average monthly runoff
- seepage
- discharge from wetland
- impoundment retention period

These factors were used to determine the average monthly volume of water stored in each wetland and, based on the configuration (shape and depth) of the wetlands, the extent of saturated/inundated soils was estimated for the Ruby Creek tributary and Upper Goslin Gulch. Acreages of proposed mitigation sites are given in the following table:

RUBY CREEK TRIBUTARY	1.79 ACRES
A	0.16 ACRES
B	0.28 ACRES
C	0.09 ACRES
D	0.28 ACRES
E	0.38 ACRES
E	0.38 ACRES
G	0.25 ACRES
UPPER GOSLIN GULCH	0.39 ACRES
TOTAL	2.18 ACRES

Establishment of Wetland Hydrology

Establishment of wetland hydrology will require creating conditions which are similar to those in the existing leach pad area wetlands. These hydrologic conditions are related to temporary retention of water in low areas of the stream channel or by retention of water in stockponds created by dikes and impoundments along the drainage bottom. Water retention in the Ruby Creek tributary and Upper Goslin Gulch mitigation areas will result in inundated or saturated soils for a duration and frequency which allows for development of wetland vegetation communities.

Surficial materials at the Ruby Creek tributary mitigation area consist of cobbly, very gravelly loams, silty loams, and loamy sands. These materials currently underlie an existing wetland formed from construction of a stockpond. With the addition of dikes and seasonal ponds in the tributary between the county road and the confluence of Ruby Creek, the area is capable of supporting an additional 1.79 acres of wetland. The primary reason that the tributary does not currently contain wetlands is because of coarse soils and a coulee bottom gradient of sufficient steepness to allow the area to drain. As a result, retention of surface runoff and saturation/inundation of soils is of insufficient duration to support hydrophytic vegetation.

The Upper Goslin Gulch mitigation area is located within the Judell soil series. This soil is composed of loams, silty loams, and silty clay loams with low coarse fragment content. Construction of a dike and pond in this drainage bottom will result in the creation of a 0.39-acre wetland. Similar to the Ruby Creek tributary, the Upper Goslin Gulch drainage does not currently contain wetlands due to a relatively steep topographical gradient. This gradient prevents retention of surface runoff and soil saturation/inundation, thus the area does not currently support hydrophytic vegetation.

Establishment of wetland hydrology in the Ruby Creek tributary and Upper Goslin Gulch will rely on flow barriers or dikes and a clay liner designed to increase retention of surface runoff and duration of soil saturation/inundation. Methods of calculation and summary water balances are presented in Appendices B-1 and B-2 of ZMI's 404 permit applications (ZMI 1995). As designed, the Ruby Creek tributary mitigation wetlands would be fully inundated or saturated for approximately four months during snowmelt runoff (March through June) and partially inundated (up to 5 feet) or saturated through August. The Upper Goslin Gulch mitigation wetland would be fully inundated or saturated for approximately five months (February through June), and partially inundated or saturated through November.

Site Development

At the Ruby Creek tributary mitigation sites, seven detention dikes between 60 and 190 feet in length with a maximum height of 6 feet will be constructed between the county road and Ruby Creek (Figure F-8). A single dike sufficient to hold 0.39 acres of water will be constructed in the Upper Goslin Gulch mitigation site (Figure F-7).

Dikes and spillways will be designed to allow for high flows during runoff and severe precipitation events. Typical design details are provided in Figures 4-3a and 4-3b of ZMI's 404 permit application (ZMI 1995).

Cover soil salvage and grading will be conducted for pond and dike construction. In order to determine the amount of grading necessary, each site will be surveyed and topographic maps prepared with two-foot contour intervals. Final wetland mitigation site plans will be prepared using the new topographic maps and final design drawings for the drainage.

A clay liner with a permeability less than 0.01 inches per hour will be placed in the impoundment areas and on the upstream face of the dike to reduce water loss to infiltration. The desired permeability could be achieved by using native clay materials that are available at Zortman Mining, Inc.'s clay source. The impoundment areas will retain flows for sufficient time during seasonal precipitation events (and snowmelt) to allow establishment of hydrophytic vegetation.

Soil Handling

Prior to construction of ponds and dikes, cover soil will be salvaged and stockpiled in non-wetland areas adjacent to the site. Soils on the mitigation sites have formed in alluvial sediments exhibiting good salvage quality to about 12 inches. Soils will be salvaged to 12 inches and will be redistributed as a subsurface soil over the liner for dike and wetland area reclamation and stabilization.

Hydric soils from the portion of Goslin Flat to be affected by the leach pad facility will be salvaged separately and respread on the mitigation sites as surface soil covering redistributed soils salvaged from site construction. Hydric soils will provide a plant material source and possibly increase organic matter content. Following redistribution, these soils will be ripped, disced or harrowed to provide an adequate seedbed.

Hydrophytic Vegetation Establishment

Hydrophytic vegetation communities in the portion of Goslin Flat to be affected are dominated by Nebraska sedge (*Carex nebraskensis*), wooly sedge (*Carex lanuginosa*) and Baltic rush (*Juncus balticus*). Other species include Columbia hawthorn (*Crataegus columbiana*), sandbar willow (*Salix exigua*), spikerush (*Eleocharis palustris*), and fowl manna grass (*Glyceria striata*). Nebraska sedge, Baltic rush, spikerush and sandbar willow are commercially available, although availability is limited and varies seasonally. The availability of wetland plants, however, is increasing and additional species may become available prior to creation of wetlands.

Frequently, seeding or planting of wetland species is not necessary to recreate hydrophytic plant communities, as these species generally colonize suitable sites. However, the rate of hydrophytic species invasion depends on proximity of suitable seed sources, distance upstream of any contributing plant materials and competition from seeded species. For wetlands created along the Ruby Creek tributary, the existing wetland and respread hydric soils will provide a seed source for downstream sites. Respread hydric soils will provide a seed source for the Upper Goslin Gulch wetland site. In order to ensure site stability, however, all sites will also be seeded rather than relying solely on natural revegetation.

The proposed base revegetation mix is presented in the following table:

SPECIES[1]			WETLAND STATUS	SEEDING RATE[2]	
Scientific Name	Variety	Common Name		Pounds PLS/acre	PLS/ sq.ft.
GRASSES:					
Agropyron dasystachyum	Critana	Thickspike wheatgrass	FACU-/FAC	6.00	22
Agropyron trachycaulum	Revenue	Slender wheatgrass	FAC/FACU	3.00	11
Elymus canadensis	-	Canada wildrye	FAC/FACU	5.00	13
Poa compressa	Reubens	Canada bluegrass	FACU	0.10	6
TOTAL				**14.10**	**52**
SHRUBS:					
Rosa woodsii	-	Wood's rose	FACU	150	
Salix exigua	-	Sandbar willow	FACW+	250	
TOTAL				**400**	

[1]The following species will be added to the mix or planted as containerized stock or plugs depending on availability: *Carex nebraskensis* (OBL), *Carex lanuginosa* (OBL), *Juncus balticus* (OBL), *Eleocharis palustris* (OBL), *Scirpus validus* (OBL) and *Typha latifolia* (OBL).

[2]Based on a broadcast rate of approximately 50-55 Pure Live Seed (PLS) per square foot; rate will be halved for drill seeding.

Although the majority of the species in the base revegetation mixture are more representative of mesic and upland communities, they are useful for providing initial site stabilization prior to colonization by hydrophytic species. Also, hydrophytic species designated in Footnote 1 to the table will be seeded or planted as available.

The following approach will be implemented for revegetation:

1) after seedbed preparation (discing or harrowing) of the respread cover and hydric soils, the area will be broadcast seeded with the wetland revegetation mixture. Containerized stock, plugs or rooted cuttings will be planted using commercially available materials or materials collected in the vicinity of the project area. All stock will be dormant and in good condition when planted. Hand tools or mechanized equipment will be used to plant stock; proper planting procedures will be observed to maximize seedling survival. Planting densities are given in the table.

2) The pond areas will be matted (Excelsior blankets, North American Green blankets or equivalent) from the drainage bottom up to the projected high water line, and in the drainage bottom where disturbances have occurred outside the projected impoundment area during construction. Above the high water line reclaimed areas may be mulched (2000 pounds of cellulose fiber) or matted.

B) Montana Gulch Wetlands Mitigation Site

Specific climatic and hydrologic factors were evaluated in the design of the wetland mitigation area supplied with surficial water. These included:

- average monthly precipitation and evaporation
- potential evapotranspiration
- average monthly runoff
- seepage

- discharge from wetland
- impoundment retention period

These factors were used to determine the average monthly volume of water stored in the wetland and, based on the configuration (shape and depth) of the wetland, the extent of saturated/inundated soils was estimated for the Montana Gulch mitigation site.

Establishment of Wetland Hydrology

Establishment of wetland hydrology will require creating conditions which are similar to those in the existing affected wetlands. These hydrologic conditions are related to temporary retention of water in low areas of the stream channel. Water retention at the Montana Gulch mitigation site will result in inundated or saturated soils for a duration and frequency which allows for development of wetland vegetation communities.

Wetlands currently existing in the upper portion of Montana Gulch are primarily ephemeral. A 0.74-acre perennial wetland with saturated soils and free-standing water is located at the juncture of Montana Gulch and the '85/'86 leach pad facility. The proposed wetland mitigation site will be located approximately 150 feet upstream from this existing wetland. A dike constructed in the drainage bottom of Montana Gulch at the mitigation site will create an additional 0.51-acre wetland.

Establishment of wetland hydrology at the Montana Gulch mitigation site will rely on a flow barrier or dike and a clay liner designed to increase retention of surface runoff and duration of soil saturation/inundation. Methods of calculation and summary water balances are presented in Appendix B of ZMI's 404 permit applications (ZMI 1995). As designed, the mitigation wetland would be fully inundated or saturated for approximately five months (February through June) and partially inundated or saturated from July through November.

Site Development

A single dike sufficient to hold 0.51 acres of water will be constructed at the Montana Gulch mitigation site (Figure F-9). The dike will be designed to allow for high flows during runoff and severe precipitation events. Typical design details are provided in Figure 4-3 of ZMI's 404 permit application (ZMI 1995).

The wetland mitigation site along Montana Gulch will require grading for pond and dike construction as well as cover soil salvage. In order to determine the amount of grading necessary, the site will be surveyed and a topographic map prepared with two-foot contour intervals. The final wetland mitigation site plan will be prepared using the new topographic map and final design drawing.

A clay liner with a permeability less than 0.01 inches per hour will be placed in the impoundment area and on the upstream face of the dike to reduce water loss to infiltration. The desired permeability could be achieved by using native clay materials available at Zortman Mining, Inc.'s clay source. The impoundment area will retain flows for sufficient time during seasonal precipitation events (and snowmelt) to allow establishment of hydrophytic vegetation.

Soil Handling

Soils on the mitigation site have formed in alluvial sediments exhibiting good salvage quality to about 12 inches. Prior to construction of the pond and dike, cover soil will be salvaged and stockpiled in a non-wetland area adjacent to the site. Hydric topsoil will be salvaged separately and respread as surface soil on that portion of the mitigation site expected to eventually support hydrophytic species. Hydric soils will provide a plant material source and possibly increase organic matter content.

Hydrophytic Vegetation Establishment

Frequently, seeding or planting of wetland species is not necessary to recreate hydrophytic plant communities as these species generally colonize suitable sites. However, the rate of hydrophytic species invasion depends on proximity of suitable seed sources, distance upstream of any contributing plant materials and competition from seeded species. For the Montana Gulch mitigation wetland, upstream adjacent wetlands and respread hydric soils will provide a seed source for hydrophytic revegetation. In order to ensure site stability, however, the site will also be seeded rather than relying solely on natural revegetation. The proposed base revegetation mixture is presented in the following table:

SPECIES[1]			WETLAND STATUS	SEEDING RATE[2]	
Scientific Name	Variety	Common Name		Pounds PLS/acre	PLS/ sq.ft.
GRASSES:					
Agropyron dasystachyum	Critana	Thickspike wheatgrass	FACU-/FAC	6.00	22
Agropyron trachycaulum	Revenue	Slender wheatgrass	FAC/FACU	3.00	11
Elymus canadensis	-	Canada wildrye	FAC/FACU	5.00	13
Poa compressa	Reubens	Canada bluegrass	FACU	0.10	6
TOTAL				14.10	52
				PLANTING RATE (stems/acre)	
SHRUBS:					
Rosa woodsii	-	Wood's rose	FACU	150	
Salix exigua	-	Sandbar willow	FACW+	250	
TOTAL				400	

[1]The following species will be added to the mix or planted as containerized stock or plugs depending on availability: *Carex nebraskensis* (OBL), *Carex lanuginosa* (OBL), *Juncus balticus* (OBL), *Eleocharis palustris* (OBL), *Scirpus validus* (OBL) and *Typha latifolia* (OBL).

[2]Based on a broadcast rate of approximately 50-55 Pure Live Seed (PLS) per square foot; rate will be halved for drill seeding.

Although the majority of species in the base revegetation mixture are more representative of mesic and upland communities, they are useful for providing initial site stabilization prior to colonization by hydrophytic species. Also, hydrophytic species designated in Footnote 1 to the table will be seeded or planted as available. Nebraska sedge (*Carex nebraskensis*), Baltic rush (*Juncus balticus*), spikerush (*Eleocharis palustris*) and sandbar willow (*Salix exigua*) are commercially available, although availability is limited and varies seasonally.

The following approach will be implemented for revegetation:

1) after seedbed preparation (discing or harrowing) of the respread cover, the area will be broadcast seeded with the wetland revegetation mixture. Containerized stock, plugs or rooted cuttings will be planted using commercially available materials or materials collected in the vicinity of the project area. All stock will be dormant and in good condition when planted. Hand tools or mechanized equipment will be used to plant stock; proper planting procedures will be observed to maximize seedling survival. Planting densities are given in the table.

