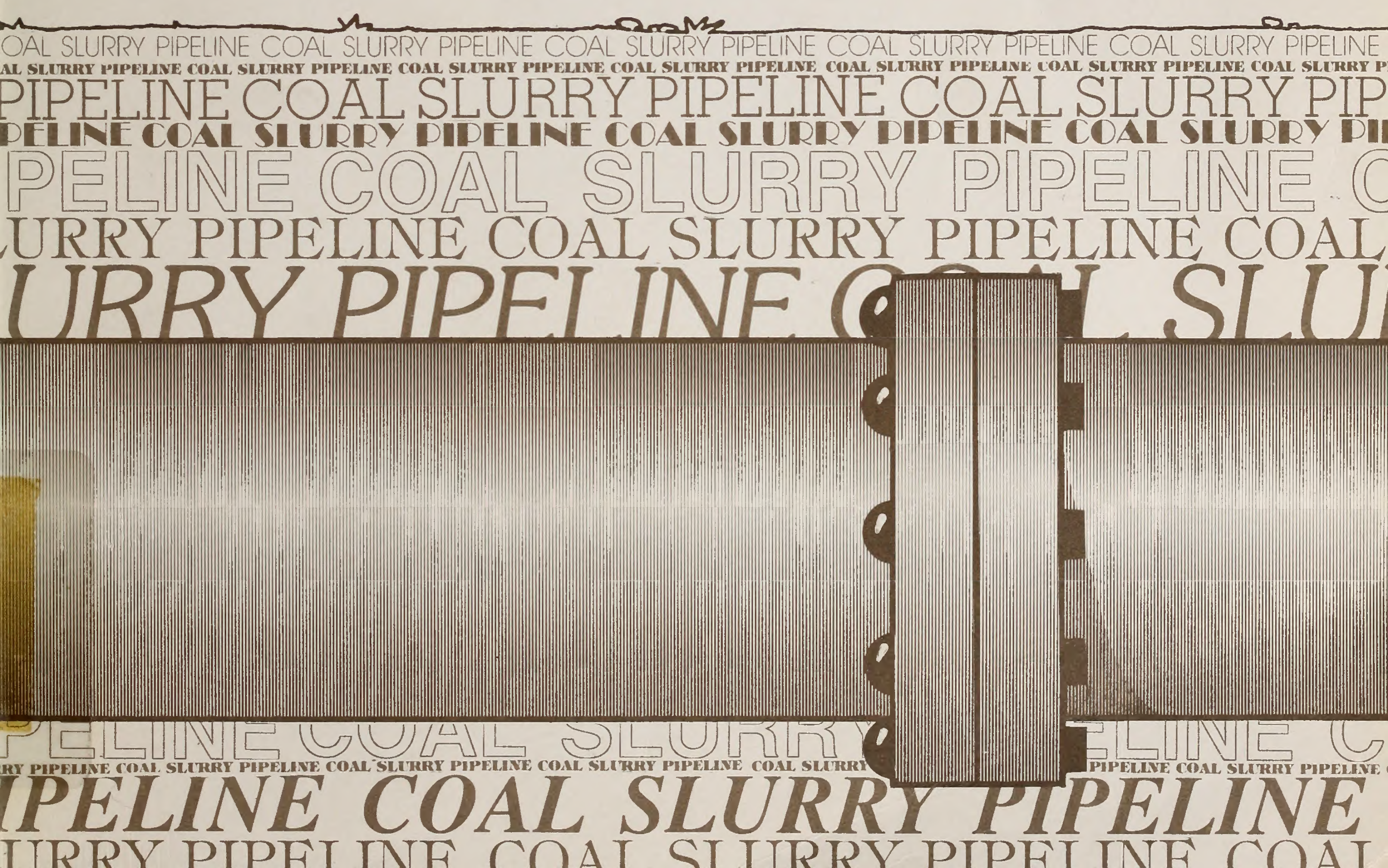
ENVIRONMENTAL IMPACT STATEMENT

ENERGY TRANSPORTATION SYSTEMS, INC.
BUREAU OF LAND MANAGEMENT

FINAL
VOLUME 1



United States Department of the Interior
BUREAU OF LAND MANAGEMENT
SPECIAL PROJECTS STAFF
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555 ZANG ST.
DENVER, COLORADO 80228

IN REPLY REFER TO:
1792(142)
ETSI

July 17, 1981

Dear Reader:

This is the final environmental impact statement (EIS) on the proposed Energy Transportation Systems Inc. (ETSI) coal slurry transportation project. The Draft EIS (INT. DEIS 80-69) was filed with the Environmental Protection Agency (EPA) on October 31, 1980. A Notice of Availability, which identified the public comment period and hearing locations, was published in the November 7, 1980, Federal Register (Vol. 45, No. 218, page 74074).

Because of the large volume of comments received and the types of revisions that were required, the entire text volume of the Draft EIS has been revised and reprinted as the Final EIS. However, the Map Volume, Appendix A of the Draft EIS, was not reprinted, because no major changes were required. Thus, the complete Final EIS document consists of two text volumes (Final Volume 1 and Final Volume 2) and Appendix A (published with the Draft EIS).

A copy of Final Volume 1 and 2 have been sent to all who provided substantive comments on the Draft EIS. A limited number of additional copies of the Final EIS are available from the Bureau of Land Management at the address shown at the top of this letter. Copies of the revised, final technical reports that support the data presented in the Final EIS and a limited number of copies of the Draft EIS can be obtained from that address, also.

Following publication of the Final EIS, a 30-day public comment period, July 17 to August 15, will follow. Concerns about the proposed action or any alternative included in the Final EIS should be directed to the ETSI EIS Project Leader at the above address. Comments must be received by August 17 in order to be considered in the Secretary's decision.

As required by Council on Environmental Quality (CEQ) regulations, no decision on the ETSI right-of-way application can be made for at least 30 days following the filing of the Final EIS. Therefore, a decision is not expected until early fall. A Record of Decision that outlines the decision and its rationale will be prepared and made available as soon as possible after a decision is made.

Sincerely yours,

Richard E Traylor

Richard E. Traylor
ETSI EIS Project Leader

DEPARTMENT OF THE INTERIOR

FINAL

ENVIRONMENTAL IMPACT STATEMENT

ON THE

ENERGY TRANSPORTATION SYSTEMS INC.

COAL SLURRY PIPELINE

TRANSPORTATION PROJECT

PREPARED BY

BUREAU OF LAND MANAGEMENT (LEAD AGENCY)

AND WOODWARD-CLYDE CONSULTANTS

July 1981

Robert F. Burford

DIRECTOR, BUREAU OF LAND MANAGEMENT

COVER SHEET

Energy Transportation Systems Inc.
Coal Slurry Pipeline Transportation Project
Environmental Impact Statement

( ) Draft (X) Final

Lead Agency

U.S. Department of Interior, Bureau of Land Management

Cooperating Agencies

U.S. Department of Interior, Fish and Wildlife Service
U.S. Department of Agriculture, Forest Service
U.S. Department of the Army, Corps of Engineers

States, Counties, Parishes, and Reservations That Could Be Affected

Arkansas	Louisiana	Nebraska	Kansas	Oklahoma
Crawford	Morehouse	Sioux	Decatur	Grant
Franklin	Ouachita	Dawes	Norton	Kay
Johnson	Caldwell	Box Butte	Graham	Noble
Pope	La Salle	Scotts Bluff	Trego	Pawnee
Conway	Grant	Morrill	Ellis	Osage
Van Buren	Rapides	Garden	Rush	Washington
Cleburne	Evangeline	Deuel	Barton	Rogers
Independence	Allen	Keith	Stafford	Mayes
Perry	Jefferson Davis	Perkins	Reno	Wagoner
Pulaski	Calcasieu	Chase	Kingman	Muskogee
Saline	Avoyelles	Hayes	Harper	Sequoyah
Jefferson	St. Landry	Hitchcock		
Cleveland	Pointe Coupee	Red Willow		
Bradley	W. Baton Rouge			
Ashley	Iberville			
	Ascension			
	St. James			

Wyoming	Colorado	South Dakota	Montana	Reservations
Campbell	Weld	Haakon	Big Horn	Pawnee
Weston	Logan	Lawrence	Rosebud	Osage
Converse	Washington	Meade	Powder River	Cherokee
Niobrara	Yuma	Pennington	Carter	
Goshen		Stanley		
Crook		Custer		
Laramie		Fall River		
		Harding		
		Butte		

Abstract

This EIS assesses the environmental consequences of the construction, operation, and maintenance of a proposed 1664-mile main coal slurry pipeline from Wyoming to Louisiana that proposes to use a well field constructed in Niobrara County, Wyoming, as its main water source. Alternatives assessed in detail are: two pipeline routes--a direct route serving an alternative set of markets and a Colorado route bypassing Nebraska; three transportation modes--slurry pipeline plus barge, all-railroad (no-action) and railroad plus barge (no-action); four water sources--Crook County well field in Wyoming, a combination water source involving well fields in both Niobrara and Crook counties in Wyoming, Oahe Reservoir in South Dakota, and treated wastewater collected by pipeline from ten locations in South Dakota. The proposed action is designed to provide an alternative mode of transportation for coal from the Powder River region of Wyoming to coal-fired generating plants that are existing, under construction, or planned in Oklahoma, Arkansas, and Louisiana.

The key issues raised in the scoping process and which this EIS focuses on are: hydrologic impacts of ground-water withdrawal, socioeconomic impacts of construction and operation, ruptures and spills impacts, and energy efficiency of this mode of transportation.

EIS Contact

Questions and comments on this EIS should be directed to:

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ERRATA SHEET

All references to Water and Power Resources Service (WPRS) should read Bureau of Reclamation. The name of this federal agency was changed too late to permit revision of the Final EIS text.

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PREFACE

The purpose of this environmental impact statement (EIS) is to present facts about the proposed Energy Transportation Systems Inc. (ETSI) coal slurry pipeline transportation project and alternatives to the proposal, and their environmental consequences, in sufficient detail to inform the public and to assist in decision making.

The draft environmental impact statement was revised on the basis of the comments received during the public review period, and the revised text volume (Volume 1) has been completely reprinted as the final environmental impact statement. Major revisions have been made in the following sections:

Water Resources	(Chapters 3,4, and 5)
Aquatic Biology	(Chapter 4)
Agriculture	(Chapter 4)
Energy Efficiency	(Chapter 2)
Slurry Pipeline Water Discharge Alternative	(Chapter 1)

In addition, two new water sources have been analyzed in the final environmental impact statement--a combination well field system involving pumping from two well fields (Niobrara County and Crook County, Wyoming) and a treated wastewater system in which wastewater from ten South Dakota locations would be collected by pipeline.

SUMMARY

Energy Transportation Systems Inc. (ETSI) has applied to the Bureau of Land Management (BLM) for a right-of-way permit to cross approximately 36 miles of federal land in Wyoming that would be needed to construct and operate an 1828-mile coal slurry transportation project. This project would transport coal from mines located near Gillette, Wyoming, to power plant customers in Oklahoma, Arkansas, and Louisiana. The coal would be crushed to a powder consistency, mixed with water to form the coal slurry, and pumped through a pipeline to a dewatering plant located at each power plant. The dewatering plants would remove the water from the coal slurry so that the coal could be used by the power plants.