2) The pond area will be matted (Excelsior blankets, North American Green blankets or equivalent) from the drainage bottom up to the projected high water line, and in the drainage bottom where disturbances have occurred outside the projected impoundment area during construction. Above the high water line the reclaimed area may be mulched (2000 pounds of cellulose fiber) or matted.

7. **Success Criteria**

Goal 1: To replace ponds (open water and wetland impoundment) habitat that would be lost in Goslin Gulch.

Success Criterion A: To create an impoundment of 0.39 acres in upper Goslin Gulch which is consistent with the design, as measured by an as-built professional survey, and observations in relation to predicted water levels in March-June and documented by photographs.

Success Criterion B: To create open water and a fringe of wetland as defined by the presence of wetland hydrology, hydrophytic vegetation, and hydric soils, by year 5, as measured by a wetland delineation, professional survey, and photographs during May or June.

Success Criterion C: Bats will use the new Upper Goslin Gulch impoundment by year 1, as measured by dusk field surveys during June, July, and August.

Success Criterion D: To provide habitat for a total of at least 10 species of native birds, mammals, reptiles, and amphibians by year 3, as measured by annual surveys.

Goal 2: To replace open water and wetlands habitat with impoundments in a tributary of Ruby Creek.

Success Criterion A: Create seven impoundments with open water and wetlands along a tributary of Ruby Creek, as follows: A-0.16 acres, B-0.28 acres, C-0.09 acres, D-0.28 acres, E-0.38 acres, F-0.35 acres, and G-0.25 acres as designed, as measured by an as-built topographic survey.

Success Criterion B: Create these seven impoundments with a combined total of at least 1.79 acres of open water and wetlands by year 3, as measured by a formal wetland delineation, staking, subsequent professional survey, and documented by photographs.

Success Criterion C: Create these seven impoundments with areas of inundation as large as predicted, as measured by observations in relation to predicted water levels in March-June and photographs.

Success Criterion D: Establish total vegetative cover at the mitigation site no less than 10 percent lower than existing cover and proportion of native herbaceous species at similar reference impoundments by year 5, as measured by ocular estimates of canopy cover at plots surveyed annually and photographed. The variance of the mitigation site data shall be within 20 percent annually and photographed. The variance of the mitigation site data shall be within 20 percent of the variance of the reference area, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion E: Achieve woody plant stem density no less than 20 percent lower than existing density at similar reference impoundments by year 5, as measured by stem counts within plots surveyed annually and photographed. The variance of stem density at the mitigation site shall be within 20 percent of the variance of the reference data, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion F: Provide habitat used by at least 10 species of native birds, mammals, reptiles, and amphibians as measured by annual ground transect surveys.

Success Criterion G: Soil loss from erosion will be minimal, as evaluated by post-construction observations during other monitoring activities and documented by photographs.

Goal 3: To replace lost non-wetland water and wetland habitat by constructing an impoundment in Montana Gulch.

Success Criterion A: Create an impoundment with open water and wetlands along Montana Gulch which replaces functions and values that would be lost to the proposed project.

Success Criterion B: Create an impoundment with an area of at least 0.51 acres of combined open water and wetlands by year 3, as measured by a formal wetland delineation, staking, subsequent professional survey, and documented by photographs.

Success Criterion C: Create this impoundment with an area of inundation as large as predicted, as measured by observations in relation to predicted water levels in March-June and photographs.

Success Criterion D: Establish total vegetative cover at the mitigation site no less than 10 percent lower than existing cover and proportion of native herbaceous species at similar reference impoundments by year 5, as measured by ocular estimates of canopy cover at plots surveyed annually and photographed. The variance of the mitigation site data shall be within 20 percent annually and photographed. The variance of the mitigation site data shall be within 20 percent of the variance of the reference area, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion E: Achieve woody plant stem density no less than 20 percent lower than existing density at similar reference impoundments by year 5, as measured by stem counts within plots surveyed annually and photographed. The variance of stem density at the mitigation site shall be within 20 percent of the variance of the reference data, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion F: Provide habitat used by at least 10 species of native birds, mammals, reptiles, and amphibians as measured by annual ground transect surveys.

Success Criterion G: Soil loss from erosion will be minimal, as evaluated by post-construction observations during other monitoring activities and documented by photographs.

8. **Monitoring Plan**

Hydrologic Monitoring

When construction of each impoundment is completed, the water level elevation expected in 60 years out of 100 shall be permanently marked with a metal post or gauge. Monthly qualitative evaluations during March-October will be made annually for at least the first 5 years and photographs taken which document water level in relation to the post.

Wetlands Monitoring

At year 3, a formal wetland delineation will be conducted at each constructed reservoir by qualified personnel in June. Wetland boundaries shall be staked and a professional survey conducted which shows the extent and acreage for wetlands and non-wetland waters.

Vegetation Monitoring

Vegetation will be monitored annually by qualified personnel for at least 3 years using U.S. Forest Service (1987) Ecodata methods at a series of randomly selected plots established at the created wetlands and at similar reference impoundments to be selected with agency input. A total of at least 20 permanent plots will be established at the newly constructed reservoirs, and an additional 20 plots will be established at existing, similar reference reservoirs. The variance of overall percent cover by morphological class and stem density at the created wetlands shall be within 20 percent of the variance (expressed as a percentage of the mean) observed at the reference sites. Surveys will be scheduled during the summer when vegetation development is at a maximum (probably June of most years).

Wildlife Monitoring

One or more permanently marked ground transect(s) shall be established that parallel wetlands A-G on the Ruby Creek tributary. At upper Goslin Gulch and Montana Gulch sites, a single observation and photo point that overlooks the entire reservoir will be chosen and permanently marked, however, observations would not be restricted to this point. A qualified wildlife ecologist shall survey the transect along Ruby Creek tributary and conduct observations for at least 1/2 hour from the observation point at the other reservoirs, at least once per year between 1/2 hour before sunrise and 3 hours after sunrise in May, June, July, August, and/or September. Surveys shall only be conducted in mornings without precipitation and only light winds (the weather conditions when bird activity is greatest). All wildlife species observed (or best possible identification) within 100 feet of the edge of the created wetlands shall be recorded. Bat use shall be monitored in the evening by visual observations or high frequency tape recordings.

Soils Monitoring

Soils will be visually checked monthly for the first year after construction, and at least bimonthly through year 3. Evidence of soil loss shall include drilling, gullying, plant pedestaling, loss of litter and increases in percent bare ground, and shall be documented photographically and mapped.

D. COMPONENT 4: OFF-SITE MITIGATION PROJECTS

After consideration of the mitigation "credits" accrued by the projects described in the previous sections, there remained a shortfall of 18.66 acres of mitigation needed after all of the potential on-site mitigation opportunities had been used. Consultation with the NRCS, BLM, Montana Department of Fish, Game, and Parks indicated that there were no other on-site or off-site, in-kind opportunities to provide compensatory mitigation. An inquiry among BLM resource specialists turned up a probable site in Alder Gulch which lacked water and therefore riparian growth. However, information provided by a BLM soil scientist indicated that if an attempt were made to reshape the Alder Gulch streambed, the efforts would not restore the surface flow, due to change that have occurred from mining in the area and the area subsurface geology. Therefore, restoration of Alder Gulch was not considered to be a viable option. However, during this process the BLM identified a series of small reservoir projects located within approximately 20 miles of the mine site that could provide off-site mitigation (see Figure F-10). These reservoirs would be similar (but larger than) the on-site projects. The overall objective of these off-site projects would be to totally (with the on-site projects) compensate for wetland and non-wetland waters affected by the proposed project. The general goals and success criteria for these projects are described below.

The current condition of these project sites are ephemeral to intermittent stream corridors on BLM rangeland. Existing functions and values are generally low and similar to those of Goslin Gulch, with low values for physical, chemical, biological, and human use characteristics. The BLM stated purpose for these projects is to provide water for livestock and wildlife, reduce erosion, store silt and stop head cutting.

1. **Location Description:** The site of the proposed Cowboy Reservoir is in the SW Quarter of the SW Quarter of Section 29, R24N, T28E. This site is located along an unnamed side drainage of Beauchamp Creek within the watershed of the Missouri River. This site is located about 19 miles southeast of the Zortman-Landusky mine site. A plan map of the Cowboy site is provided as Figure F-11. The site of the proposed Hump Reservoir is in the SW Quarter of the NW Quarter of Section 28, R24N, T27E, also along an unnamed side drainage of Beauchamp Creek. This site is about 15 miles southeast of the mines. A plan map of the Hump site is provided as Figure F-12. Two additional potential reservoir sites, called Cutter and Flintstone reservoir projects, were also considered as compensatory mitigation during this process. It was concluded, however, that Cutter and Flintstone were not necessary because construction of Cowboy and Hump reservoirs would provide sufficient acreage of wetlands and non-wetland waters. The locations of all four proposed reservoirs are shown in Figure F-10.

2. **Ownership Status:** Both sites are on Federal land managed by the Bureau of Land Management (BLM), Phillips Resource Area, located in Malta, Montana. The sites are both within 1/2 mile of dry fork road and readily accessible by foot.

3. **Present and Proposed Uses of Mitigation Area:** The sites of the Cowboy and Hump reservoir sites are Federal rangeland and currently grazed by livestock, as well as used by a variety of local wildlife. Present vegetation for Cowboy reservoir area is grassland consisting of blue grama, western wheatgrass, green needlegrass, and including some big sagebrush. Beaucamp Creek runs for 3 months of the year and during precipitation events. The Hump reservoir area vegetation includes western wheatgrass and bluebunch wheatgrass, big sagebrush, skunkbrush sumac, and junipers. It is expected that emergent vegetation consisting of cattail, bulrush, and sedges will develop in the shallow areas of both reservoirs. Development of riparian areas will be faster and easier to maintain in the sheep pastures as they prefer to graze on the uplands to the drainage ways. Emergent vegetation

will also move into Cowboy Reservoir but may be at a slower pace as cattle will make more use of areas adjacent to water during July and August. The three pasture deferment rotational grazing system will allow cattle to be in any one pasture during this hot dry season only one year out of every three. Shrub and tree development are considered unlikely.

The storage provided at Cowboy Reservoir would create 4.32 acres of wetland and 2.53 acres of non-wetland waters. The storage at Hump Reservoir would create 8.83 acres of wetland and 3.91 acres of non-wetland waters. These two reservoirs would collectively create a total of 13.15 acres of wetland and 6.34 acres of non-wetland waters (19.49 total acres). The sites currently contain ephemeral to intermittent drainages that, if classified as jurisdictional waters, would be partly replaced with the proposed reservoirs. Approximately 0.15 acres of non-wetland waters would be affected by the footprint of the dams and the reservoir. This acreage (if jurisdictional) would be subtracted from the total mitigation acreages provided by this plan.

4. **Present and Proposed Uses of Adjacent Areas:** The adjacent areas to the Cowboy and Hump reservoir sites are also Federal rangeland with similar characteristics.

In the vicinity of Hump reservoir, there are other reservoirs on different side drainages 1/2 mile upstream to north, and 1/2 mile to the northeast. There are other smaller dams that would provide water to livestock along the stream. The current grazing system for Hump is from May 15 to November 30, using a 3-pasture systems. Two of these pastures are grazed by sheep in the area of the reservoir, and a third pasture farther away grazed by cattle.

In the vicinity of Cowboy reservoir, there is an upstream reservoir located in a different pasture in another side-drainage. The nearest water within the pasture containing Cowboy reservoir would be in the creek itself. Water is available to livestock in pools that hold water during the dry season along the creek system. Current grazing system is also 3-pasture deferred system, used May 1 to November 30, and grazed by cattle.

Both sites are within 3/4 mile of Dry Fork Road, a road constructed by BLM to provide access to these grazing allotments. No transmission lines exist in the vicinity.

5. **Schedule for Implementation and Completion:** Construction of these two reservoirs would take place concurrent with the initiation of filling activities (following any required archeologist clearance).

6. **General Planning and Engineering Requirements:** The overall objectives of these two projects are to create an additional 13.15 acres of wetland and 6.44 acres of non-wetland waters to replace values lost or degraded as a result of impacts that occurred as a result of alleged past impacts or those that would occur as a result of the proposed alternative.

Plans for construction of the two reservoirs showing topography are provided in Figures F-11 and F-12.

Cowboy reservoir specifications are as follows:

Storage: 45.5 acre feet of storage
Compacted earthfill: 14,097 cubic yards of compacted earthfill placement
Excavation: 850 cubic yards
Drainage area: 260 acres
Runoff: 28 acre feet
Top elevation: 89.0
Spill elevation: 85.0
Capacity at spill elevation: 45.5 acre feet
Slopes: Uphill: 3:1, Downhill: 2:1
Spillway Width: 40 feet
Spillway Slopes: 2:1

Hump reservoir specifications are as follows:

Storage: 67.1 acre feet of storage
Compacted earthfill: 16,327 cubic yards of compacted earthfill placement
Excavation: 600 cubic yards
Drainage area: 480 acres
Runoff: 36 acre feet
Top elevation: 100.0
Spill elevation: 96.0
Capacity at spill elevation: 67.1 acre feet
Slopes: Uphill: 3:1, Downhill: 2:1
Spillway Width: 12 feet
Spillway: natural

Both reservoir sites would be seeded with a native seed mixture approved by the BLM and COE. Maintenance would be the responsibility of Zortman Mining Inc. for the approximate life of mine, 8 years. Fencing may be used if necessary to achieve success criteria. ZMI would enter into an agreement with BLM regarding long-term maintenance after success criteria has been achieved.

7. **Success Criteria**

The goals and success criteria for these projects are similar to those of the on-site mitigation reservoirs and are listed below.

Goal 1: To replace open water and wetlands habitat with off-site impoundments on BLM rangeland.

Success Criterion A: Create two impoundments (see Figures F-11 and F-12) with open water and wetlands along intermittent streams as follows: Hump reservoir - 12.74 acres, Cowboy reservoir - 6.85 acres, as designed, as measured by an as-built topographic survey.

Success Criterion B: Create these impoundments with a combined total of at least 19.59 acres of open water and wetlands by year 3, as measured by a formal wetland delineation, staking, subsequent professional survey, and documented by photographs.