The slurry transportation project would require a total of 20,500 acre-feet of water per year: 20,200 acre-feet from the Madison Formation and a total of 300 acre-feet from local wells at some pump stations along the route. The water from local wells would be used as evaporation makeup for the clean water storage ponds and for domestic purposes. ETSI proposes to obtain the Madison water from a well field that would be constructed in Niobrara County, Wyoming. Part of the 20,200 acre-feet could also be obtained from a reserve water source, a well field owned by the city of Gillette. As much as 20,000 acre-feet of this water would be mixed with coal to form the slurry and would be exported from Wyoming. The water would be used by the power plants as cooling-water makeup after being separated from the coal at the dewatering plants.

In addition to this proposed action, several alternatives were identified. The alternatives considered in this analysis can be grouped into three categories: system alternatives, component alternatives, and process variations. System alternatives included the no-action all-rail and no-action rail-barge alternatives (which are alternatve transportation modes), the market alternative, and the pipeline barge alternative. The component alternatives include route alternatives (Colorado alternative; Fort Smith route-variation) and water source alternatives (Crook County well field; combined well field; Oahe, including water purchase from South Dakota or Water and Power Resources Service; and treated wastewater). The process variations are coal cleaning and slurry pipeline water discharge.

The various component alternatives and process variations can be assembled into a wide range of system alternatives; for example, the Crook County well field, Colorado, and market alternatives could be combined to form a system alternative to the proposed action. The EIS analyzes the impacts of the component alternatives and process variations individually rather than combined as a total system to avoid confusion and duplication. However, it must be remembered that the final decision on the project will be a total system decision.

AREAS OF CONTROVERSY

In the scoping process conducted during the early stages of the environmental impact statement (EIS) development, several areas of controversy related to the proposed action were identified. Of major concern were the possible ground-water impacts to present and future users of Madison aquifer water. A related concern was the transportation of water from an area where readily available water is relatively scarce to an area where it is abundant.

The effect of pipeline ruptures and slurry spills on vegetation and wildlife habitat, especially near rivers, streams, or wetlands, was identified as another area requiring detailed analysis.

A number of issues related to a comparison of coal transportation by a slurry pipeline as opposed to a railroad system were identified: energy efficiency, loss and/or creation of jobs, and economic benefits of competitive coal transportation systems.

MAJOR IMPACT CONCLUSIONS

The major environmental impacts of the proposed action and alternatives discussed here are detailed in Chapters 4 and 5 of this EIS and are compared in Chapter 2. A summary of the impacts comparison is presented in Tables 2-3 and 2-4.

HYDROLOGY

The predicted impacts of withdrawing 20,200 acre-feet of water annually from the Madison aquifer over a 50-year period were calculated using a numerical model that contains estimates of aquifer system properties. Conclusive assessments of impacts can be made only when the effects of large-scale, long-term withdrawal are carefully observed and documented.

Wyoming state law and stipulations that authorize the withdrawal of Madison Formation water require that ETSI compensate any existing Wyoming water users that are affected by ETSI pumping (Appendices C-2, C-3). ETSI has offered this same type of protection to the state of South Dakota and the city of Edgemont, South Dakota (Appendicies C-7, C-8).

Niobrara County Well Field

The major environmental impact identified for the proposed action would result from pumping 20,200 acre-feet of water per year from the Madison Formation at the proposed Niobrara County well field. Pumping this volume of water for the 50-year project life would decrease the potentiometric (pressure) surface of the Madison aquifer within a region extending north, south, and east from the Niobrara County well field. This region would encompass the western half of Fall River and Custer counties, South Dakota; the northern part of Sioux and Dawes counties, Nebraska; and the eastern half of Niobrara County, the extreme southern part of Weston County, and the northeastern corner of Goshen County, Wyoming (Map 5-6).

The greatest drawdowns would occur at the well field, and drawdowns would decrease away from the well field. After 50 years of pumping, cumulative drawdowns (ETSI plus existing and proposed users) greater than 100 feet would occur in the Madison aquifer in an area greater than 3400 square miles in Niobrara and Goshen counties, Wyoming, and in Sioux and Fall River counties, South Dakota. Drawdowns greater than 200 feet would occur in an area of more than 2100 square miles in Niobrara, Sioux, and Fall River counties. Drawdowns greater than 400 feet would occur only within a radius of 15 miles north, south, and east of the Niobrara well field (Map 5-6).

These drawdowns would affect some existing Madison water users, primarily the city of Edgemont, South Dakota (Table 5-5). The city of Edgemont currently obtains its water supply from several free-flowing and pumped Madison wells with a present potentiometric surface about 200 feet above the ground. The hydrologic studies conducted indicate that after 50 years of pumping by ETSI, Edgemont is predicted to have to pump from below a depth of about 100 feet in order to obtain Madison water.

The predicted drawdowns would also affect ground-water discharge to several surface waters. After 50 years of pumping, the base flow of the Cheyenne River, Cascade Springs, and springs in the Hot Springs area of South Dakota would be reduced by 1 cubic foot per second (cfs), 4 cfs, and 2 cfs, respectively (Table 5-11).

Water levels in the Inyan Kara aquifer are also predicted to be affected of the pumping of Madison water from the Niobrara well field. After 50 years of pumping, Inyan Kara drawdowns greater 100 feet would occur in a 1600-square-mile area, and drawdowns greater than 200 feet in a 260-square-mile area (Map 5-6).

Niobrara County Well Field and Gillette Well Field

If part of the required water was purchased from the city of Gillette, Wyoming, to reduce the amount of water pumped from the Niobrara County well field, drawdowns at and near the Niobrara well field would be reduced. The area affected by the Niobrara well-field pumping would be similar to that described for pumping the total 20,200 acre-feet from Niobrara. However, drawdowns near the well field would be about 30 percent less (Table 5-6). In addition, drawdowns resulting from pumping from the Gillette well field would increase, extending over most of Crook County and over the northwestern part of Campbell County (Map 5-10).

Crook County Well Field

The withdrawal of 20,200 acre-feet of water per year from the Madison aquifer at the Crook County well field for the 50-year project life (cumulative case-ETSI plus existing and proposed users) would cause the Madison potentiometric surface to decrease more than 25 feet over a 23,600-square-mile area, including parts of Crook, Campbell, Johnson, Sheridan, and Weston counties in Wyoming; Carter, Powder River, and Rosebud counties in Montana; and Butte, Harding, and Lawrence counties in South Dakota (Map 5-14).

The greatest drawdowns would occur at the well field, and drawdowns would decrease away from the well field. After 50 years of pumping, drawdowns greater than 100 feet would occur in an area of more than 5200 square miles in Weston, Powder River, and Carter counties. Drawdowns greater than 200 feet would occur only within a radius of 10 miles from the Crook County well field (Map 5-14). These drawdowns would affect some existing Madison water users, primarily the Bell Creek oil field water wells in Montana, a well at Devils Tower National Monument, a well at Hulett, and the Gillette well field (Table 5-7). Flow may decrease from 1 to 4 cfs in some streams and springs that receive ground water from the Madison Formation (Table 5-13).

Pumping from the Crook County well field would also affect the Inyan Kara aquifer. After 50 year of pumping, cumulative impacts (ETSI plus existing and proposed users) are predicted to be greater than 25 feet of drawdown in a 7800-square-mile area, and greater than 100 feet in a 290-square-mile area (Map 5-14).

Crook County Well Field and Gillette Well Field

If part of the required water was purchased from the city of Gillette to reduce the amount of water pumped from the Crook County well field, the area affected would be somewhat smaller overall but would extend farther south than that described for pumping the total 20,200 acre-feet from Crook County (Map 5-18).

Combined Well Field

Use of the combined well field alternative (Niobrara County and Crook County well fields pumping 10,100 acre-feet each) would change the area of impact on the Madison and Inyan Kara aquifers. This combination is predicted to have the following cumulative impacts (ETSI plus existing and proposed users) at the end of 50 years: drawdowns greater than 25 feet over 18,400 square-miles of the Madison aquifer and 7800 square-miles of the Inyan Kara aquifer; drawdowns greater than 100 feet over 3700 square-miles of the Madison aquifer and 330 square-miles of the Inyan Kara; and drawdowns greater than 200 feet over 530 square-miles of the Madison aquifer (no area of the Inyan Kara would have this depth of drawdown) (Map 5-22).

The cumulative impact of the combined well field on stream and spring flow at the end of 50 years pumping would range from 1 to 4 cfs (Table 5-15).

Oahe Reservoir

There would be no ground-water or spring and stream flow impacts as a result of pumping water from the Oahe Reservoir.

Treated Wastewater

Use of treated wastewater from South Dakota would not cause any ground-water impacts. However, it would result in reduction of stream flows ranging from 1.3 cfs to 12.4 cfs in four different South Dakota streams.

SOCIOECONOMIC CONSIDERATIONS

Of greatest concern for all the pipeline systems (proposed action and market, Cypress Bend pipeline-barge, and Colorado alternatives) are the impacts that would be associated with the influx of construction workers to Campbell, Converse, Weston, and Niobrara counties in Wyoming. Construction of a slurry pipeline system would generate about 1624 additional jobs (direct and secondary) and bring over 2600 new people into the four-county area of Wyoming during the peak construction period (last quarter of 1984). These increases in population and employment would be absorbed in the overall growth of the area, with only minor impacts on the regional economy. There would be significant short-term impacts on some communities and counties within the region.

The influx of construction workers to the Niobrara County well field would significantly affect the economic and population base of Niobrara County, particularly the town of Lusk. Because the pipeline-related facilities would be located in the county but outside Lusk, the town would receive little of the increased tax revenue but much of the increased population. Fixed-site and pipeline construction workers would increase the town's population by 21 percent for a period of one to two years. Substantial short-term housing shortages are anticipated in Lusk as well as in the Gillette Planning Area, especially during the peak construction period of 1984.

Under the combined well field alternative, the impact on Lusk would be the same, but of much shorter duration, six months to a year.

No significant impacts are anticipated from the addition of about 243 permanent workers and their families to the affected Wyoming counties during the operation phase of the project. The addition of pipeline facilities for the proposed action or any of the pipeline alternatives would have beneficial effects on assessed valuations and property tax revenues in Converse and Weston counties, and a significant impact (52 percent increase) in Niobrara County. However, there would be a negative net fiscal impact on Campbell County, the city of Gillette, and the Campbell County school district (Table 4-10), with significant deficits projected for Gillette and the school district.

Given the fast pace, short duration, and geographically linear spacing of pipeline and pump station construction, and the existing capacities in the host counties and communities, no significant impacts would result from construction of facilities outside Wyoming for the proposed action or any of the pipeline alternatives. During operation there would be beneficial effects associated with increased revenues to counties and parishes. Generally, increases in annual county revenues would range from $70,000 (Norton, Kansas) to $1,190,000 (Morrill, Kansas) in 1980 dollars, and from a 2 percent increase over the 1976-77 property tax revenues (Reno, Kansas) to 144 percent (Sioux, Nebraska) (Table 4-13). The amount of revenue would vary with the portion of pipeline located within a given jurisdiction and the means by which a given state and county calculate taxes. The significance of the revenue increase would vary, depending on the size of the existing tax base and decisions on how to incorporate the new source of revenue into the county tax structure.

Dewatering plants would be built adjacent to power plants and within easy commuting distance of cities or large metropolitan areas that have an available local construction labor pool. Construction would take eight quarters and have a peak demand of 150 to 260 workers. Because of the moderate demand for construction labor and the availability of construction workers from local labor pools, construction of the dewatering plants would not be expected to cause substantial in-migration of construction workers or to stimulate significant secondary employment for any of the pipeline systems. Pipeline construction in the dewatering plant areas would not be expected to cause significant socioeconomic effects, either independently or in combination with the dewatering plants, with one exception. For the pipeline-barge alternative, construction of the dewatering plant and barge loading facility at Cypress Bend, Arkansas, would create a significant localized impact during the construction phase. The impact would be due to a peak population increase of 1593 for less than two years, which would affect housing and some public services in the towns of Arkansas City, McGehee, Dermott, and Dumas, Arkansas.

Operation rather than construction impacts would be of most concern for the no-action all-rail alternative. The movement of 37.4 million (short) tons of coal per year would result in increases in employment, rail accidents, and community disruption in towns along the railroad route. The no-action alternative would require approximately 5800 workers, including operation as well as maintenance and support personnel. Due to existing overemployment in some of the affected railroads and expected future gains in productivity, the number of new jobs that might be involved is unknown. Alliance, Nebraska, is the only town identified as likely to be significantly affected by an increase in population.

For the no-action all-rail alternative, it was shown that the shipment of 37.4 MMTA of coal via coal train would result in an expected 17 non-fatal casualities and 4 fatal casualties from grade crossing accidents per year along the proposed route. The all-rail alternative would account for an estimated 20 daily trains between Wyoming and Kansas City. The maximum number south of Kansas City would be 8 trains. This traffic would affect approximately 500 communities.

The impacts of the rail part of the rail-barge alternative would be similar to those identified for the all-rail alternative. The 2 to 3 barge tows per day that would be required for the barge part would not significantly increase traffic, congestion, or accidents on the Mississippi River and would not affect recreational use of the river.

RUPTURES AND SPILLS

The coal slurry pipeline would be designed and operated to specifications that would minimize the probability of a break or rupture in the pipeline. A break or rupture could occur and in the worst case could result in the release of up to 544,000 barrels of coal slurry into the environment, even though valves would be located at each pump station. However, the likelihood of such a spill occurring is remote. The spill volume could be reduced by prompt repair and possible plugging of the pipeline with coal as the line sections drain.

A coal slurry spill is not expected to result in any risk to the health or safety of any humans. Coal slurry, unlike other pipeline contents such as oil and gas, is nonexplosive, nonflammable, and essentially nontoxic, since nearly half of the slurry is water and coal is a relatively inert substance.

A spill would result in some environmental consequences, with the severity dependent on the spill location. Large-volume spills in small streams would result in the largest losses to fish and other aquatic life, as a result of smothering, clogging of gills, and other physical effects of high coal particle concentrations in the water column. Small-volume spills or spills in larger streams would result in the same type of effects but would cause more localized losses to aquatic organisms and short-term changes in the aquatic habitat, since the concentration of the coal slurry would be more quickly diluted to harmless levels.

One location on the Colorado alternative route is of major concern. A major spill at Deception Creek in Barton County, Kansas, could cause a reduction in suitable whooping crane habitat in Cheyenne Bottoms. The whooping crane is a federally listed endangered species. However, ETSI will be required to install valves or use best possible pipeline rupture technology for maximum protection of this area if this alternative is selected.

Spills on land would result in the loss of some small animals such as rodents. Such a spill is expected to have only a short-term effect, since the coal could be removed if necessary after the water has seeped into the ground or evaporated. Spills on wetlands would be more severe and could result in localized significant changes in the vegetation and wildlife habitat.

ENERGY EFFICIENCY

The amount of energy consumed during transportation of the coal would vary according to the mode of transportation (pipeline, rail, or barge) as well as the route and the source of water used to form the slurry. An energy analysis indicates the following efficiencies (arranged in descending order):

1. All-rail mode (no-action alternative); proposed action with combined well field alternative (650,000 Btu/ton)

2. Proposed action with water from the Niobrara County well field (665,000 Btu/ton)

3. Market alternative (663,000 to 726,000 Btu/ton, depending on water source)

4. Proposed action with water from the Crook County well field (672,000 Btu/ton)

5. Proposed action with treated wastewater alternative (679,000 Btu/ton)

6. Rail-barge mode (no-action alternative) (744,000 Btu/ton)

7. Cypress Bend pipeline-barge alternative (771,000 to 831,000 Btu/ton)

VEGETATION

While vegetation impacts would be locally significant during construction of any of the pipeline systems, actual impacts on vegetation would be generally insignificant and for the most part temporary with a successful reclamation program. The erosion control and revegetation plan outlined by ETSI (Appendix C-1) would be expected to ensure successful revegetation and reestablishment of grazing along any disturbed right-of-way acres (Appendix C-1, Development of the Erosion Control and Reclamation Procedures and Their Effectiveness section). A few small areas where adequate vegetation cannot be established and maintained would require continuing management and intensive erosion control measures. The acres of vegetation permanently removed by surface facilities would be small for any of the pipeline systems: 853 acres for the proposed action, 843 acres for the market alternative, and 818 acres for the Cypress Bend pipeline-barge alternative. Construction of the Colorado alternative pipeline segment would not change the acres of land permanently removed by any of the pipeline systems.

Because no new track construction would be required for the all-rail no-action alternative, vegetation would not be affected. The expansion of the barge loading facilities required for the rail barge alternative would remove an unknown number of acres from production.

Neither the proposed action nor any of the alternatives would affect any federal or state threatened or endangered plant species (FWS 1980a), except for the Colorado alternative. The Colorado butterfly-weed and the persistent sepal yellowcress could occur on the Colorado alternative route and are species currently under review for listing as threatened or endangered by the Fish and Wildlife Service. Once the precise locations of these plants are identified, the possible impacts and mitigation measures will be determined.

WILDLIFE

The most direct construction impact on wildlife would be the clearing of wildlife habitat from the pipeline right of-way and facility sites. Other construction impacts on wildlife include interruption of the habitat continuum and secondary impacts associated with human presence and activity.

For much of the vegetative habitat that would be affected, construction impacts would be temporary (less than 5 years). A temporary impact would exist for the pipeline right-of-way, since the presence of an underground pipeline would not preclude use by wildlife when vegetation is reestablished, except in the case of large trees growing directly over the pipeline, which would not be allowed to reestablish. However, because of the small number of trees potentially involved (1581 acres along 581 miles) relative to the number available in a given area, this loss of habitat would not be considered significant, except in some localized situations that may be identified (if the project is approved) when a staked line is established.

Concern has been expressed in South Dakota about the possible impact on wildlife resulting from reduction in spring and stream flow that may be caused by use of the Niobrara County or Crook County well fields. The lack of available specific data precludes developing quantified predictions of impact as a result of changed flows. Some impact may occur, but because of the adaptability of the species involved and the high rainfall experienced by the area, it is not felt that this would be a significant impact.

Several animal species of concern (classified as threatened or endangered by either the federal or a state government) are or could be found along the various pipeline routes (Table 4-17). Nine species could be affected by the proposed action, eight by the market alternative, ten by the Cypress Bend pipeline-barge alternative, and six by the Colorado alternative. One species could be affected by the Crook County alternative water supply system and five by the Oahe alternative. Species that could be affected by the treated wastewater alternative are undetermined as of this date. Based on a preliminary study of the area traversed by the wastewater collection system, it is felt that none would be impacted. If this alternative is selected a detailed analysis to determine if any species could be affected would be initiated. Potential impacts to these species would be minimized through compliance with regulations associated with their protected status.

Appendix D-4 outlines the procedures that would be followed to ensure that federally listed threatened and endangered species would be adequately protected. Three species from the FWS list of 13 that could occur along any of the pipeline routes have been determined by the FWS Biological Opinion (Appendix D-4) to be in a "may affect" category: black-footed ferret, red-cockaded woodpecker, bald eagle, and American alligator.

No significant impacts on wildlife would be expected from the no-action alternatives.

AQUATIC BIOLOGY

One of the major concerns associated with any of the pipeline systems would be the loss of benthic (river- or stream bottom) habitat and increased turbidity at stream crossings, and the effects of slurry spills. About 111 square yards of river or stream bottom and its complementary fish food potential would be temporarily lost during construction for each 10 feet of river crossed. These impacts would be expected to be localized, short-term, and of limited biological significance.

Increased turbidity levels would be anticipated to last for only a few hours after completion of construction and to affect a relatively small section of a river or stream within 1000 feet of the dredging activity. Fish would be expected to temporarily move to less turbid areas and would not be affected. Effects on less mobile species such as freshwater mussels would range from death to temporary weakening. However, these impacts would also be expected to be localized, short-term, and of limited biological significance.

Reduction in spring and stream flow in South Dakota as a result of use of Madison Formation water could significantly affect the aquatic resources of the Black Hills region. The magnitude of the impact cannot be determined with the available data.

Reduction of stream flow as a result of the removal of the treated wastewater is predicted to not significantly affect the aquatic resources of those streams (South Dakota Game and Fish 1981).

Impacts on aquatic species that would result from a slurry spill are summarized under Ruptures and Spills, above. No significant impacts on aquatic species would be expected from the no-action alternatives.

CULTURAL RESOURCES

The magnitude of impact resulting from construction of any of the pipeline systems cannot be determined until a site-specific inventory and evaluation is conducted for areas delineated by the appropriate State Historic Preservation Officers. However, because of mitigation procedures outlined in a Memorandum of Agreement between the Bureau of Land Management, the Advisory Council on Historic Preservation, and the appropriate State Historic Preservation Officers (Appendix D-3), impacts are not expected to be significant.

No impacts on cultural resources would be expected from the all-rail no-action alternative, because no new rights-of-way would be required. Expansion of barge loading facilities, the only construction required for the railroad-barge no-action alternative, could cause significant impacts if any cultural sites are present.

AGRICULTURE

Construction impacts along any of the pipeline rights-of-way would be generally insignificant and temporary. Successful restoration of cropland areas and revegetation of native rangeland areas would be expected with implementation of ETSI's Erosion Control and Revegetation Plan (Appendix C-1). The primary agricultural concern associated with any of the pipeline systems would be long-term loss of crop production on prime or other important agricultural lands at surface facility sites. However, the impact of this potential crop production loss would be relatively minor from a regional standpoint for any of the pipeline systems, since it would range from 305 acres to 375 acres spread over 5 or 6 states. The largest potential loss of cropland at any one surface facility location would be 35 acres (pump station and dewatering plant), except for the Cypress Bend dewatering plant and barge loading facility, which would remove 205 acres.

An additional agricultural concern would be the long-term loss of grazing production at surface facility sites and reduction in grazing capacity in localized areas where right-of-way revegetation resulted in less vegetation density.

During project operation the primary agriculture concern is the potential impact on irrigated croplands as a result of possible reduction in spring, stream, and well flows. Without a specific case-by-case analysis, it is impossible to predict exact impacts that may occur on the agricultural sector. It is likely though that if the changes in flow rates do occur there could be some impact experienced by the agricultural sector.

There would be no agricultural impacts associated with the no-action alternatives.

AIR QUALITY

Construction of any of the pipeline systems would cause temporary increases in fugitive dust and gaseous pollutants but no significant impacts on air quality. The increases would not be expected to exceed federal secondary or state air quality standards. Operation of the preparation plants would lead to increases in pollutant concentrations, but these increases would not exceed any air quality standards.