Success Criterion C: Create these impoundments with areas of inundation as large as predicted, as measured by observations in relation to predicted water levels in March-June and documented by photographs.

Success Criterion D: Establish total vegetative cover at the mitigation site no less than 10 percent lower than existing cover and proportion of native herbaceous species at similar reference impoundments by year 5, as measured by ocular estimates of canopy cover at plots surveyed annually and photographed. The variance of the mitigation site data shall be within 20 percent of the variance of the reference area, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion E: If woody species are planted, achieve woody plant stem density no less than 20 percent lower than existing density at similar reference impoundments by year 5, as measured by stem counts within plots surveyed annually and photographed. The variance of stem density at the mitigation site shall be within 20 percent of the variance of the reference data, expressed as a percentage of the mean. The reference area(s) shall be unfenced prior to the time the mitigation sites are constructed, and fenced at the same time as the mitigation sites.

Success Criterion F: Provide habitat used by at least 10 species of native birds and mammals as measured by annual ground transect surveys in June and July.

Success Criterion G: Soil loss from erosion will be minimal, as evaluated by post-construction observations during other monitoring activities and documented by photographs.

8. **Monitoring Plan**

Hydrologic Monitoring

When construction of each impoundment is completed, the water level elevation expected in 60 years out of 100 shall be permanently marked with a metal post or gauge. Monthly qualitative evaluations during March-October will be made annually for at least the first 5 years and photographs taken which document water level in relation to the post.

Wetlands Monitoring

At year 3, a formal wetland delineation will be conducted at each constructed reservoir by qualified personnel in June. Wetland boundaries shall be staked and a professional survey conducted which shows the extent and acreage for wetlands and nonwetland waters.

Vegetation Monitoring

Vegetation will be monitored annually by qualified personnel for at least 3 years using U.S. Forest Service (1987) Ecodata methods at a series of randomly selected plots established at the created wetlands and at similar reference impoundments to be selected with agency input. A total of at least 20 permanent plots will be established at the newly constructed reservoirs, and an additional 20 plots will be established at existing, similar reference reservoirs. The variance of overall percent cover by morphological class and stem density at the created wetlands shall be within 20 percent of the variance (expressed as a percentage of the mean) observed at the reference sites. Surveys will be scheduled during the summer when vegetation development is at a maximum.

V. REPORTING

Annual monitoring reports would be prepared and submitted to the COE. A typical outline for a typical monitoring report is given below.

1. Title Page

2. Participants

   Names, titles, companies and qualifications of those conducting the monitoring and preparing the report.

3. Copy of COE permit, including special conditions and any letters of modification.

4. Introduction, describing the purpose of the document and a location map.

5. Methods, a detailed written description of monitoring methods used accompanied by maps which show the locations of all mitigation sites, permanent transects and observation points, and including a section on any contingency methods that were undertaken that year to remedy any problems observed during monitoring.

6. Results, organized by project/location (Ruby Gulch tailings removal, Ruby tributary reservoir creation, off-site reservoirs) and general category, with specific emphasis on comparing data achieved to the applicable success criterion:

   Post-construction as-built survey results

   Hydrology
   Wetlands
   Vegetation
   Wildlife
   Soils

The results sections will include text, tables showing data in relation to numerical success criteria if quantitative data are recorded (tables could be in an appendix and the results summarized in this section), maps, and photographs (which could also be in appendices). Copies of field data sheets from each year of study would also be included in an appendix.

7. Discussion, focusing on the overall trends observed (this section would be particularly important after year 1), relationship to success criteria, success of contingency methods employed

8. Conclusions and recommendations, which states which success criteria are being met and not being met and probable reasons why; recommended changes (if any) to success criteria, monitoring methods or intensity; and recommendations for cessation of monitoring if success criteria have been met.

Monitoring reports would be required until mining and reclamation are completed, and success criteria have been achieved for 3 consecutive years. An interagency meeting with the regulatory agencies and ZMI would be held annually for the first 5 years and after that as determined by the Agencies, to review the prior year's monitoring results and make any necessary adjustments.

VI. MITIGATION COMPLETION REPORTS

ZMI will submit a notice of mitigation completion for each project to COE, stipulating that final success criteria have been met, final figures and maps, and legible copies of all field and laboratory data sheets.

VII. CONTINGENCY MEASURES

This section describes the typical anticipated management activities, and identifies potential contingency measures that may also be necessary to facilitate achievement of success criteria.

Topography and Geomorphology

If as-built surveys indicate that topography, gradient, sinuosity of stream, stream geometry, and substrate as constructed either do not conform to the design or do not result in a geomporphically stable system, a plan for corrective action will be developed, submitted to the agencies for review, revised if necessary, and implemented as agreed upon.

Hydrology

If monitoring indicates that a constructed reservoir does not hold as much water as predicted during the months it is expected to be inundated (in relation to the rainfall that occurred), the reason for the shortfall shall be investigated. If leakage is the problem, the source of the leak will be removed, such as replacing part of the clay lining. If wetland hydrology is lacking at the reservoir fringe as a result of soil permeability, addition of a clay "hardpan" layer would be considered as a remedial method.

Wetlands

If the extent of wetlands at the fringes of the reservoirs and along Ruby Gulch is smaller than designed, the cause shall be investigated. The lack of hydrology is addressed above. A lack of vegetation would be the result of soil conditions, animal damage, or erosion and is addressed below.

Vegetation

Potential problems that would lead to a failure to achieve the vegetation success criteria include noxious weeds, low germination and/or growth and low cover and density, wildlife and livestock damage. Noxious weed control will stress mechanical or biological control in preference to chemical control, depending on site conditions and land ownership. Fencing would be used to control wildlife and livestock access to reduce damage. Fencing could be used to reduce livestock access to a part instead of the entire shoreline of each reservoir. Rock could be used to armor the access point and reduce compaction and increased turbidity.

At the Montana Gulch reservoir, fencing shall be 3-strand barbed wire with the bottom wire no lower than 16 inches above ground to allow wildlife access. The Ruby Creek tributary wetlands will be fenced with 4-strand barbed wire. The upper Goslin Gulch mitigation site will be fenced with 3-stranded barbed wire with the bottom wire no lower than 16 inches from the ground to allow wildlife access. The reservoirs shall be fenced a minimum of 5 years and a maximum of 10 years to insure site protection. If wildlife use appears to negatively affect revegetation success, site-specific control measures will be implemented, including but not limited to seedling protection caps, screens, or chemical repellents.

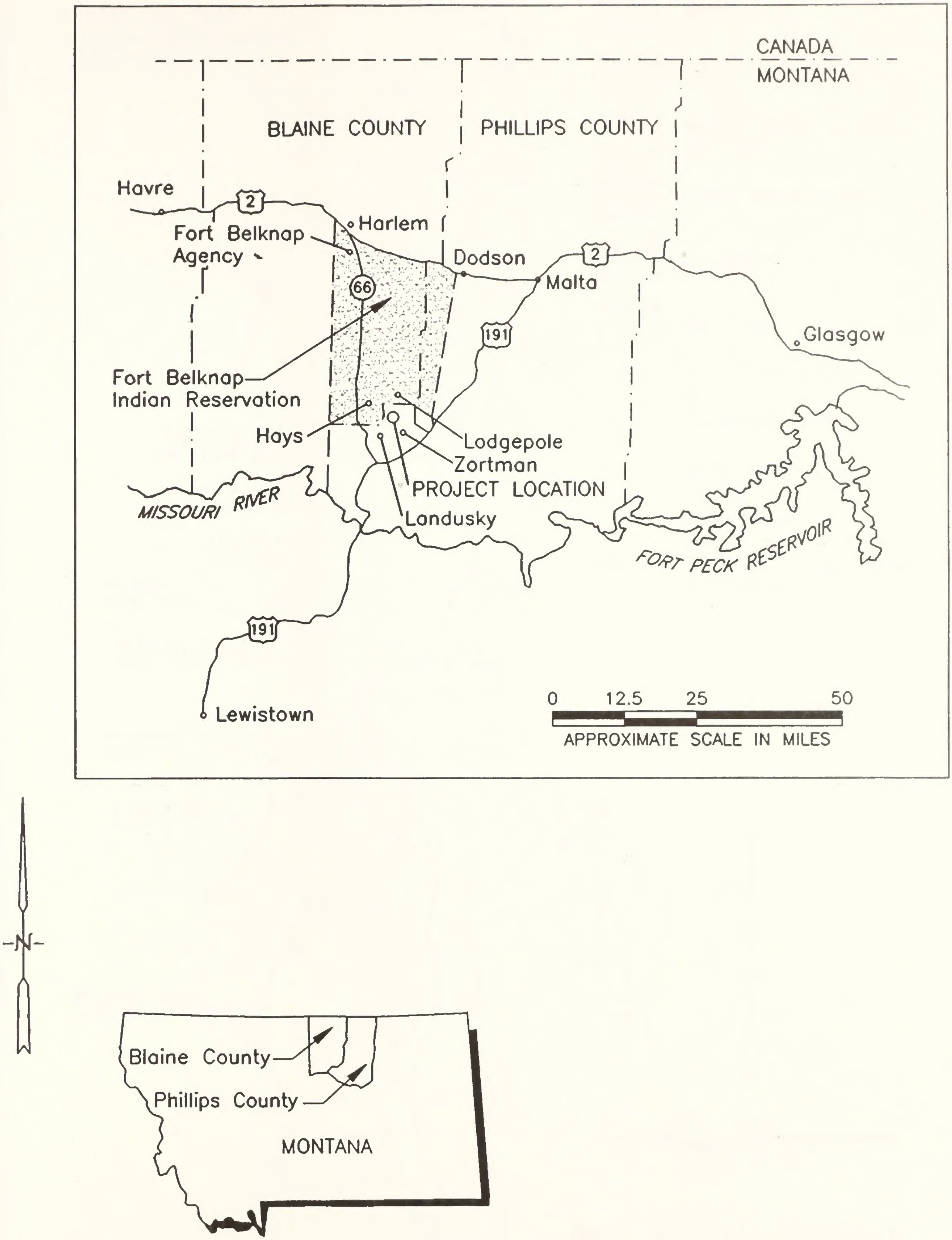
Wildlife

A lack of wildlife use would most probably be a result of a lack of suitable habitat structure and composition. Habitat improvement would result from the other remedial methods discussed in this section and there is probably no other contingency possible to establish wildlife use where it is lacking.

Soils

If rills or gullies form on graded slopes or channels, selective filling and/or erosion control procedures (erosion control mats or nets, mulch, straw bales, filter fences or slash filter windows) will be installed as necessary.

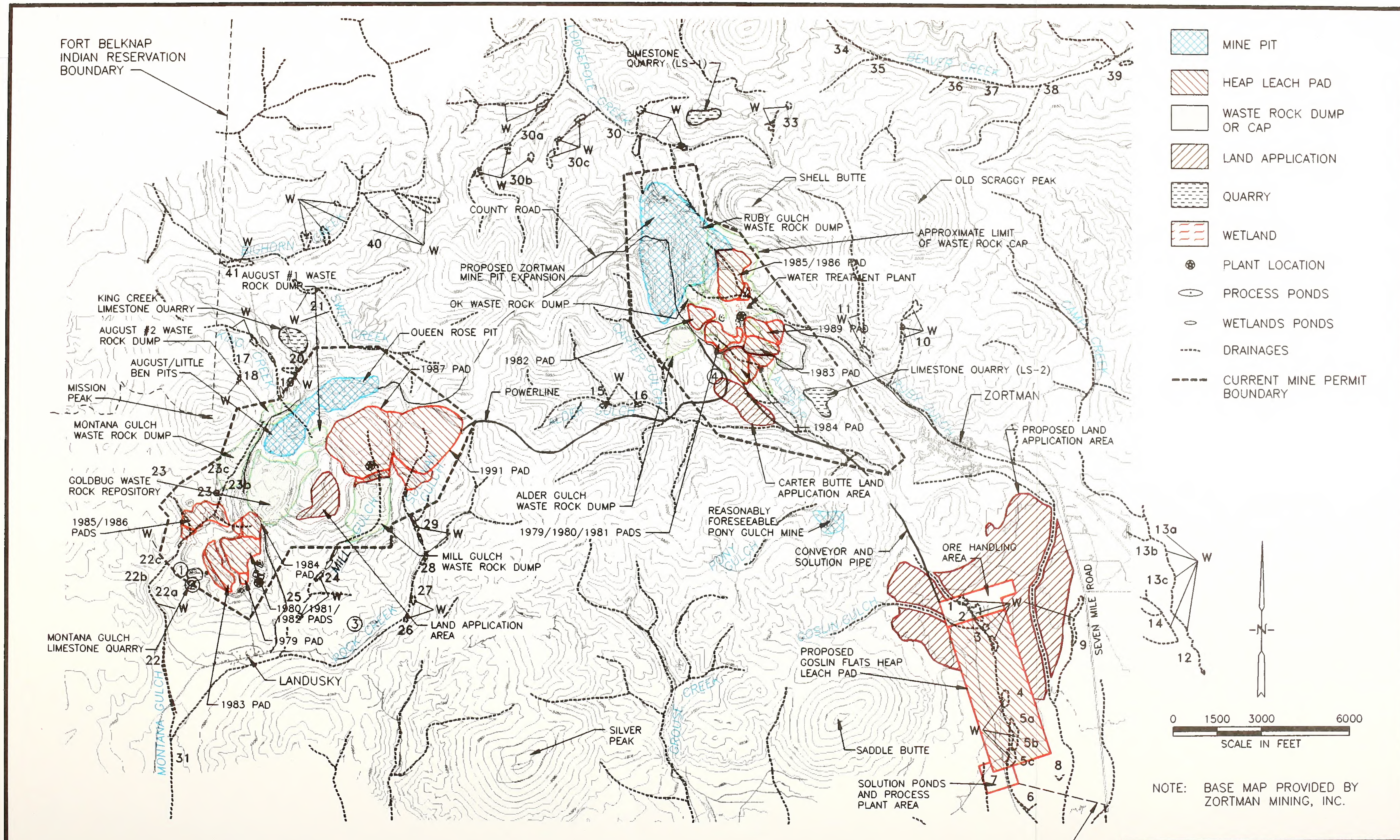
Specific remediation plans will be prepared for any site where problems develop.
These plans will be prepared in consultation with involved regulatory agencies.



SOURCE: DSL/BLM 1990.

LOCATION OF ZORTMAN
AND
LANDUSKY MINE EXPANSIONS

FIG. F-1



ALTERNATIVE 7
ZORTMAN-LANDUSKY EXISTING AND PROPOSED FACILITY LOCATIONS SHOWING WATERS OF THE U.S.

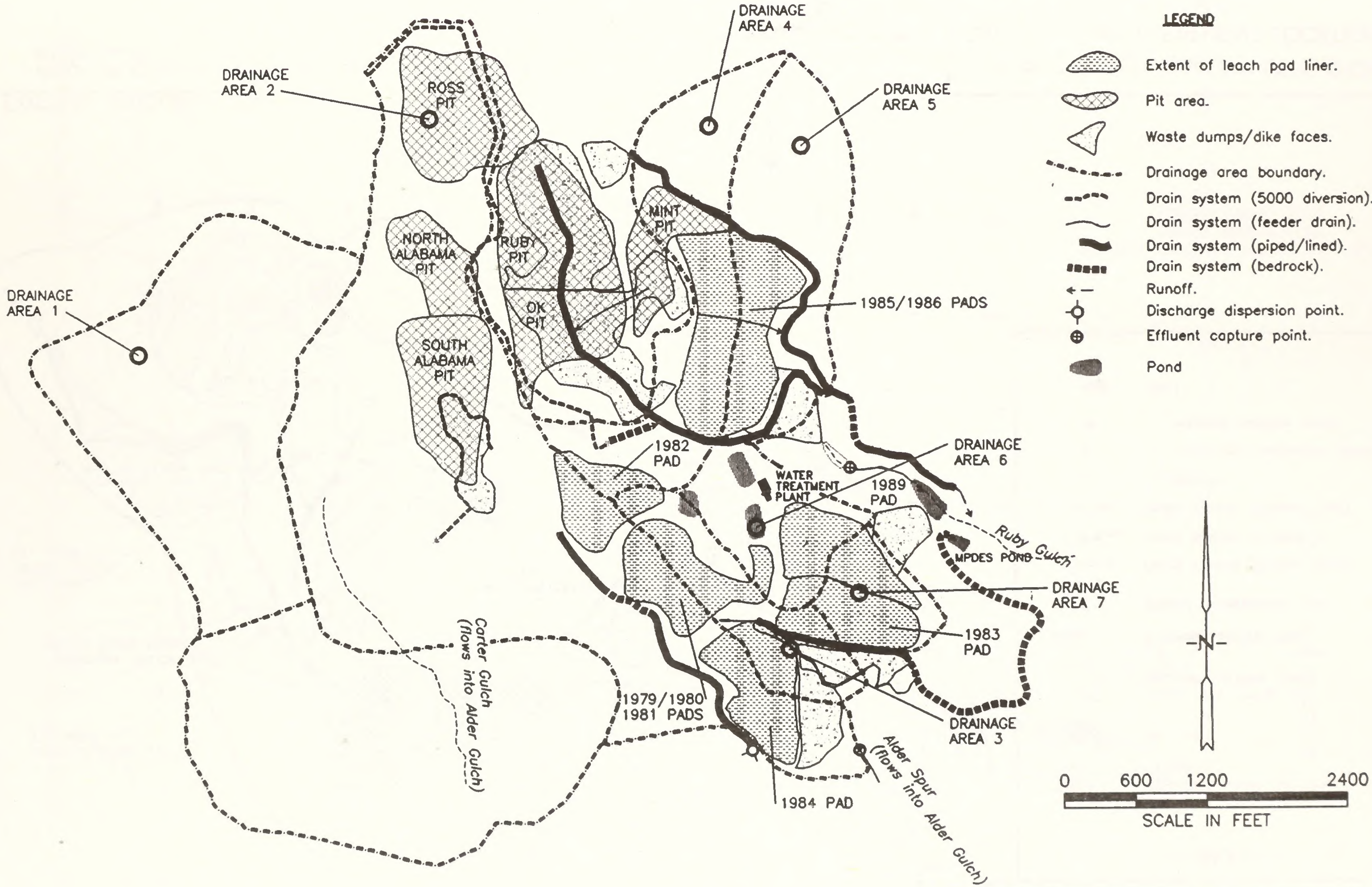
ZOR-WETI

FIG. F-2

JURISDICTIONAL WETLANDS
NON-WETLAND WATERS
ZORTMAN/LANDUSKY MINES

ZOR-JWET

FIG. F-3



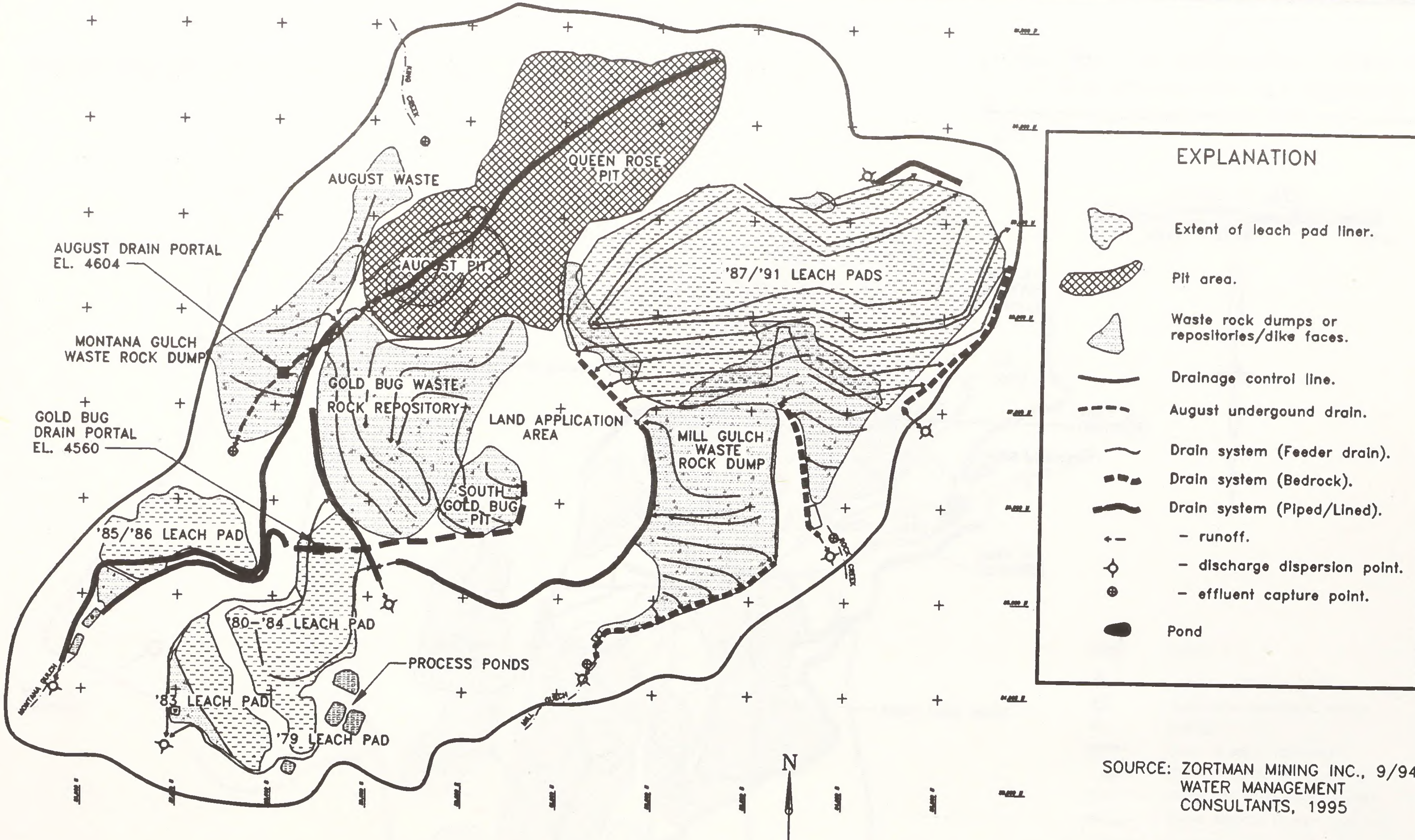
EXISTING ZORTMAN MINE DRAINAGE PLAN: INDICATES CURRENTLY PERMITTED EXISTING LOCATIONS FOR WATER HANDLING, CAPTURE AND TREATMENT FEATURES

SOURCE: ZORTMAN MINING INC., 10/94

ON-SITE WATER QUALITY MITIGATION CAPTURE AND TREATMENT LOCATIONS (ZORTMAN)

FIG. F-4

173E014A



SOURCE: ZORTMAN MINING INC., 9/94
WATER MANAGEMENT
CONSULTANTS, 1995

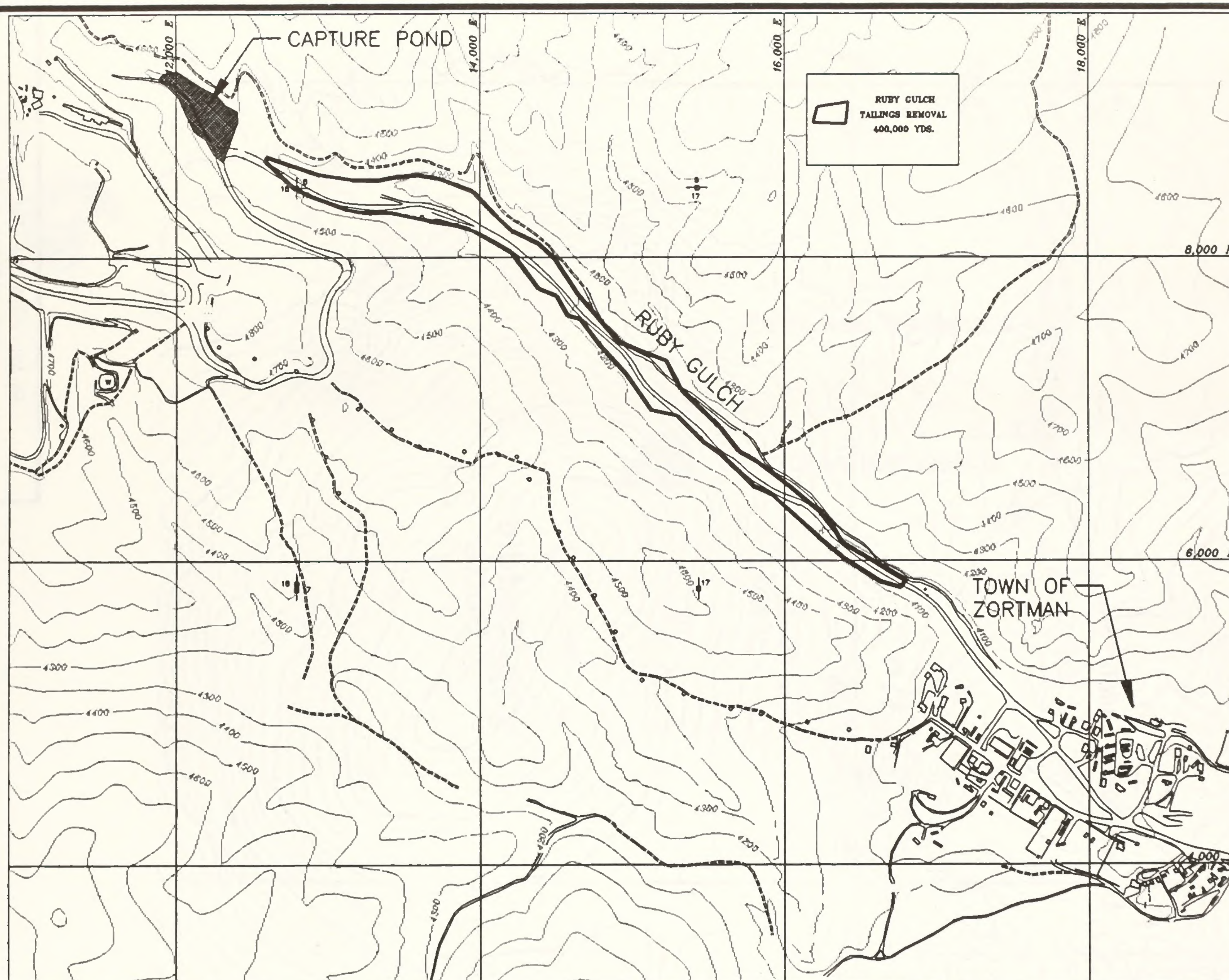
EXISTING LANDUSKY DRAINAGE PLAN:

INDICATES CURRENTLY PERMITTED EXISTING LOCATIONS FOR WATER HANDLING, CAPTURE AND TREATMENT FEATURES

ON-SITE WATER QUALITY MITIGATION CAPTURE AND TREATMENT LOCATIONS (LANDUSKY)