Impacts from operation of coal unit trains would include coal dust blown off hopper cars and pollutant emissions from locomotive engines. Coal losses would be spread over the entire route, and violations of the total suspended solids standards would not be expected. Locomotive emissions would lead to temporary increases in ambient pollutant concentrations during every round trip. However, these short-term ambient concentrations would be expected to be below federal ambient air quality standards (OTA 1977).

RECREATION RESOURCES

For all pipelines, the increase in project-related newcomers to the Gillette, Wyoming, area during the construction period could cause an increase in local hunting activity, possibly impairing the quality of the hunting experience. The construction phase of pipeline activity would result in short-term (approximately 2 to 4 weeks) disruption to recreational resource experiences for use of state scenic rivers and rivers identified for possible future study by the Heritage Conservation and Recreation Service, Nationwide Rivers Inventory, Phase I program, state and national trails, National Natural Landmarks, and state parks and recreation areas (lying within 5 miles of the pipeline).

Temporary impacts to the Caney River and Illinois Bayou would be of concern for the market and Cypress Bend pipeline barge alternatives, because they are recognized as the most important recreation rivers in Kansas and Arkansas, respectively.

There would be no significant impact to recreation resources with either of the no-action alternatives.

TRANSPORTATION NETWORKS

It is not expected that any major traffic disruptions or roadway deteriorations would result from activities related to construction, operation, or maintenance of any of the pipeline systems. In most places construction would occur in rural areas and would last only a few days. Because there would be little traffic along the affected roadways, impacts would be considered insignificant. Assuming equipment movement near urban centers would be scheduled around prime commute hours, traffic disruptions would also be short-term and considered insignificant.

It is anticipated that pipeline-related construction would have no significant impacts on the railroads, because it is assumed that in gaining permission to cross railroad rights-of-way there would be agreement on the timing of construction activity to ensure no disruption in rail traffic.

The no-action alternatives would cause some transportation impacts, because approximately 500 communities could be affected by delays near at-grade crossings. The movement of 37.4 million tons of coal alone would not cause significant community disruption; however, considered with other rail traffic and expectations for growth in this traffic, it could cause significant disruption, especially in towns where public service facilities such as schools and hospitals are separated from residential areas by railroad tracks.

VISUAL RESOURCES

For the pipeline systems, surface disturbance and removal of vegetation during construction and the addition of structures would affect the visual character of some areas seen by the public. The effects would be considered significant at 36 locations along the proposed action route, 33 for the market alternative, and 23 for the Cypress Bend pipeline-barge alternative.

Increased train traffic through inhabited areas would detract from the visual character of these communities. Motion would not be a new element in the affected scene; rather, its frequency would increase. The no-action alternative would require an estimated 20 daily trains between Wyoming and Kansas City. The maximum required daily south of Kansas City would be 8 trains.

NOISE

Noise levels generated by the proposed action and alternatives were found to be insufficient to produce impacts, except for the no-action alternative. Noise levels resulting from railroad operation would range from 50 to 100 decibels (PMM 1977) depending on train speed and weight, numbers and types of locomotives, and track type. Where train noise levels would exceed EPA-suggested noise levels for protection of public health and safety (55 decibels), persons located closer than about 2000 feet from the tracks would be exposed to levels above this limit. Thus unit train operation would have a significant noise impact, but the number of people affected would depend on population distribution along the rail route.

WILDERNESS

No impacts on wilderness would result from construction or operation of the proposed action or alternatives, because no Bureau of Land Management Wilderness Study Areas, Forest Service Second Roadless Area Review and Evaluation areas, or state wilderness/natural areas would be affected.

GEOLOGY, SOILS, TOPOGRAPHY

The geology and topography would not be affected by the proposed action or any of the alternatives. Soils would be affected by construction activities associated with any of the pipeline systems. Major concerns would be disturbance of topsoil, soil compaction, alteration of soil profile along the excavated pipeline trench, and accelerated soil erosion. Impacts would be minimized or eliminated by implementation of reclamation procedures described in the Erosion Control and Revegetation Plan (Appendix C-1).

ISSUES TO BE RESOLVED

The decision maker must resolve two issues: (1) Is an additional mode of transportation for coal desirable? (2) If so, which of the available water sources for a coal slurry system would be preferable?

CHAPTER 1

PURPOSE, NEED, AND DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

1.A INTRODUCTION

Energy Transportation Systems Inc. (ETSI) proposes to construct a coal slurry pipeline transportation project. The complete transportation project would involve 1828 miles of water and coal slurry pipelines. The 1664-mile main slurry pipeline would carry a coal-water mixture, called a slurry, from the Powder River Basin of northeastern Wyoming to locations in Oklahoma, Arkansas, and Louisiana. Ultimately the coal would be dried for use in electric power generating plants. Construction is proposed to begin in 1983 and would continue in phases through 1989. Limited operation of the system would start in 1985. A project life of 50 years is planned.

In order to construct the pipeline, ETSI is required to obtain right-of-way permits to cross public land in Wyoming-6 miles of land administered by BLM and 27 miles within the Thunder Basin National Grassland administered by the Forest Service--as well as 18 miles of Indian-allotted land in Oklahoma. In addition, Section 404 (Clean Water Act) and Section 10 (River and Harbor Act) permits to cross certain rivers, streams, and wetlands are required by the U.S. Department of the Army, Corps of Engineers. Before decisions on any of these permit applications can be made, the environmental impacts of the proposed project must be assessed. The Bureau of Land Management (BLM) was assigned lead responsibility for the impact analysis, which is documented in this environmental impact statement (EIS).

In accordance with Council on Environmental Quality (CEQ) regulations, BLM involved the public in identifying significant issues and potential impacts of the proposed action that would be analyzed in the EIS. This was done through public scoping meetings held in various locations. The major issues identified were water, socioeconomics, energy efficiency, and ruptures or spills. (See Appendix B for a more detailed discussion of public involvement in the scoping process.) The EIS places the most emphasis on the impact analyses for these areas, because of the significance of their impacts. Analyses of impacts on vegetation, wildlife, aquatic biology, cultural resources, agriculture, air quality, recreation resources, transportation networks, wilderness, visual resources, geology, soils, and topography are also presented, although in less detail.

The coal slurry transportation project is considered as a new transportation mode, because Wyoming coal would be transported to southern markets regardless of whether the project is built (see Section 1.C). The EIS assesses impacts from the time the coal is delivered to the ETSI coal piles until it is delivered to the power plants. Because the proposed pipeline has not been staked, impacts along a 1-mile corridor of the route shown on the Appendix A maps are considered.

This chapter includes background on the ETSI proposal; the purpose and need for the proposed project; an overview of the proposed action and alternatives to the proposal; and a detailed description of the proposed action and alternatives, stressing impact-causing features. Information in this chapter has been summarized from the Project Description Technical Report (WCC 1981a), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228; telephone (303) 234-6737.

1.B BACKGROUND

ETSI, a joint venture of Bechtel Petroleum Inc., Lehman Brothers Kuhn Loeb, Kansas-Nebraska Natural Gas Co., Texas Eastern Slurry Transport Company, and Atlantic Richfield Co. (ARCO), was organized in 1973 to develop and construct a coal slurry pipeline to transport low-sulfur western coal to power plants in Oklahoma, Arkansas, and Louisiana. The initial concept of the ETSI system involved the construction of a 1000-mile coal transportation system from Wyoming to Arkansas that would deliver 25 million (short) tons annually (MMTA) of coal.

In 1974 ETSI filed a formal application with the Department of the Interior (DOI) to cross approximately 33 miles of federal land in Wyoming. BLM deferred actual start-up of the EIS until ETSI developed more detailed plans for an adequate water supply and resolved the constraints put on the pipeline route by the refusal of the railroad industry to grant easements for crossing under tracks.

Although the U.S. Congress has debated the issue of granting eminent domain to slurry pipeline systems, as of July 1981, no federal legislation on granting eminent domain has been passed. However, eminent domain rights for coal slurry pipelines have been established by Oklahoma, Louisiana, and Texas. ETSI also obtained, through the courts, permission to cross all railroad lines along the route and obtained approval from the state of Wyoming to export the necessary water from the Madison Formation, a deep aquifer underlying the Powder River Basin. With these major obstacles removed, BLM initiated action on ETSI's request for a right-of-way permit and prepared the EIS.

In the meantime, ETSI expanded the proposed main slurry pipeline from 1000 miles to 1664 miles, extending from near Gillette, Wyoming, to Baton Rouge, Louisiana. Nine delivery sites were proposed. Each site is located within the boundary of an the existing or planned coal-fired power plant. The proposed throughput of the system was also increased, from 25 MMTA to 37.4 MMTA.

1.C NEED FOR PROJECT

The need for coal as a fuel for power generation results from regulatory requirements placed upon existing power plants to convert to coal (DOE-ERA 1980, 1981) and from the planned construction of new coal-fired power plants within the United States over this decade (Power Engineering 1980). These present projections of the need for additional electric power are apparent throughout the mid-South, the market area for the proposed slurry transportation system (BLM 1980). Thus, the regulations requiring existing power plants to convert to coal and the planned construction of new facilities projects a substantial increased need for low-sulfur coal in Oklahoma, Arkansas, and Louisiana. The proposed slurry transportation project would provide a cost-competitive option for transporting this coal.

The proposed action and its alternatives are designed to transport a maximum of 37.4 million tons per year. The delivery of this tonnage would build up from an initial amount in 1985 to the maximum by 1989. As shown in Table 1-1 potential markets for coal exist in Oklahoma, Arkansas, and Louisiana. A new power plant or expansion of an existing one is planned for 13 locations. As indicated by the data on the table, both Oklahoma and Louisiana are anticipating large increases in power demand. Power plant coal usage in Oklahoma was 1.5 MMTA in 1977 and is projected to increase to 45.5 MMTA by 1990 (Oklahoma Health Department 1981).

The projected coal need for just the known, permitted, or under construction plants in the proposed ETSI service area is over 54.5 MMTA (Table 1-1). This demand exceeds the amount proposed to be delivered by the ETSI project. Of the 54.5 MMTA total, ETSI has commitments for delivery of 24.6 million tons per year and is negotiating for an additional 12.8 MMTA (ETSI 1981), for a total of 37.4 MMTA.

The coal slurry pipeline would augment the existing or projected rail transport of coal to these markets. Cost-competitive transportation systems would provide an incentive to deliver coal at the lowest possible price. To meet the projected 1990 coal demands of 45.5 MMTA in Oklahoma, the Oklahoma Health Department (1981) projects that it would require a coal train consisting of 100 cars each having a 100-ton capacity arriving every 115 minutes. In Arkansas it is projected that by using a coal slurry pipeline rather than rail, rate payers could save up to $1 billion on utility bills over the life of the pipeline (Criner 1981).

1.D PURPOSE AND OBJECTIVE OF PROPOSED ACTION

The purpose of the proposed coal slurry transportation project is to transport 37.4 MMTA of low-sulfur western coal from Wyoming to power plants in Oklahoma, Arkansas, and Louisiana beginning in early 1985. The coal transported by the proposed project would be used to generate electric power for major portions of these states.

1.E OVERVIEW OF PROPOSED ACTION AND ALTERNATIVES

The proposed coal slurry transportation project and alternatives to the project are discussed in detail in the rest of this report. Map 1-1 shows the general arrangement of the major components of the proposed project and the no action (railroad) alternatives. A larger scale map showing the proposed project and all major alternatives is provided in the back cover pocket of Volume 1 of this final environmental impact statement.

Table 1-2 shows a very simplified overview of the proposed action and alternatives. It is not intended to be definitive; rather, it is intended to emphasize the differences among the proposed action and alternatives and to illustrate their relationships. The proposed action and major alternatives considered in this environmental impact statement are:

1. Proposed action. The proposal would involve the transportation of Wyoming coal via a coal slurry pipeline to nine power plants in Oklahoma, Arkansas, and Louisiana.

2. Market alternative. This alternative would follow a somewhat different route to serve a slightly different set of power plants.

3. Cypress Bend pipeline-barge alternative. This would involve the transportation of coal slurry by pipeline to a barge loading facil-

TABLE 1-1
MID-SOUTH POWER PLANT COAL DEMAND

Potential Power Plant Market	Letter of Intent[e]	Power Plant/Unit(s) Coal Need (MMTA)	Power Plant/Unit Status
Ponca City, OK [a]	Yes	6.6	planned and permitted
Oologah, OK [b,c]	No	3.5	planned and permitted
Pryor, OK [a,b,c]	Yes	5.3	planned and permitted
Muskogee, OK [a]	Yes	5.0	4 units planned; 2 permitted
Independence, AR [a,b,c]	Yes	5.0	permitted and under construction with retrofit capability for coal slurry system
White Bluff, AR [a,b,c]	Yes	5.0	existing
New Roads, LA [a,b]	No	2.0	3 units scheduled for construction (1980, 1981, 1983)
Baton Rouge, LA [b]	No	11.3	decision to build to be made in late 1981 or early 1982
Wilton, LA [a,b]	No	5.0	proposed
Boyce, LA [a,b]	No	1.8	permitted and scheduled for construction (1982)
Lake Charles, LA [a,b]	No	4.0	2 units scheduled for construction (1982, 1985)
Sooner, OK [d]	No	Unknown	3 units proposed
Hugo, OK [d]	No	Unknown	proposed

Source: ETSI 1981; Oklahoma Health Department 1981; Arkansas Public Utilities Commission 1981; Louisiana Public Service Commission 1981

MMTA = million (short) tons annually

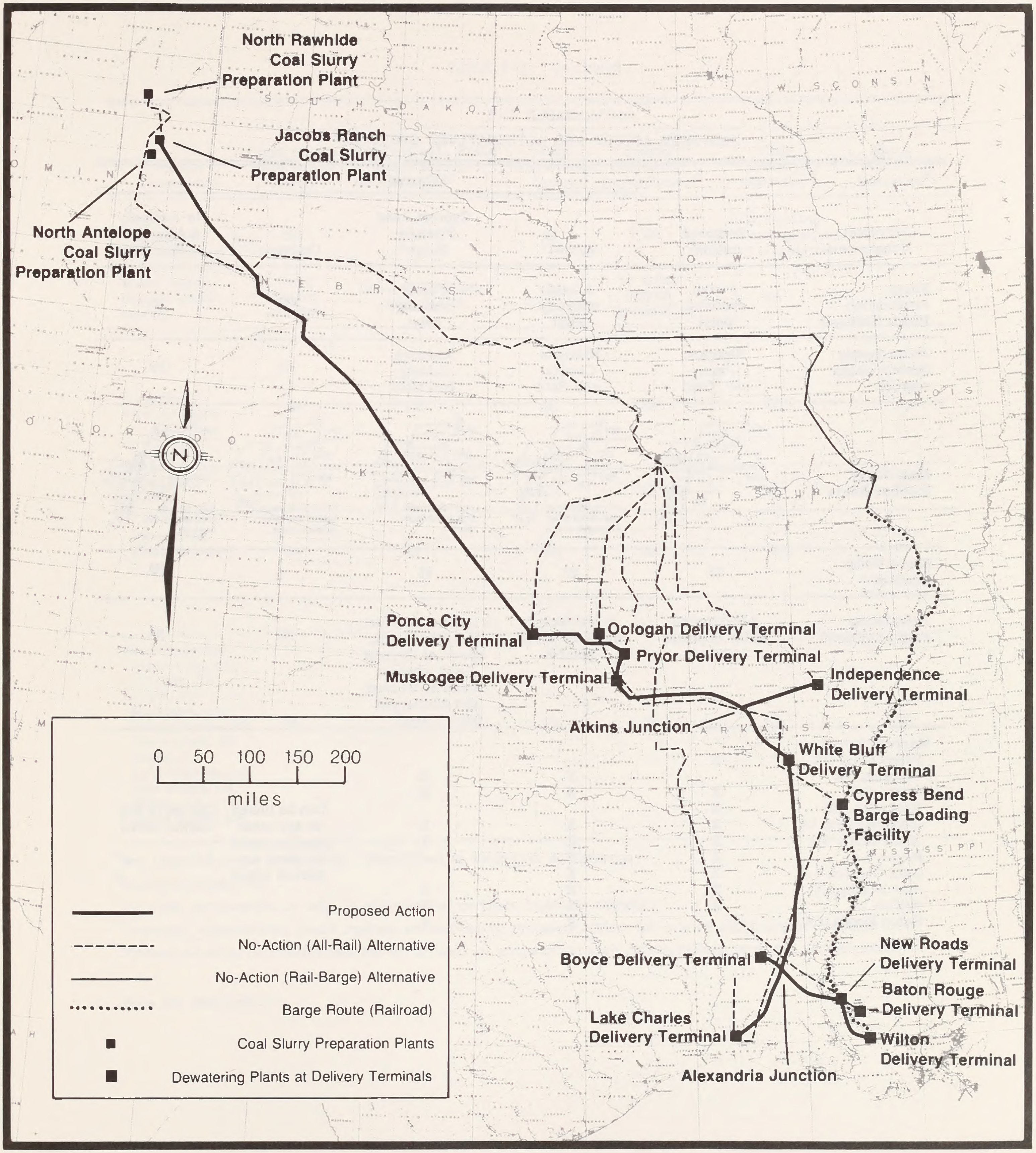
[a] ETSI proposed action market

[b] ETSI market alternative market

[c] ETSI Cypress Bend pipeline-barge market

[d] Potential coal need, but not proposed for ETSI delivery

[e] "Yes" signifies ETSI has a letter of intent from power company to enter into a contract for coal delivery



Map 1-1. LOCATION AND GENERAL ARRANGEMENT OF PROPOSED COAL SLURRY TRANSPORTATION PROJECT AND THE NO-ACTION ALTERNATIVE

TABLE 1-2

PROPOSED ACTION AND ALTERNATIVES OVERVIEW[a]

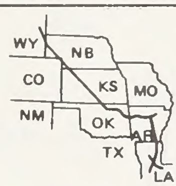
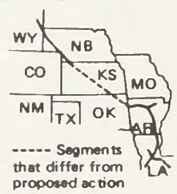
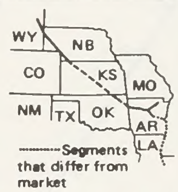
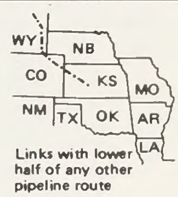
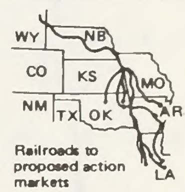
<table>
<tr><th></th><th></th><th colspan="4">Alternatives</th></tr>
<tr><th>Project Components</th><th>Proposed Action[b]</th><th>Market[b]</th><th>Cypress Bend Pipeline–Barge[b]</th><th>Colorado[c,d]</th><th>No-Action[b]
• All-rail
• Rail-barge</th></tr>
<tr><td>Slurry Preparation Plants (number)</td><td>3 (coal crushing only)</td><td>3 (coal crushing only)</td><td>3 (coal crushing only)</td><td>NA</td><td>NA</td></tr>
<tr><td>Water Supply System (major source)</td><td>Niobrara County well field</td><td>Niobrara County well field</td><td>Niobrara County well field</td><td>NA</td><td>NA</td></tr>
<tr><td>Main Slurry Pipeline Route</td><td>
</td><td>
</td><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Slurry Pump Stations</td><td>23</td><td>22</td><td>15</td><td>5</td><td>NA</td></tr>
<tr><td>Dewatering Plants (number)</td><td>9 (extracted water to power plants)</td><td>9 (extracted water to power plants)</td><td>5 (extracted water to power plants, except at Cypress Bend, where it would be treated and discharged into river)</td><td>NA</td><td>NA</td></tr>
<tr><td>Markets Served</td><td></td><td></td><td></td><td rowspan="12">Can be linked to any other pipeline route to serve any market listed</td><td rowspan="12">Can serve any market listed</td></tr>
<tr><td>Ponca City, OK</td><td>X</td><td></td><td></td></tr>
<tr><td>Oologah, OK</td><td></td><td>X</td><td>X</td></tr>
<tr><td>Pryor, OK</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Muskogee, OK</td><td>X</td><td></td><td></td></tr>
<tr><td>Independence, AR</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>White Bluff, AR</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Boyce, LA</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Lake Charles, LA</td><td>X</td><td>X</td><td></td></tr>
<tr><td>New Roads, LA</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Wilton, LA</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Baton Rouge, LA</td><td></td><td>X</td><td>X</td></tr>
</table>

TABLE 1-2 Continued

Project Components	Alternatives					
	Crook County Water Supply System[d]	Combined Well Field Water Supply System [d]	Oahe Water Supply System[d]	Treated Wastewater Supply System[d]	Coal Cleaning Operation[e]	Slurry Pipeline Discharge[e]
Slurry Preparation Plants (number)	NA	NA	NA	NA	Coal crushing and cleaning before slurry preparation	NA
Water Supply System (major source)	Crook County well field	Crook & Niobrara well fields	Oahe Reservoir	10 South Dakota Communities	NA	NA
Main Slurry Pipeline Route	NA	NA	NA	NA	NA	NA
Slurry Pump Stations	NA	NA	NA	NA	NA	NA
Dewatering Plants (number)	NA	NA	NA	NA	NA	Extracted water treated and discharged into rivers
Markets Served Ponca City, OK Oologah, OK Pryor, OK Muskogee, OK Independence, AR White Bluff, AR Boyce, LA Lake Charles, LA New Roads, LA Wilton, LA Baton Rouge, LA	NA	NA	NA	NA	NA	NA

[a]Not intended to be definitive. Simplified to emphasize differences.

[b]System alternative.

[c]Colorado alternative is only an alternative northern pipeline segment.

[d]Component alternative; could replace corresponding proposed action (or system alternative) component.

[e]Process alternative; could replace or be used in conjunction with corresponding proposed action process.

NA = not applicable

ity at Cypress Bend, Arkansas, with prior pipeline deliveries in Oklahoma and Arkansas. The remaining coal would be dewatered and transported by barge on the Mississippi River to delivery sites in Louisiana.

4. Colorado alternative. This is an alternative northern pipeline segment that would connect with any of the routes described above. Under this alternative the pipeline would enter Kansas via Colorado instead of Nebraska.

5. Fort Smith, Arkansas, route-variation alternative. This short alternative segment would avoid a water impoundment in the lower portion of the Lee's Creek drainage basin. The city of Fort Smith proposes to construct this impoundment.