FIG. F-5

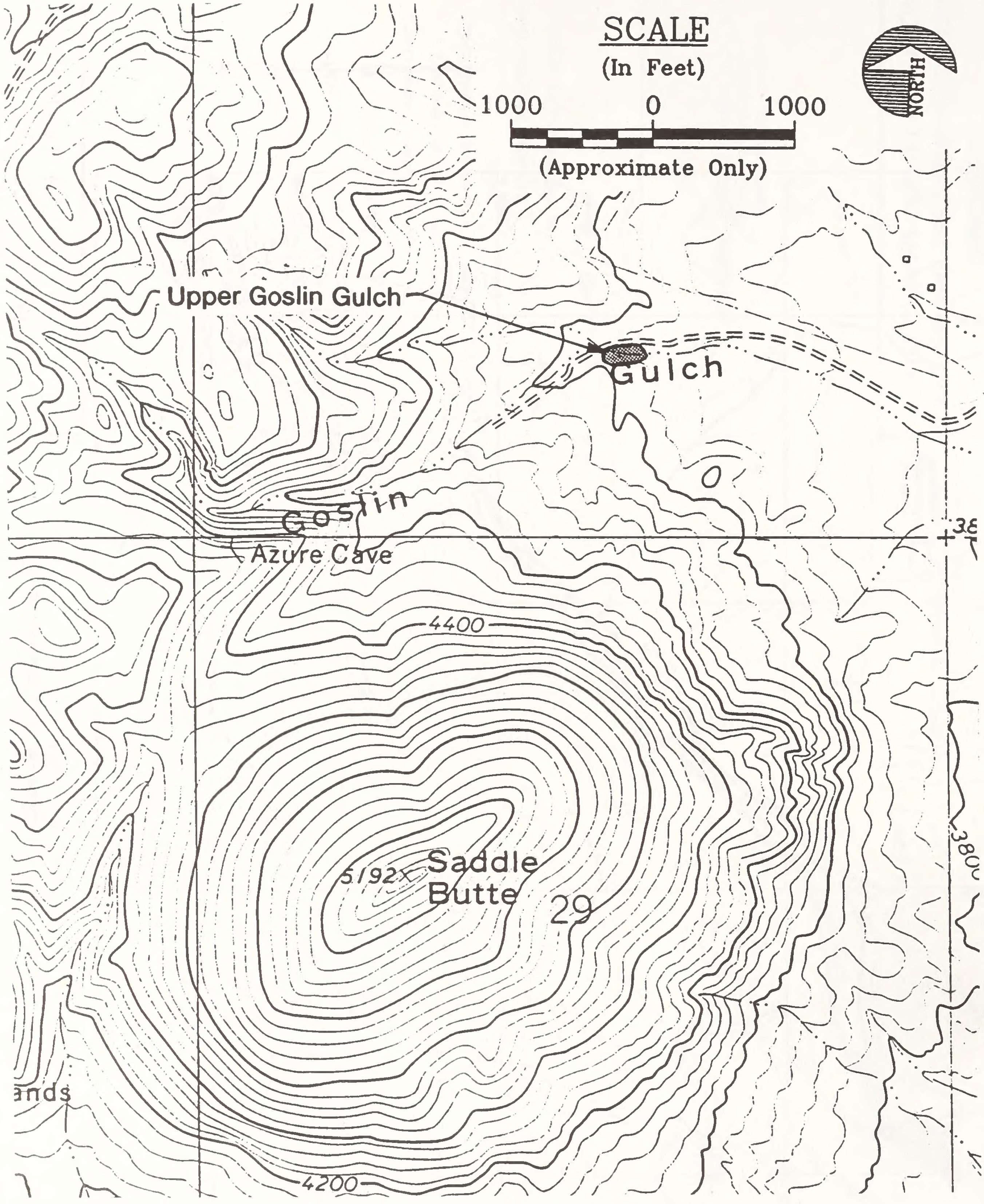
173E0012



RUBY GULCH TAILING REMOVAL/RESTORATION PROJECT

FIG. F–6

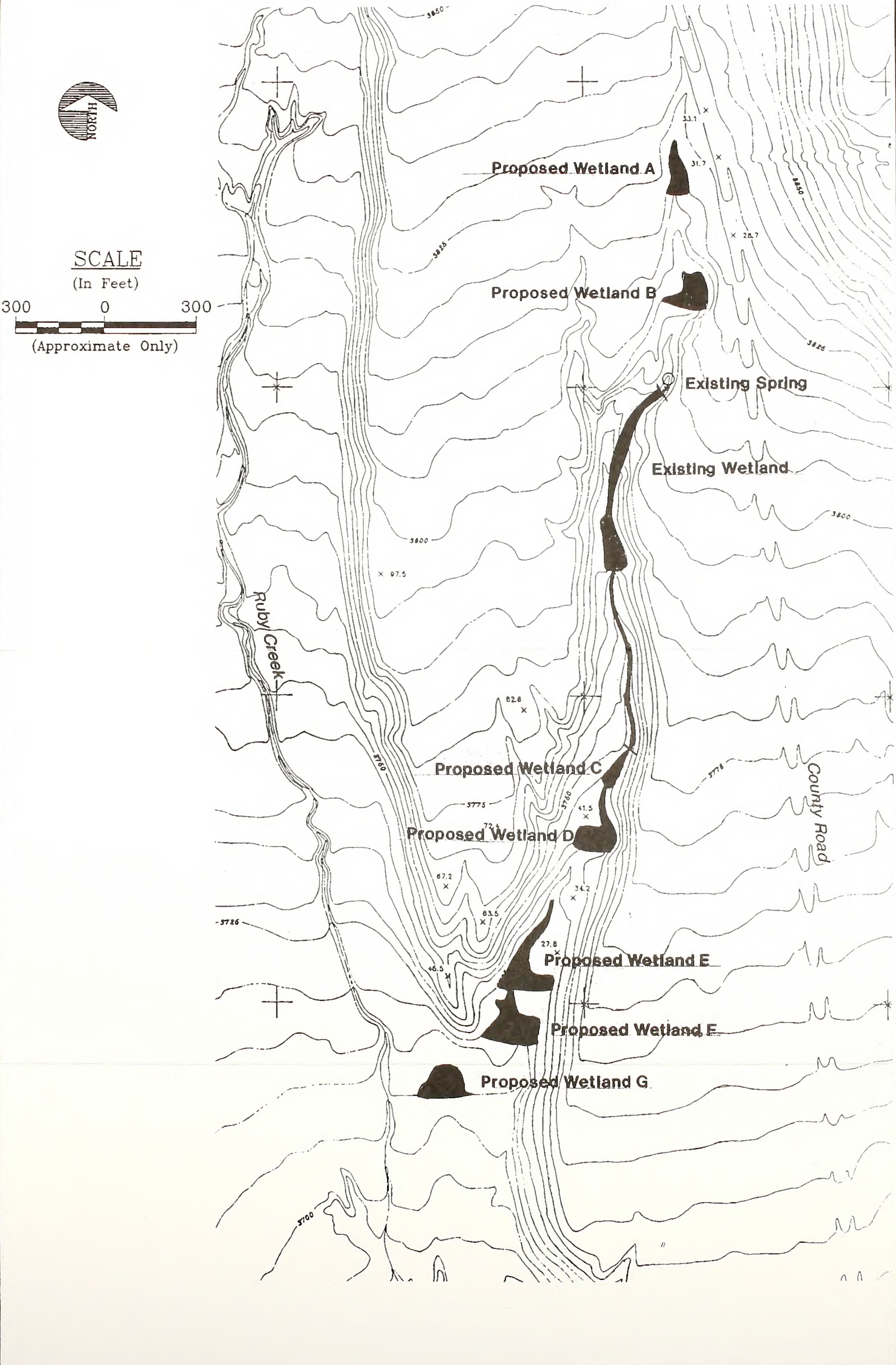
ZOR–F6



SOURCE: HYDROMETRICS, INC.

PLAN VIEW OF WETLANDS
MITIGATION SITE
UPPER GOSLIN GULCH
WETLAND MITIGATION SITE

FIG. F–7

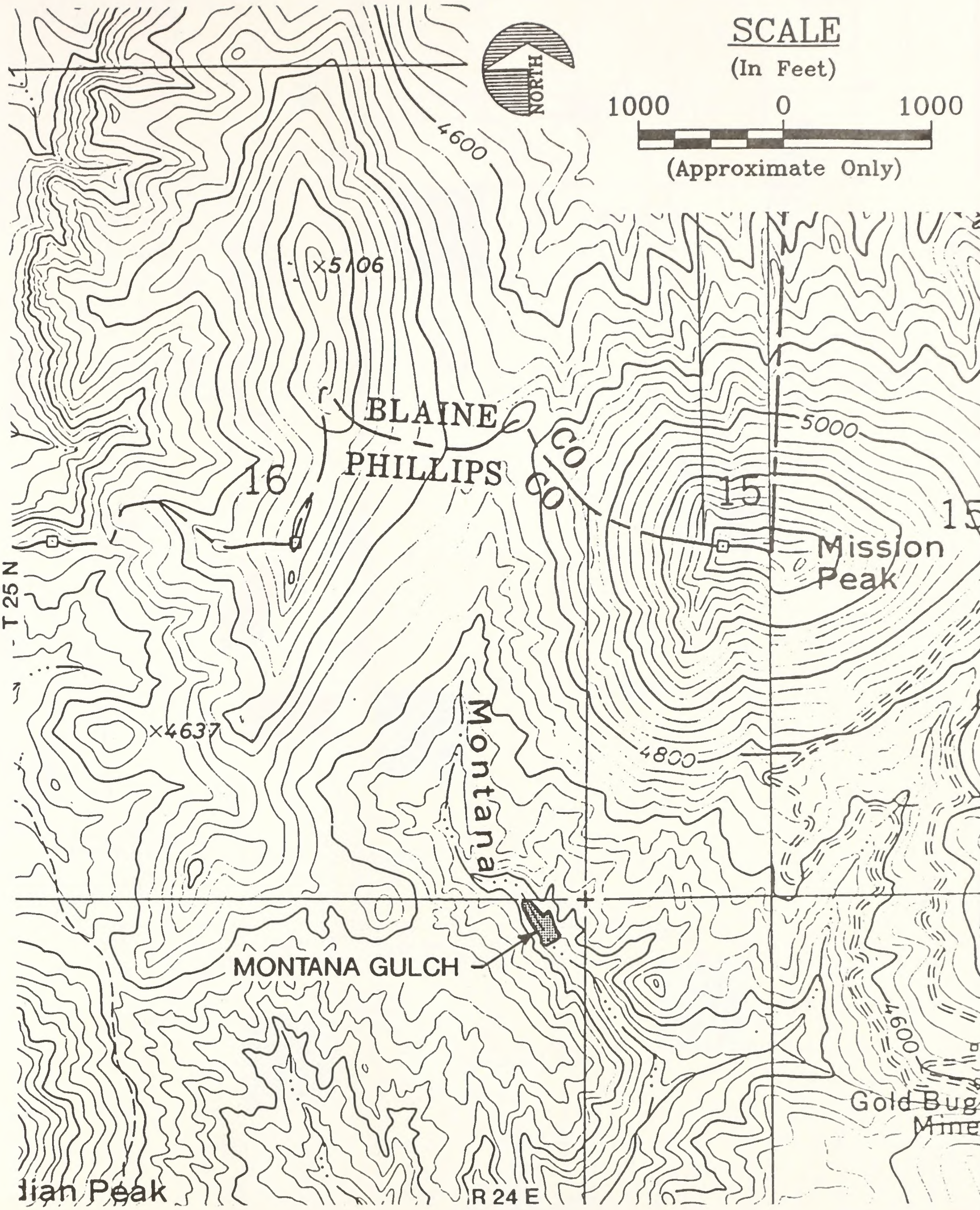


SOURCE: HYDROMETRICS, INC.

PLAN VIEW OF WETLANDS
MITIGATION SITE
RUBY CREEK TRIBUTARY
WETLAND MITIGATION SITE

ZOR-F8

FIG. F-8

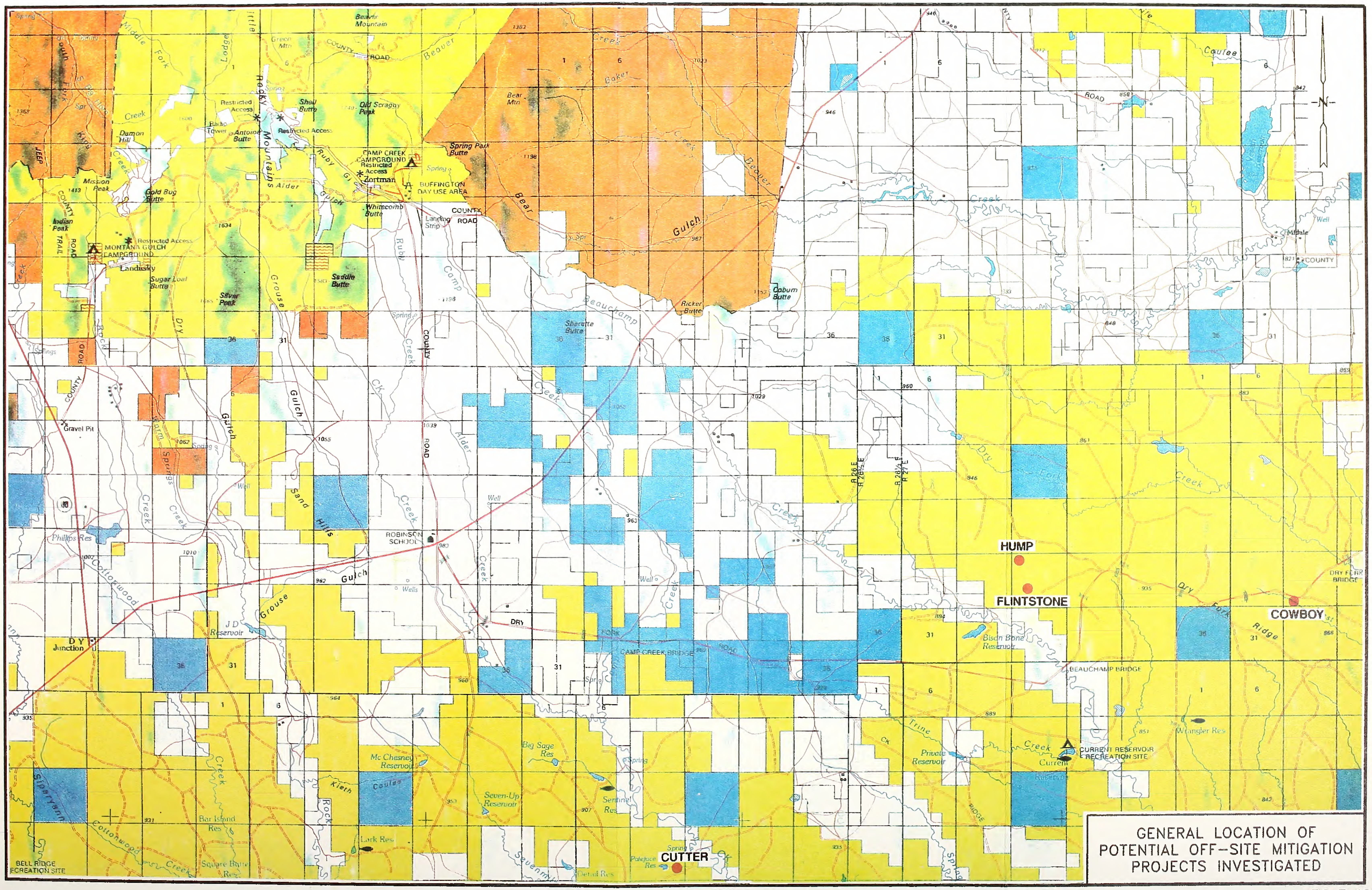


SOURCE: HYDROMETRICS, INC.