6. "No-action" alternative. This alternative is the method of transport that would be available if a coal slurry pipeline were not built. Thus the no-action alternative is transportation by railroad or a railroad-barge combination.

7. Proposed water supply system and its component alternatives. Under the proposed action, the main source of water for the coal slurry mixture would be wells drilled into the Madison Formation in Niobrara County, Wyoming. Four alternative main water sources, considered component alternatives, are also analyzed: wells drilled into the Madison Formation in Crook County, Wyoming; a combined water source involving well fields in both Niobrara and Crook counties, Wyoming; water transported by pipeline from the Oahe Reservoir near Pierre, South Dakota; and treated wastewater collected by pipeline from 10 locations in South Dakota.

8. Two process variations. An optional coal cleaning operation and a slurry pipeline water discharge operation are evaluated.

1.F **PROPOSED ACTION**

1.F.1 GENERAL DESCRIPTION

The proposed coal slurry transportation project would consist of four major operating facilities: (1) coal slurry preparation plants, (2) water supply system, (3) coal slurry pipelines and pump stations, and (4) coal slurry dewatering plants. These facilities are shown conceptually on Figure 1-1. The delivery locations and the proposed delivery schedule are shown in Table 1-3. It is anticipated that limited deliveries would be made to all markets but Wilton prior to the proposed operation of the pipeline. (See Table 1-26 for tonnages.)

During construction of the project, approximately 22,730 acres would be disturbed. Approximately 1 percent of this land is federally controlled. All of the disturbed acres would be reclaimed, including reseeding when required by the landowner or surface management agency, as outlined in Appendix C-1. These acres would be returned to their preconstruction use wherever possible. Exceptions would be in the case of large trees growing directly over the pipeline. Construction of the surface facilities would require approximately 953 acres, but only 853 acres would be used during the operational phase.

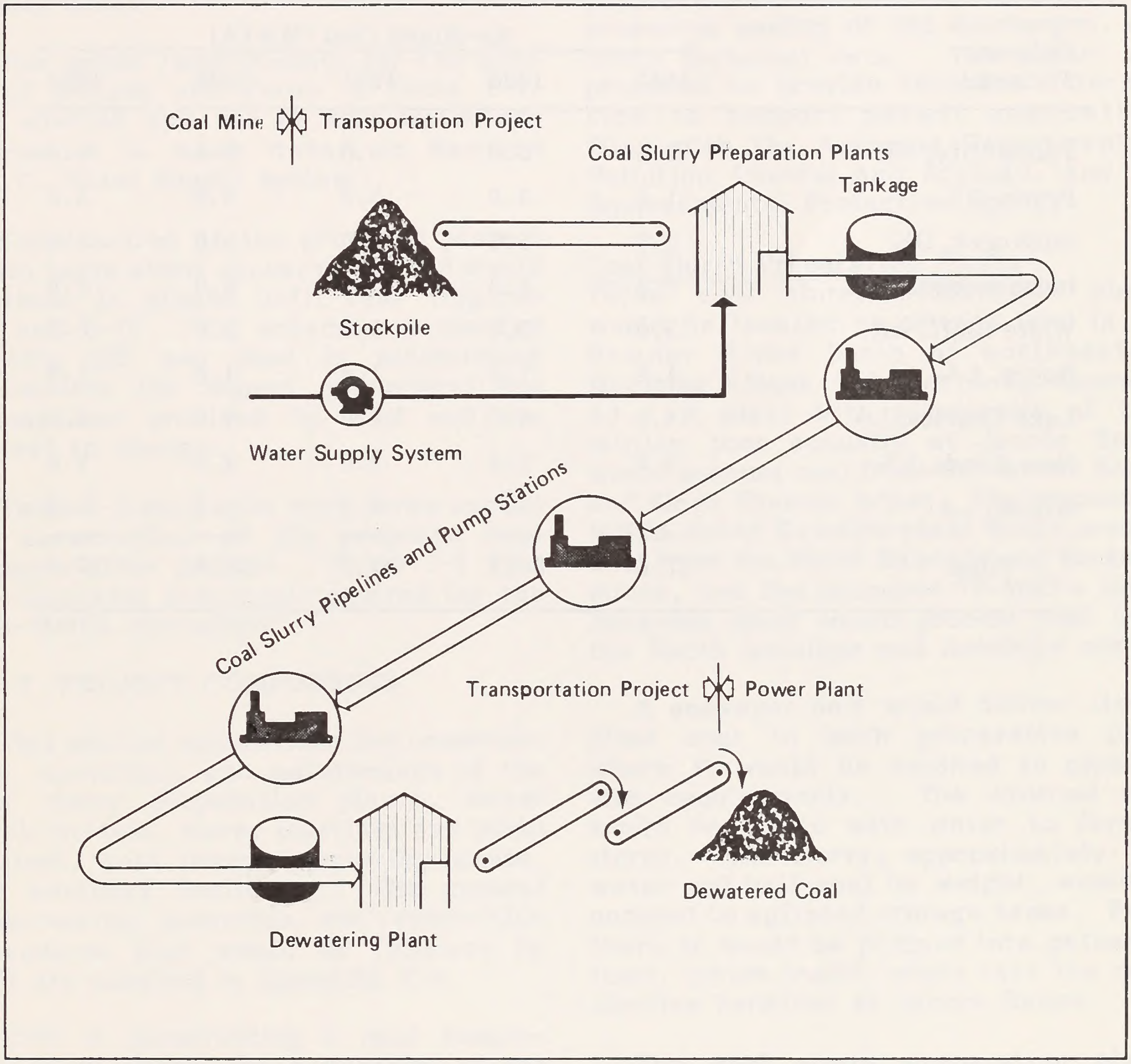


Figure 1-1. CONCEPTUAL DESCRIPTION OF COAL SLURRY TRANSPORTATION PROJECT

TABLE 1-3

PROPOSED COAL DELIVERY SCHEDULE: PROPOSED ACTION

Delivery Terminal	As-Mined Coal (MMTA)				
	1985	1986	1987	1988	1989
Ponca City, OK	3.3	5.0	6.6	6.6	6.6
Pryor, OK	1.5	3.0	3.0	3.0	3.0
Muskogee, OK	5.0	5.0	5.0	5.0	5.0
Independence, AR	5.0	5.0	5.0	5.0	5.0
White Bluff, AR	5.0	5.0	5.0	5.0	5.0
Boyce, LA	1.8	1.8	1.8	1.8	1.8
Lake Charles, LA	4.0	4.0	4.0	4.0	4.0
New Roads, LA	2.0	2.0	2.0	2.0	2.0
Wilton, LA	--	--	2.5	2.5	5.0
Total	27.6	30.8	34.9	34.9	37.4

At project termination, all surface facilities associated with the project would be removed. The disturbed acreage would then be reclaimed according to the procedures outlined in Appendix C-1. The pipeline would be left in the ground to avoid disturbing the reclaimed right-of-way area.

The water requirements for the proposed project are shown in Table 1-4. The sources and use of this water are discussed in more detail in Section 1.F.2, Water Supply System.

Construction of the proposed project would begin about January 1983 and would continue in phases until 1989 (Figures 1-2 and 1-3). The schedules presented in this EIS and used in establishing parameters for impact assessment are assumptions provided by ETSI and are subject to change.

Table 1-5 shows the work force needed for construction of the proposed coal transportation project. Table 1-6 lists the operating personnel required for the 37.4-MMTA throughput.

1.F.2 PROJECT COMPONENTS

This section summarizes the construction, operation, and maintenance of the coal slurry preparation plants, water supply system, slurry pipelines and pump stations, coal slurry dewatering plants, and ancillary facilities. The general construction, operation, and reclamation procedures that would be followed by ETSI are detailed in Appendix C-1.

ETSI is constructing a coal evaluation plant within the boundaries of the Arkansas Power and Light White Bluff generating station, approximately 35 miles south of Little Rock, Arkansas. The purpose of the plant is to evaluate equipment that would be used in the coal slurry preparation plants and dewatering plants as well as to facilitate the design of the slurry pipeline itself. The objective of the evaluations is to optimize the detailed design of these facilities. An engineering report for the plant, prepared by Plummer and Associates, Inc. (1981), describes the proposed wastewater treatment system, projected quality of the discharges, and other technical data. The report was prepared to provide technical information to support permit applications filed with the Arkansas Department of Pollution Control and Ecology, and the Environmental Protection Agency.

Coal Slurry Preparation Plants

Three coal slurry preparation plants would be located on private land in the Powder River Basin of northeastern Wyoming (Maps A-2 and A-3, Appendix A). A plant with a capacity of 22.4 million tons annually at Jacobs Ranch would process coal from the Jacobs Ranch and Black Thunder mines. The proposed 5 MMTA North Rawhide plant would process coal from the North Rawhide and Buckskin mines, and the proposed 10-MMTA North Antelope plant would process coal from the North Antelope and Antelope mines.

A conveyor belt would deliver stockpiled coal to each preparation plant where it would be crushed to pipeline size requirements. The crushed coal would be mixed with water to form a slurry. The slurry, approximately half water and half coal by weight, would be pumped to agitated storage tanks. From there it would be pumped into gathering lines, which would empty into the main pipeline terminus at Jacobs Ranch.

The coal slurry preparation plants would include dust collection facilities at all transfer points that are likely to be sources of airborne dust. The amount of particulate dust for a typical 5-MMTA plant with dust collectors would be 230 tons per year; it would be 330

TABLE 1-4

WATER REQUIREMENTS: PROPOSED ACTION

Use	Amount (acre-feet)	Source	Where Used
Annual Requirements			
Coal transport medium	20,000	Niobrara County well field	Exported from Wyoming
Preparation plant storage pond evaporation makeup, dust suppression, plant washdown	200	Niobrara County well field	Preparation plants (Wyoming)
Pump station storage pond evaporation makeup*	(state totals)		
	60	2 local wells	Wyoming pump stations
	85	2 local wells	Nebraska pump stations
	105	2 local wells	Kansas pump stations
	50	3 local wells	Oklahoma pump stations
Subtotal	300		
Total	20,500		
Construction Requirements (total for project)			
Water-well drilling operations	112	Niobrara County well field	Wyoming
Fugitive dust control, concrete		Vary with construction location	Various construction locations
Pipeline hydrotesting	1,650	Local sources	Various locations along pipeline
Initial packing of pipeline, filling of pump station storage ponds	2,535	Niobrara County well field	Exported from Wyoming

*Domestic water requirements would be negligible. Domestic water would be obtained from local wells or local water supply systems, where available.