PLAN VIEW OF WETLANDS
MITIGATION SITE
MONTANA GULCH
WETLAND MITIGATION SITE

20R-F9

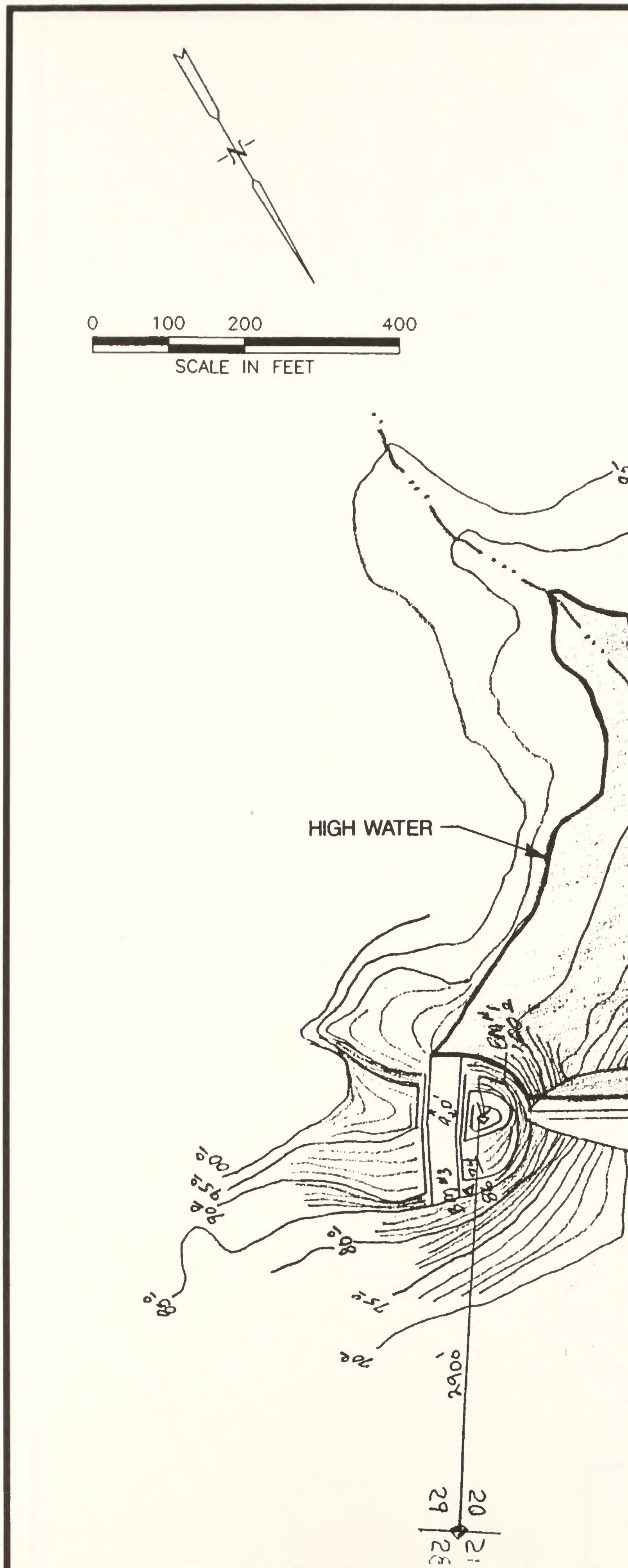
FIG. F-9



GENERAL LOCATION OF POTENTIAL OFF-SITE MITIGATION PROJECTS INVESTIGATED

FIG. F-10

ZOR-F10



COWBOY OFF-SITE
MITIGATION PLAN

FIG. F-11

HUMP OFF-SITE
MITIGATION PLAN

FIG. F-12

ZOR-F12

APPENDIX F

ATTACHMENT A
COE SPECIAL CONDITIONS/BMP'S

A. LIST OF SPECIAL CONDITIONS

1. That all construction debris will be disposed of on land in such a manner that it cannot enter a waterway or wetland.

2. That measures will be employed to prevent or control spilled petroleum products, chemicals, or other deleterious materials from entering the water and the permittee will formulate a contingency plan to be effective in the event of a spill.

3. That steps will be taken to prevent materials spilled or stored on shore from washing into the water as a result of cleanup activities, natural runoff, or flooding, and that, during construction, any materials which are accidentally spilled into the water will be retrieved.

4. That all work in the waterway is performed in such a manner so as to minimize increases in suspended solids and turbidity which may degrade water quality and damage aquatic life outside the immediate area of operation.

5. That only clean riprap materials will be utilized in order to avoid the percolation of fines which would result in excessive local turbidity.

6. That the clearing of vegetation will be limited to that which is absolutely necessary for construction of the project.

7. That close coordination will be maintained by the contractor with downstream water uses, advising them of any water quality changes to be caused by the construction. (Any fill in river or stream.)

8. That all earthwork and mining debris removal operations on shore will be carried out in such a manner that sediment runoff and soil erosion to the water are controlled.

9. That when the District Engineer has been notified that a (dredging) or (filling) activity is adversely affecting fish or wildlife resources or the harvest thereof and the District Engineer subsequently directs remedial measures, the permittee will comply with such directions as may be received to suspend or modify the activity to the extent necessary to mitigate or eliminate the adverse effect as required.

10. That fuel storage tanks above ground shall be diked or curbed or other suitable means provided to prevent the spread of liquids in case of leakage in the tanks or piping.

B. AFTER-THE-FACT
LIST OF SPECIAL CONDITIONS

1. That equipment for handling and conveying materials associated with the operation of this facility shall be operated to prevent dumping or spilling the materials into the waterway.

2. That equipment for handling and conveying materials during future work on this project shall be operated to prevent dumping or spilling the materials into the waterway except as approved herein.

3. That all areas along the bank disturbed or newly created as a direct result of the operation of the facility authorized herein, will be seeded with vegetation indigenous to the area for protection against subsequent erosion.

4. That the clearing of vegetation in conjunction with any future work associated with the activity authorized herein will be limited to that which is absolutely necessary and may be subject to prior approval.

5. That during future work on this project, the use of machinery in the waterway will be kept to a minimum.

6. That fuel storage tanks above ground shall be diked or curbed or other suitable means provided to prevent the spread of liquids in case of leakage in the tanks or piping. Such dike, curbed area, or device shall have a capacity of at least equal in volume to that of the tanks plus 10 percent.

7. That the permittee, upon receipt of a notice of revocation of this permit, shall, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the waterway to its former conditions. If the permittee fails to comply with the direction of the Secretary of the Army or his authorized representative, the Secretary or his designee may restore the waterway to its former condition, by contract or otherwise, and recover the cost thereof from the permittee.

8. The United States shall not be responsible for damage to property or injuries to persons which may arise from or be incident to the work herein authorized, and the permittee shall hold the United States harmless from any and all such claims, except to the extent that the damage or injury is caused solely by the negligence of the United States.

C. COE REGULATIONS (33 CFR 330.6)
(as applicable)

(a) In addition to the conditions specified in § 330.5 of this Part, the following management practices shall be followed to the maximum extent practicable in order to minimize the adverse effects of these discharges on the aquatic environment. Failure to comply with these practices may be cause for the district engineer to recommend or the division engineer to take discretionary authority to regulate the activity on an individual or regional basis pursuant to § 330.8 of this Part.

1. Discharges of dredged or fill material into waters of the United States shall be avoided or minimized through the use of other practical alternatives.

2. Discharges in spawning areas during spawning seasons shall be avoided.

3. Discharges shall not restrict or impede the movement of aquatic species indigenous to the waters or the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters).

4. If the discharge creates an impoundment of water, adverse impacts on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow shall be minimized.

5. Discharge to wetlands areas shall be avoided.

6. Heavy equipment working in wetlands shall be placed on mats.

7. Discharges into breeding areas for migratory waterfowl shall be avoided.

8. All temporary fills shall be removed in their entirety.

TABLE F-1
ALTERNATIVE 7:
SUMMARY OF DIRECT AND INDIRECT IMPACTS BY DRAINAGE WETLANDS AND NON-WETLAND WATERS

	EXISTING		PROPOSED	
	Drainage	Acre	Drainage	Acre
Direct Impacts - Wetlands			Goslin Gulch and tributaries	1.06
			Rock Creek	.03
				1.09
Indirect Impacts - Wetlands			Goslin Flats	**0.48**
Direct Impacts - Non-wetland Waters	Carter Gulch	0.12	Carter Gulch	0.07
	Alder Spur and tributaries	0.11	Alder Gulch and tributaries	0.20
	Ruby Gulch and tributaries	0.58	Alder Spur and tributaries	0.14
	Tributaries to Lodgepole Creek	0.03	Ruby Gulch and tributaries	0.81
	Montana Gulch with tributaries	0.75	Goslin Gulch and tributaries	2.28
	King Creek	0.35	Tributaries to Lodgepole Creek	0.06
	South End Drainages	0.06	King Creek	0.03
	North End Drainages (Swift Gulch)	0.21	Rock Creek tributaries	0.02
	Rock Creek Tributaries	0.35	Mill Gulch with tributaries	0.03
	Mill Gulch with tributaries	1.18		**3.64**
		3.73		
Indirect Impacts - Non-wetland Waters	Ruby Gulch and tributaries	2.41	Ruby Gulch tributaries	3.96
	Ruby Gulch below Z-1B	0.63	Goslin Flats	3.12
	King Creek below L-5	0.86	Antoine Spur	0.22
	Rock Creek to ZLW-12	0.24		**7.3**
	ZLW-12 to Mill Creek	2.64		
	Mill Creek to Montana Gulch	2.86		
	Montana Gulch to L-1	4.96		
		14.60		

APPENDIX G
HELP MODELING DOCUMENTATION

APPENDIX G - HELP MODELING DOCUMENTATION
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<u>LIST OF FIGURES</u>

1.0 INTRODUCTION

The purpose of this appendix is to provide information about the assumptions and input into the HELP model and about how the output was analyzed.

The objective of the HELP model phase of this study is to estimate the amount of precipitation that would infiltrate into mine waste under the various alternatives. These values are used to compare the effectiveness of the different caps and to obtain an estimate of the amount of surface water and ground water flow that would require capture and treatment.

The HELP model is a quasi-two-dimensional, gradually varying, deterministic, computer-based water budget model. It was developed by the U.S. Army Corps of Engineers Waterways Experiment Station for the U.S. EPA Office of Solid Waste with the purpose of performing water balance analyses for the design and evaluation of land disposal facilities. Development began in 1982 and version 3.04, which was used for this study, was released on April 10, 1995.

2.0 MODEL INPUT

2.1 Climatological Input

2.1.1 Climatological Input Independent of Design

The HELP model synthetic precipitation program was used to generate 20 years of daily precipitation, temperature and solar radiation for Havre, Montana, the location nearest the mine site for which the synthetic generation option was available. The input was augmented with data from the mine site to improve the statistical characteristics. Once generated, the same synthetic data were used for all modeling.

2.1.2 Climatological Inputs Dependent Upon Design

Evapotranspiration, the remaining climatological input, is comprised of two parameters: maximum leaf area index and evaporative zone depth. These two parameters are dependent upon design, and each varies as a function of specific design elements.

The HELP user's guide defines leaf area index (LAI) as the dimensionless ratio of the leaf area of actively transpiring vegetation to the nominal surface area of the land on which the vegetation is growing. This is equivalent to the product of the fraction of the ground covered by plants and the typical LAI of those plants. The fraction of the ground that is expected to be covered by plants, and the quality of that vegetation, was estimated for each alternative primarily from experience at other sites. The LAI for the expected quality of vegetation was interpolated by using guidance values listed in the user's guide for poor, fair, and good grass, as shown in Table G-1.

TABLE G-1. INTERPOLATION OF MAXIMUM LEAF AREA INDEX FOR EXPECTED VEGETATION

Stand of Grass In Help User's Guide	Maximum LAI (given & *interpolated*)	Type of Grass Expected
Poor	1.0	Poor
	1.5	
Fair	2.0	
	2.5	Fair/Good
	3.0	Good/Fair
Good	3.5	

With these interpolated maximum LAI values for the expected vegetation, and the estimation of the ground coverage, the effective maximum LAI for each alternative was computed as the product described above. Table G-2 shows the computation of effective maximum LAI for each alternative.

TABLE G-2. COMPUTATION OF EFFECTIVE MAXIMUM LAI's USED FOR HELP MODEL

Alternative and Name of Cover	Percent of Vegetative Cover (per DEQ/BLM)	X	Typical Maximum LAI for plants	÷ 100% =	Effective Maximum LAI (values used in HELP model runs)
Alternative 1	25		1		0.25
Alternative 2	35		2.5		0.88
Alternatives 3 and 7					
barrier	60		3		1.8
water balance	70		3		2.1
haul roads and NAG surfaces	50		3		0.75
pit benches	25		1		0.25
Alternatives 4 and 6	60		3		1.8

The other climatological input is the average evaporative zone depth (ET depth), the average depth to which evaporation (or evapotranspiration) has an effect. In this study, the ET depth is computed as an average of the evaporative zone depth for bare soil and the maximum expected rooting depth, weighted for the fraction of the surface covered with plants. The maximum evaporative depth for bare soil is 10.2 inches, which was determined with guidance from the HELP user's manual. The maximum rooting depth, which varies for each alternative, was dictated by the reclamation design.