FIGURE 1-2

ASSUMED PIPELINE AND PUMP STATION CONSTRUCTION SCHEDULE: PROPOSED ACTION

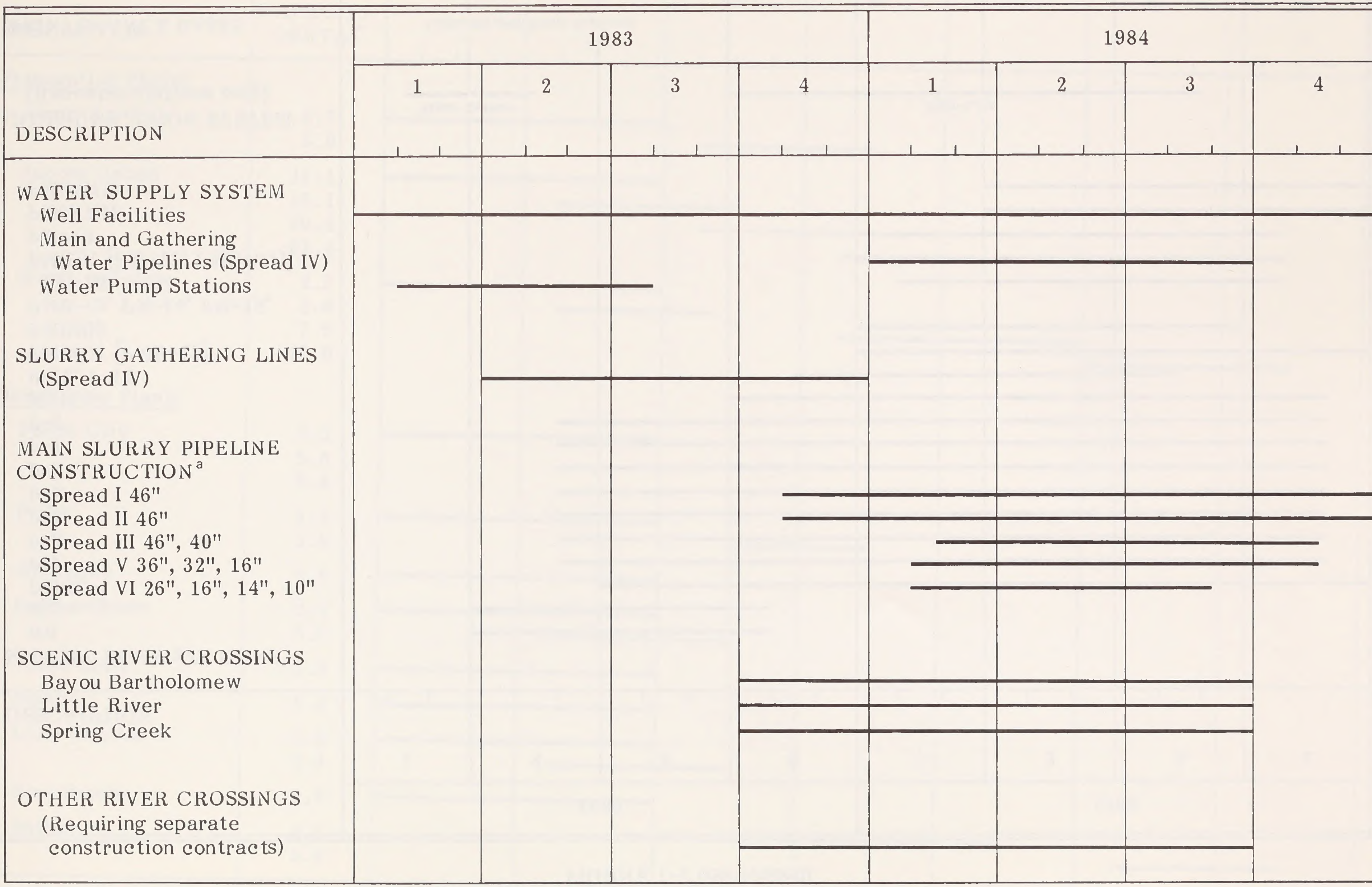
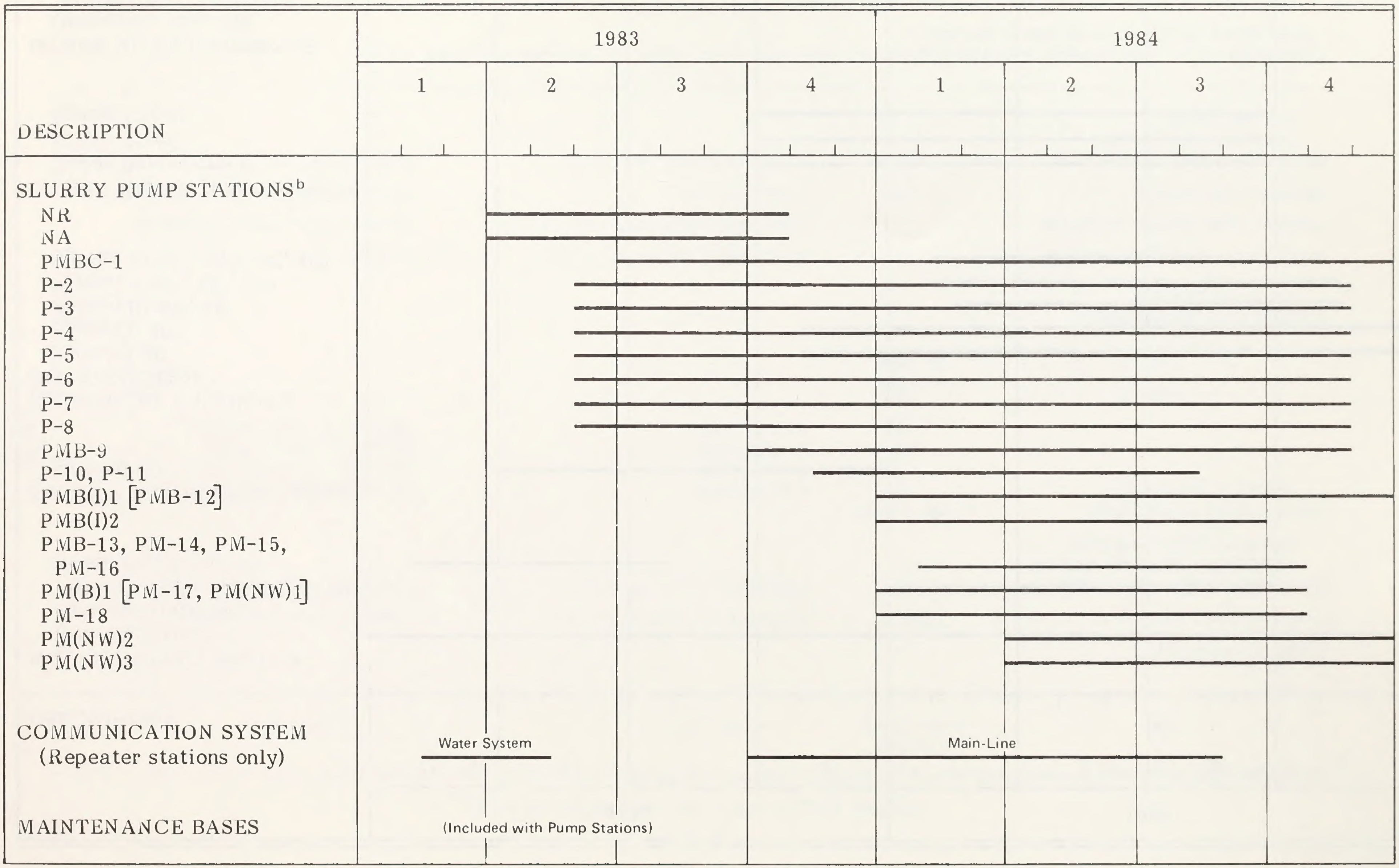


FIGURE 1-2 (concluded)



[a]See Table 1-6 for spread locations.

[b]See strip maps in Appendix A for description of symbols and locations of pump stations. There are only 23 different slurry pump station locations; pump stations shown in brackets are at same location as first pump station listed in the row.

FIGURE 1-3

ASSUMED PREPARATION AND DEWATERING PLANTS CONSTRUCTION SCHEDULE: PROPOSED ACTION

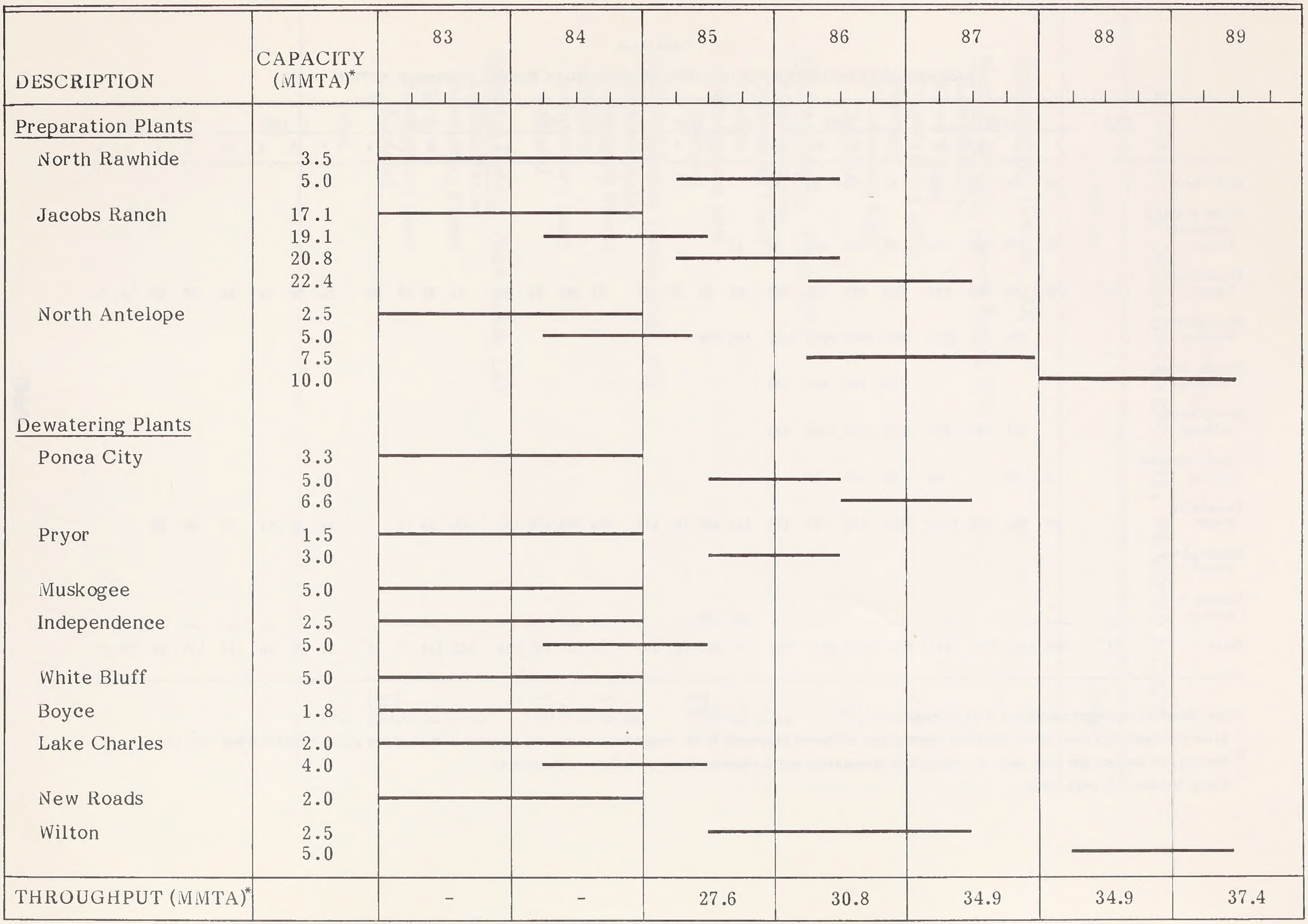


TABLE 1-5

ASSUMED QUARTERLY BUILDUP OF CONSTRUCTION WORK FORCE: PROPOSED ACTION

	1982	1983				1984				1985				1986				1987				1988				1989			
	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Well Field		41	41	41	41	41	41	41	41																				
Water & Slurry Gathering Lines		60	360	360	60	60	260	260	30	15																			
Preparation Plants	34[c]	129	189	259	342	402	440	238	202	66	83	95	57	81	107	91	92	93	61	58	33	20	26	21	49	56	25	18	5
Main Slurry Pipeline			100	500	2950	2950	2950	2950	2950	300	100																		
Special River Crossings[a]						150	150	150	150																				
Slurry Pump Stations			265	685	975	1870	1970	1680	945																				
Communication System		20	20		20	20	20	20																					
Dewatering Plants		58	378	726	1155	1332	1182	903	488	145	140	105	173	204	240	230	192	150	83	18		20	45	65	70	60	40		
Maintenance Bases[b]																													
Testing & Startup	—	—	—	—	—	—	—	—	—	260	260	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	34[c]	308	1353	2571	5543	6825	7013	6242	4806	786	583	200	230	285	347	321	284	243	144	76	33	40	71	86	119	116	65	18	5

Note: Numbers represent number of workers required.