The model limits the maximum ET depth to the thickness of the uppermost layer of soil. This limitation is only reasonable when the underlying layer inhibits the penetration of roots. Under alternatives where the underlying layer would be expected to allow for root penetration, the thickness of the uppermost layer was adjusted to equal that of the average rooting depth. This accompanied a commensurate reduction in the thickness of the underlying capillary break layer so that the total thickness of soil above the waste in the model equal to that in the design. Computation of the weighted average ET depth for the each alternative, and the instances where the uppermost layer was limiting, is illustrated in Table G-3.

TABLE G-3. EVAPORATIVE ZONE DEPTHS BY ALTERNATIVE AND COVER TYPE

Alternative and Name of Cover	Percent of Vegetative Cover	Maximum Rooting Depth	Weighted Average ET Depth	Modeled Average ET Depth
Alternative 1	25	8	not applicable	8.0
Alternative 2	35	8	not applicable	8.0
Alternative 3 and 7				
barrier	60	24	18.5	18.5
water balance	70	36	28.3	28.3
haul roads & NAG surfaces	50	18	14.1	14.1
pit benches	25	12	10.7	10.7
Alternative 4				
facility cover	60	24	18.5	18.5
Alternatives 5 and 6				
facility cover	60	24	18.5	18.5
Alternatives 4-6				
slope cover	60	24	18.5	18.5
Mill Gulch				
facility cover	60	24	18.5	18.5
slope cover	60	24	18.5	18.5

2.2 Design Input

2.2.1 Soil Characteristics

From top to bottom the facilities consist of an uppermost soil layer, ± a subsoil, ± a capillary break, ± a filter fabric, ± a geomembrane, ± a clay barrier, overlying waste.

Both the uppermost soil layer and the subsoil are designed to be a gravely loam, but because is not a USDA or USCS soil classification, HELP model does not contain this as a default soil texture. The default values for the closest approximation, a sandy loam, were used instead.

The capillary break is designed to be non-acid-generating waste with less than 0.2% total sulfur (NAG blue waste). The default values for gravel were used to approximate this.

The filter fabric was not included in the HELP model analysis. Because the filter fabric has a high hydraulic conductivity, the fact that there are no default values for filter fabric in the model, and because HELP does not consider sediment migration between layers, this simplification is warranted.

The synthetic liner is designed and modeled as either polyvinylchloride (PVC) or a geosynthetic clay liner (GCL), depending upon the alternative. The values used for PVC are taken from HELP default values, but because the HELP model does not have GCL as a default geotextile, its parameters were manually entered with information from the Bentomat Specification Guidelines (1993). The HELP model requires that the synthetic liner include information on pinhole density, installation quality, and defect density to account for manufacturing and installation defects. This study assumes that these parameters will fall within the range of good to fair. The HELP user's guide indicates that the pinhole density is typically 0.5 to 1 per acre, so this study used an average of 0.75. The installation quality was assumed to be good. For defect density, a value of 7 is used, which is the median value expected for the "fair" category.

In all cases the soil type for the clay barrier is both a USDA and USCS CL. Because of the impracticality of compacted clay liners for clay thicknesses less than 12 inches, (Richardson 1995), clay less than 12 inches thick is assumed to be uncompacted. For layer thickness 12 inches or greater, clay is assumed to be compacted. Under both circumstances HELP default values are used. Under alternatives where the clay layer is within the 3 foot depth expected to be affected by frost, it is expected that additional degradation will occur due to freeze-thaw cycles (Richardson 1995). This is accounted for by an increase in the hydraulic conductivity by a factor of 30, which is a reasonable value between the one and two orders of magnitude increase that Zimmie and La Plante (1990) demonstrate.

The values for the thickness and hydraulic characteristics of the repository waste and underlying layers are taken directly from previous Hydrometrics (1993) HELP modeling report on the Mill Gulch waste rock repository.

2.2.2 HELP Model Layer Types

The HELP model recognizes four types of layers: vertical percolation, lateral drainage, barrier soil, and geomembranes. The HELP model accepts them in limited patterns of arrangement. In practice it is expected that one soil layer may perform two of these functions or conversely, that two soils would perform the same function. For example, a capillary break gravel overlying a sloped geosynthetic clay liner would be expected to act as a lateral drainage layer in its lower reaches and as a vertical percolation layer above this. Conversely, topsoil and subsoil with the same soil texture could be expected to perform as a single vertical percolation layer.

In covers where no geosynthetic clay liner overlies the repository waste, the top six inches of repository waste are considered to be a barrier soil so that infiltration can be accurately calculated (see Figure G-1 of this appendix). Overlying any barrier soil or geomembrane is 4 inches of lateral drainage, the remaining thickness of the soil is considered to be vertical percolation. The lowermost 6 inches of waste are considered to be lateral drainage at a slope of six percent, the representative slope for all drainages. Figure G-1 illustrates how this is performed for the water balance cover.

2.2.3 Runoff Curve Number

The SCS runoff curve number was computer-calculated by the HELP program. HELP calculates this number according to slope, slope length, soil texture, and stand of grass. The slope varies between 2 percent and 50 percent, with a constant slope length of 200 feet (this length approximates both the length between pit benches and the length of a square acre with equal sides). The soil texture is always a sandy loam, which is the HELP model default soil texture that most closely approximates the gravely loam expected to be used as the uppermost layer of soil. The stand of grass is either good or fair, depending upon the amount of preparation the surface underlying the cap is expected to receive.

3.0 MODEL OUTPUT

3.1 Output Values

The HELP model output that was used for analysis is the average annual totals and standard deviations. Figure G-2 and Table G-4 show this output and how it varies with alternative type.

TABLE G-4. HELP MODEL OUTPUT

		HELP Model Output (percent of average annual precipitation)							
Alternative and		runoff		evapotranspiration		lateral drainage		infiltration	
Name of Cover	slope	mean	st. dev.	mean	st. dev.	mean	st. dev.	mean	st. dev.
Alternative 1	10	11.838	9.291	65.370	14.842	0.000	0.000	22.792	8.706
	50	11.918	9.265	65.373	14.835	0.000	0.000	22.709	8.653
Alternative 2	10	11.546	8.800	65.400	14.766	0.001	0.001	22.771	9.659
	50	11.581	9.357	65.420	14.789	0.000	0.000	22.716	9.658
Alternatives 3 and 7									
barrier	5	8.555	8.617	78.775	16.063	4.359	5.801	8.041	4.687
	20	8.587	8.616	78.954	15.976	5.091	6.556	7.097	3.915
water balance	33	7.676	8.303	81.821	15.179	0.000	0.000	10.503	4.581
haul roads & NAG surfaces	20	9.672	8.731	75.132	15.742			15.196	6.293
pit benches	5	10.814	8.961	70.570	15.483	0.000	0.000	18.254	7.277
Alternative 4									
facility cover	5	8.555	8.617	78.775	16.063	12.111	10.251	0.028	0.021
Alternatives 5 and 6									
facility cover	5	8.555	8.617	78.775	16.063	12.134	10.268	0.005	0.004
Alternatives 4-6									
slope cover	33	8.594	8.621	79.035	15.888	4.050	6.359	7.788	4.477
	50	8.602	8.628	79.128	15.867	3.767	6.265	7.968	4.593
Mill Gulch									
facility cover	2	8.581	8.610	78.772	16.057	12.465	10.017	0.132	0.097
slope cover	33	8.629	8.570	78.790	16.073	4.707	6.695	7.822	3.932
	50	8.638	8.563	78.798	16.070	4.990	6.886	7.523	3.724

3.2 Model Accuracy

The greatest strength of the HELP model is to show a relative comparison between different cover alternatives. Absolute values for water budget estimates, however, are subject to significant error because of the minimal data requirements needed to run the HELP model. Under ideal circumstances, the cumulative annual total for a water budget component can be estimated within the following error bounds: 25 percent of the total or 2 percent of the precipitation for the surface runoff component, 10 percent of the total or 7 percent of the precipitation for the evapotranspiration component, and 10 percent of the total or 0.1 percent of the precipitation for the percolation or leakage through liners component (Landreth, et al. 1991).

4.0 ANALYSIS

4.1 Assumptions

It is assumed that all soils, including the waste, are at field capacity. Therefore all precipitation that enters the waste through percolation should equal the drainage from the waste after a time-lag. Because this is a long-term analysis, the time-lag can be neglected. This simplifies to: *infiltration into waste = drainage from waste.*

4.2 Computation of Infiltration and Drainage

Infiltration (equivalent to drainage) is considered to be any precipitation that comes into contact with the waste. If a clay layer or geosynthetic clay liner overlies the waste, infiltration is obtained directly from the HELP model output as the amount of percolation through the barrier. If no barrier overlies the waste, infiltration is calculated indirectly as precipitation less the sum of evapotranspiration, runoff, and lateral drainage above the waste. The change in waste storage is non-zero when infiltration is taken to be percolation through the barrier, but by definition is equal to zero when infiltration is calculated by subtraction from 100%.

Figure G-3 shows a plot of precipitation, calculated infiltration and seepage from waste for the water balance cover for the first five years of operation. Although the pattern of discharge varies greatly from that for the seepage from waste, the cumulative totals are similar. For example, the cumulative calculated infiltration for the first 60 months is 12.96 inches, and the cumulative seepage from the waste is 11.10 inches. At 58 months, prior to the final precipitation event, the two cumulative totals differ by only 3.0 percent. This indicates that (1) the method for calculating infiltration is reasonable, and that (2) the assumption that infiltration equals drainage is also reasonable when considering the time-lag. The time-lag between infiltration and discharge is the result of water going into storage until the field capacity for the soil is reached. These conditions are expected during the period of the year when vegetation is dormant.

4.3 Water Budget Estimates

The volume of water drained from the waste (equal to the volume of infiltration) is computed as the product of the amount of infiltration into the waste and the areal extent of the facility. This is computed separately for the flat and steep portion of each facility. The summation of these volumes for all active facilities in each drainage gives the estimated volume of seepage through waste for each drainage. This volume is added to the expected groundwater seepage to give the total estimated flow requiring capture and treatment. The determination of these secondary components is explained below.

The total areal extent of each facility, and which facilities are active under each alternative, is found in Section 2.5.1 through the end of Chapter 2.0 of the EIS and is summarized in Table G-5. The proportion of each that is flat or steep was estimated by planimeter.

TABLE G-5. SUMMARY OF AREAL EXTENT OF FACILITIES BY DRAINAGE BASIN

Facility	Drainage	Total Area of Facility (acres)	Flat Area of Facility (acres)	Steep Area of Facility (acres)
ZORTMAN				
- 85/86 leach pad & dike	Ruby Gulch	33.7	4.5	29.2
- 89 leach pad & dike	Ruby Gulch	18.6	3.5	15.1
- Ruby Gulch waste rock dump	Ruby Gulch	9.4	2.8	6.6
- OK Pit waste dump	Ruby Gulch	8.0	2.4	5.6
- 82 leach pad (free draining)	Ruby Gulch	16.1	5.5	10.6
- 79/80/81 leach pad (free draining)	Ruby Gulch	18.7	1.8	16.9
- Alt. 7 waste rock repository	Ruby Gulch	155.1	3.6	151.5
- 84 leach pad & dike	Alder Spur	17.7	4.7	13.0
- 83 leach pad & dike	Alder Spur	10.9	2.6	8.3
- Alt. 7 waste rock repository	Alder Spur	94.9	6.1	88.8
- Alder Gulch leach pad	Alder Gulch	180	58.4	121.6
- Alder Gulch waste rock dump	Carter Gulch	16	3.9	12.1
- Carter Gulch waste rock repository	Carter Gulch	162	66.2	95.8
- Goslin Flats leach pad	Goslin Gulch	250	88.0	162.0
- Ruby Flats waste rock dump	Ruby Flats/			
LANDUSKY				
- 87/91 leach pad & dike 1-3	Mill Gulch	92.8	20.3	72.5
- Mill Gulch waste rock dump	Mill Gulch	70.0	11.7	58.3
- 79 leach pad (free draining)	Mill Gulch	7.0	4.8	2.2
- 80/81/82 leach pad (free draining)	Mill Gulch	25.5	13.1	12.4
- 87/91 leach pad & dike 1-3	Sullivan Creek	92.7	20.3	72.4
- Sullivan Park waste rock dump	Sullivan Creek	21.4	0.0	21.4
- Gold Bug Pit waste rock repository	Montana Gulch	86.4	39.5	46.9
- Montana Gulch waste rock dump	Mont. Gulch/King Creek	27.5	14.5	13.0
- 84 leach pad & dike	Montana Gulch	13.5	1.0	12.5
- 85/86 leach pad & dike	Montana Gulch	26.1	3.8	22.3
- 1983 leach pad & dike	Montana Gulch	22.0	11.1	10.9

The expected groundwater seepage for each drainage was determined by estimating the current groundwater seepage and adjusting this value for the reduction in recharge expected due to the capping of pits, haul roads, etc. The main component of this current groundwater seepage was determined by subtracting the modeled seepage through current facilities under unreclaimed non-perforated conditions from the measured seepage volume downstream of the facility.

5.0 SUMMARY

Input to the HELP model was taken directly from design. Parameters required for HELP that are not specifically stated in the EIS are arrived at systematically based upon known information. Further modification to account for model limitations were also undertaken.

The volume of effluent drained from the facilities was arrived at with a knowledge of the areal extent of each facility. Estimations were performed to account for the amount of flat and steep portions of the facilities and, in instances where a single facility covers multiple drainage basins, to account for the area in each basin.

The HELP model is best used for relative comparisons between alternative types. Errors in absolute values of output stem from the minimal amount of data required to run the model.

Copies of HELP input and output files and the spreadsheets on which seepage volumes were calculated are held on file by the Montana Department of Environmental Quality (DEQ) in Helena, Montana and the Bureau of Land Management (BLM) in Lewistown, Montana.

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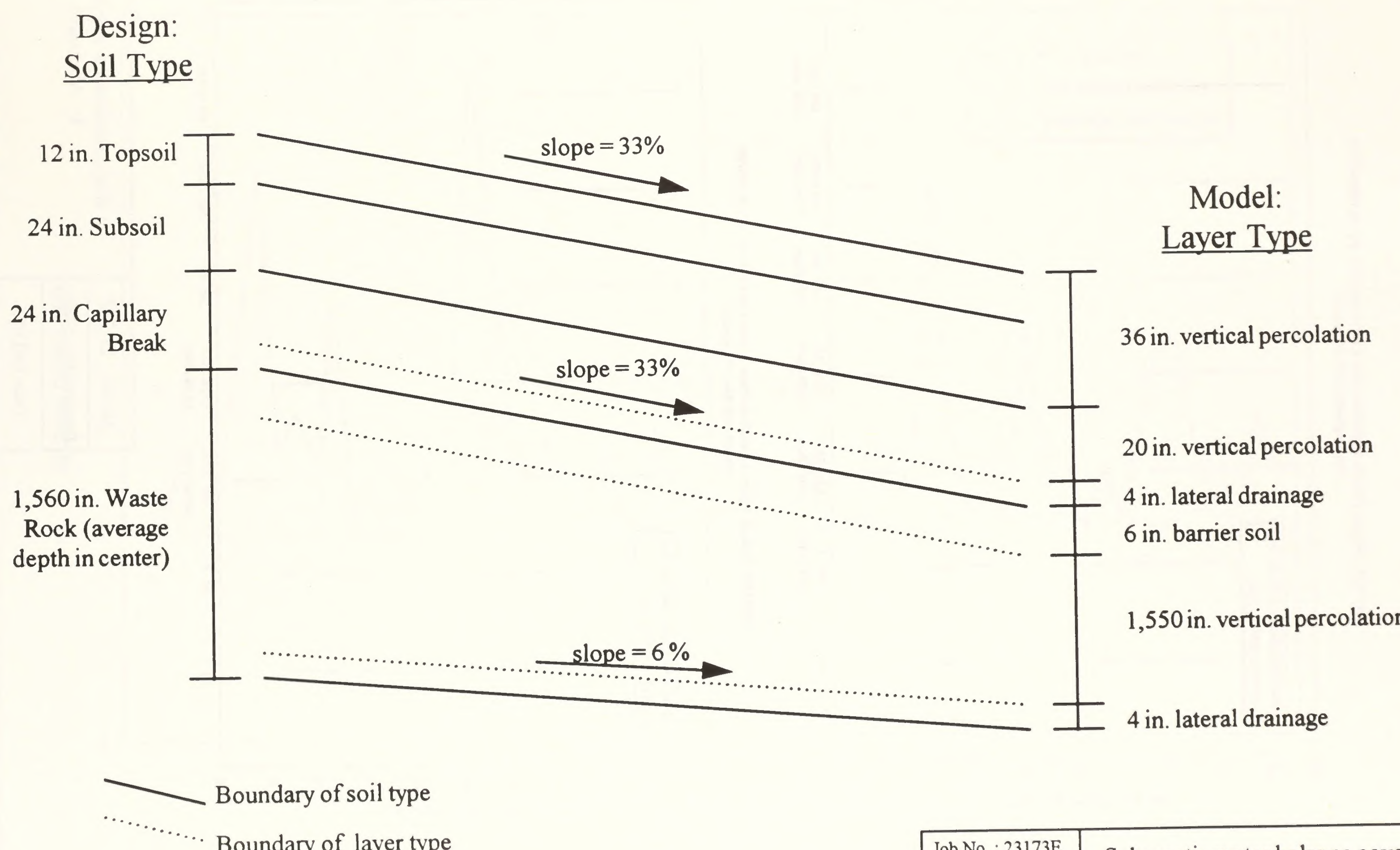
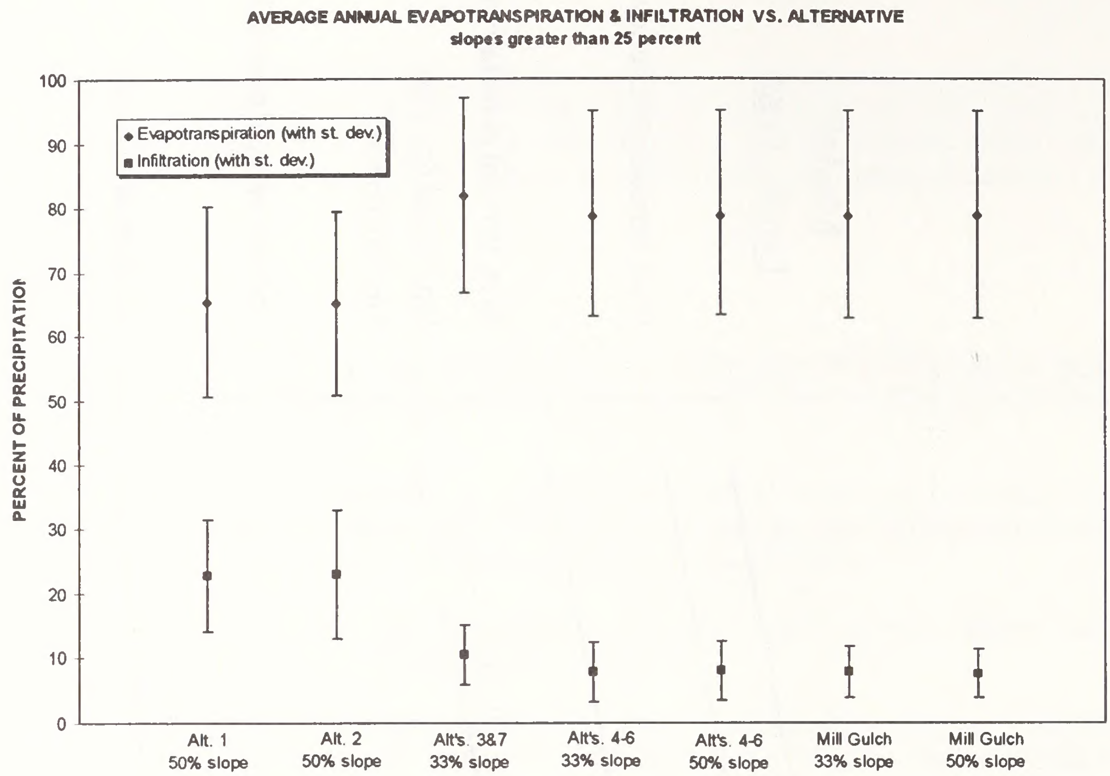
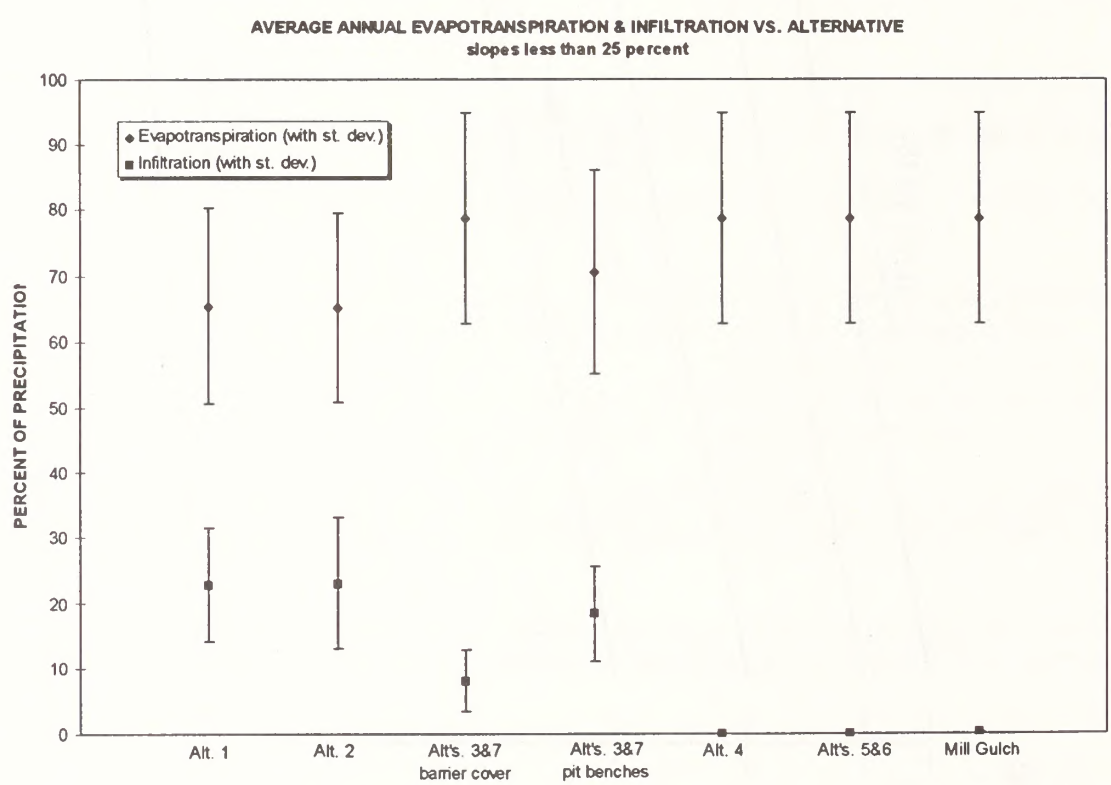


Job No. : 23173E	Schematic water balance cover (not to scale)
Prepared by : SMT	
Date: 10/23/95	

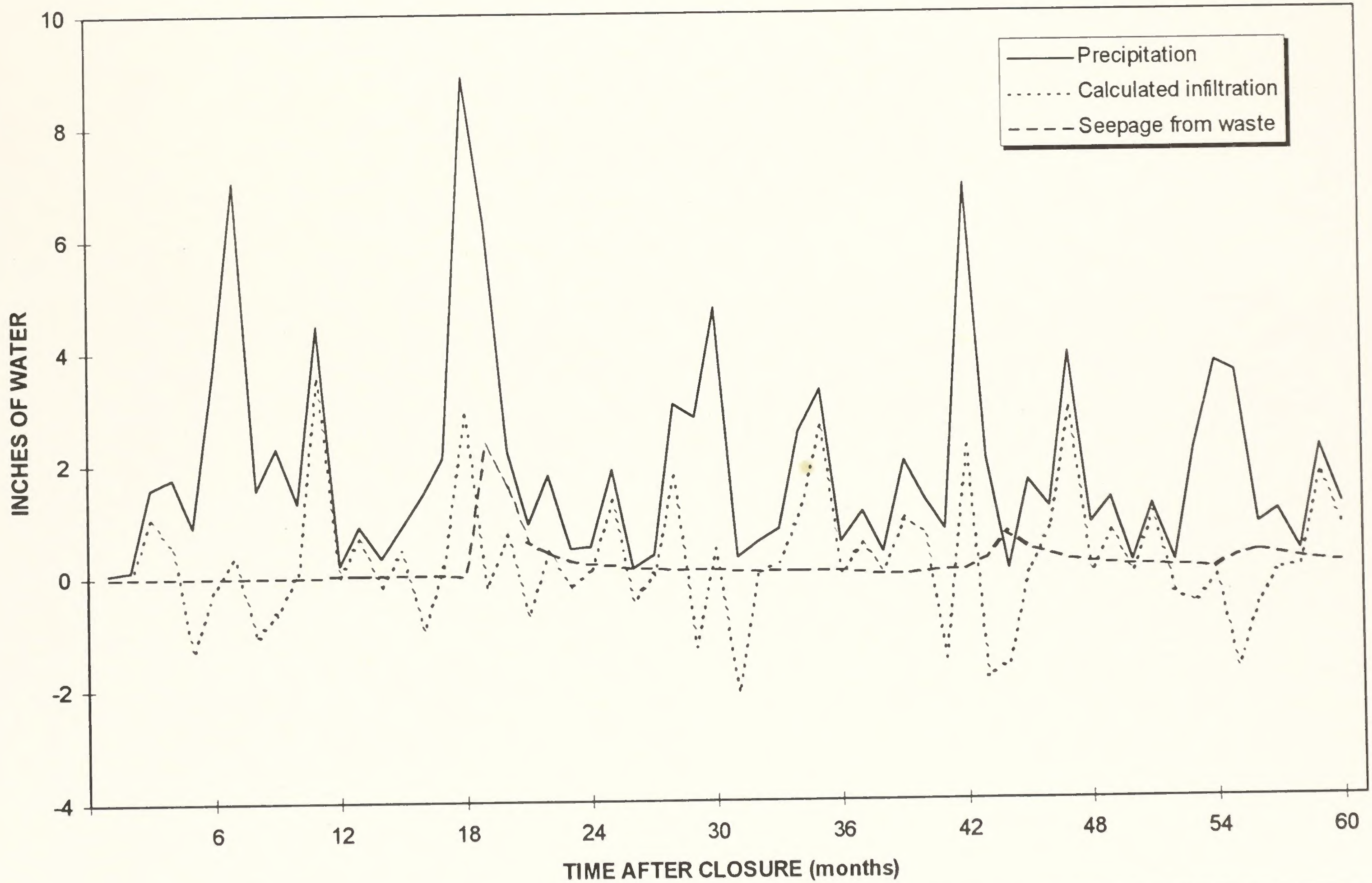
FIGURE G-1.





Job No. : 23173E	Evapotranspiration and Infiltration by Alternative
Prepared by : SMT	
Date: 10/23/95	

FIGURE G-2



Job No. : 23173E	Water Balance Cover: Precipitation, Calculated Infiltration, and Seepage Through Five Years After Closure
Prepared by : SMT	
Date: 10/23/95	

FIGURE G-3