[a] River crossings that may require separate construction contracts (Appendix D-6). Standard crossings are included in main slurry pipeline construction work force.

[b] Numbers of workers are incorporated in respective preparation and dewatering plant work force requirements.

[c] Initial mobilization work force.

TABLE 1-6

SUMMARY OF OPERATING PERSONNEL: PROPOSED ACTION

Location	Total
Headquarters (Denver, CO)	41
Western District (Jacobs Ranch, WY)	
Administration	4
Water Supply	11
Preparation Plants	196
Pipelines	9
Maintenance Base	23
Subtotal	243
Central District (Pryor, OK)	
Administration	3
Dewatering Plant	64
Pipeline	24
Maintenance Base	33
Subtotal	124
Eastern District (White Bluff, AR)	
Administration	3
Dewatering Plants	110
Pipeline	18
Maintenance Base	47
Subtotal	178
Southern District (New Roads, LA)	
Administration	3
Dewatering Plants	93
Pipeline	24
Maintenance Base	47
Subtotal	167
Total	753

tons per year for a 10-MMTA plant. These emission quantities are for airborne dust from the starting point of the coal-loading conveyor to the preparation plant and include all emission points inside the plant boundary.

The preparation plants would be constructed in phases from 1983 to 1989 as the pipeline throughput increases (Figure 1-3). During project operation, the buildings, roads, and all other structures associated with coal slurry preparation plants would occupy about 235 acres.

A maximum work force of approximately 440 persons would be required to construct the three preparation plants to initial capacity. An estimated maximum of 107 construction workers would be needed to increase the total capacity of the three plants to 37.4 MMTA (Table 1-5). A total of 196 people would be required to operate the plants: 117 at Jacobs Ranch, 27 at North Rawhide, and 52 at North Antelope.

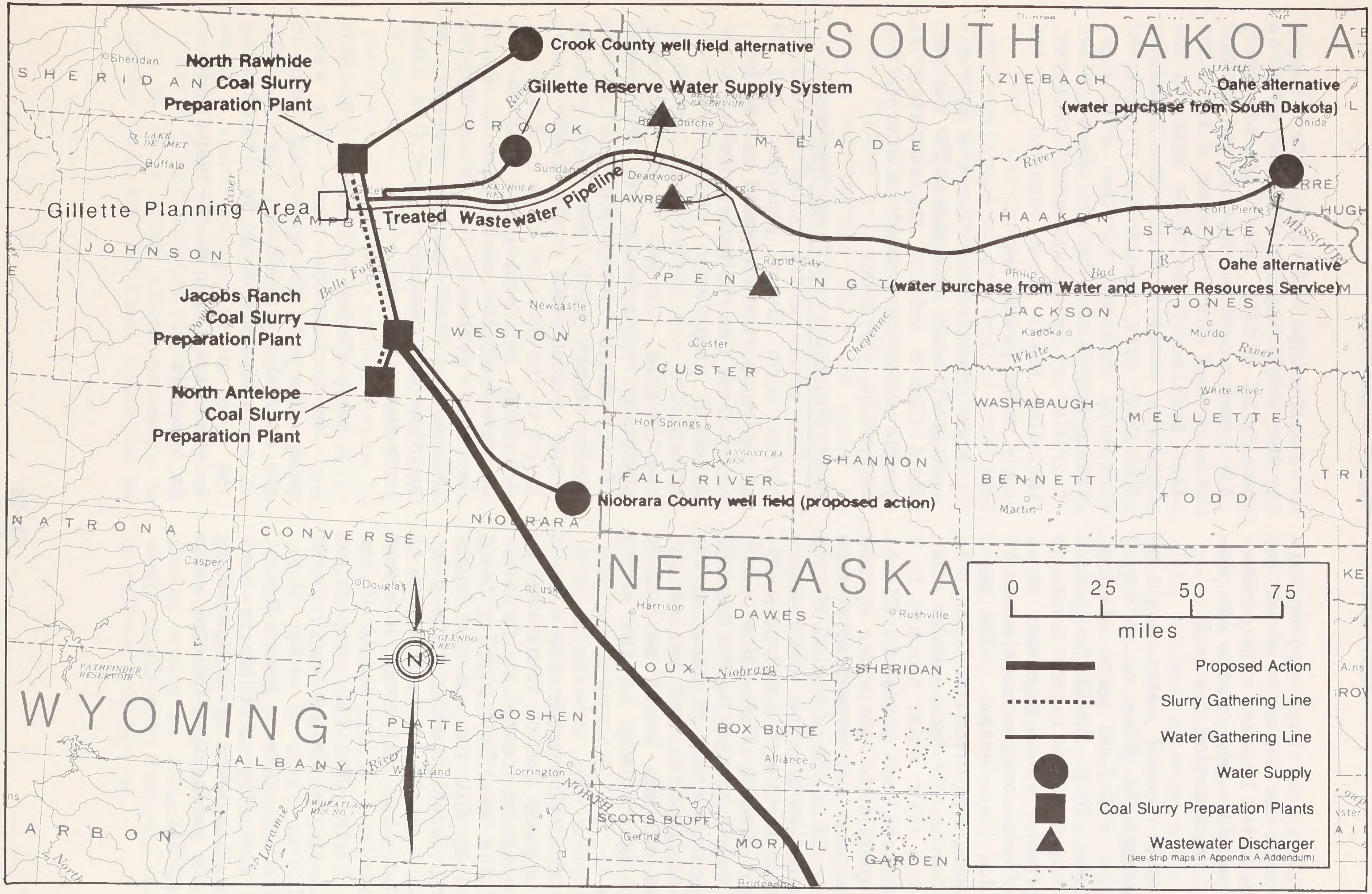
Water Supply System The proposed water supply system would supply the 20,200 acre-feet of water required to operate the coal transportation project. Approximately 20,000 acre-feet per year would be required to transport 37.4 MMTA of coal from Wyoming. Two hundred acre-feet would be required at the preparation plants to make up for evaporation from the storage ponds, and for dust suppression, plant washdown, and other uses not connected with slurry. Some of this water could be reused as slurry makeup water, thereby reducing the total quantity required from the well field. In addition, 300 acre-feet per year supplied from local wells would be required for evaporation makeup at pump station storage ponds (Table 1-4).

The proposed water supply system would include two components: (1) a main supply source, the Niobrara County well field; and (2) a reserve supply, which could be purchased from Gillette, Wyoming (Map 1-2). In addition, a well at each mainline slurry pump station in Wyoming (except at Jacobs Ranch preparation plant), Nebraska, Kansas, and Oklahoma would provide the water needed for storage pond evaporation makeup. Stations in Arkansas and Louisiana would not require water for this purpose because rainfall would exceed evaporation at these locations.

The legal requirements associated with the use of the Niobrara County well field and Gillette water are included in Appendices C-2 through C-6. The measures ETSI would have to undertake should existing Madison Formation water users in Wyoming be affected by the project are detailed in Appendix C-3. ETSI has offered similar sets of protection measures to the state of South Dakota and the city of Edgemont, South Dakota (Appendix C-7 and Appendix C-8). However, neither agreement has been signed. The Fall River County Commissioner have prepared written comments on ETSI's proposal to the city of Edgemont (Appendix C-9).

ETSI conducted aquifer tests using five test wells in 1974 in the southwest portion of the proposed Niobrara well field site. Additional tests were conducted in 1978 using a nearby abandoned oil well. The types of tests conducted and their results are discussed in detail in the Well Field Hydrology Technical Report (WCC 1981b), Appendix H. The design of the well field is based on these test results.

The Niobrara County well field would consist of 5 monitoring wells and approximately 40 to 45 production wells drilled to an average depth of 4000 feet (Map A-53, Appendix A). The number of production wells may vary depending on the yield of the wells. The 5 monitoring wells would detect drawdown in well



Map 1-2. LOCATION AND GENERAL ARRANGEMENT OF PROPOSED ACTION AND ALTERNATIVE WATER SUPPLY SYSTEMS

levels, if any, so that appropriate measures could be taken to avert any potential negative impact. The production wells would supply water for processing and transporting the coal.

The production-well water would be pumped through 62 miles of gathering lines to the well-field pump station. The gathering lines would be placed along the edges of the access roads in the well field, where possible, so a minimum of additional acreage would be disturbed for construction. The pump station would pump the water through 68 miles of buried, 26-inch outside diameter (O.D.) main water pipeline to a distribution head tank at Jacobs Ranch. This tank would distribute water to each preparation plant and associated storage pond. Some 16 miles of buried 16-inch O.D. distribution pipeline would transport water to the North Antelope plant. A 55-mile, 22-inch O.D. line would transport water to the North Rawhide plant. Approximately 37 miles of the main water pipeline and all of the distribution pipeline would be laid in the same right-of-way as the slurry pipelines.

The reserve water supply system would consist of a pump station to be built by ETSI. It would be located at the intersection of the well-field pipeline being constructed by Gillette and the Jacobs Ranch North Rawhide water-distribution pipeline that would be constructed by ETSI. The pipelines would intersect approximately 7 miles south of the proposed North Rawhide preparation plant. The pump station would direct surplus Gillette water in either direction, to North Rawhide or Jacobs Ranch. ETSI and the city of Gillette have signed a memorandum of understanding regarding the purchase of Gillette water (Appendix C-5).

Construction of the water supply system would begin in 1983 and would be completed in late 1984. Approximately 2.5 acres would be cleared and leveled at each well site. An area of 150 x 105 feet (0.5 acre) would be required for operation of each well. The remaining disturbed area would be revegetated following removal of the drill rigs. During operation, the well-field surface facilities would occupy about 28 acres, including the 3 acres required for the main water pump station.

A construction work force of approximately 41 would be required for the well field (Table 1-5). Approximately 11 people would be needed to operate the water supply system.

<u>Slurry Pipelines and Pump Stations</u>

Two buried slurry gathering lines, a buried main slurry pipeline, and 23 slurry pump stations would be required. Slurry from the North Rawhide and North Antelope preparation plants would be transported via 55-mile, 32-inch O.D. and 16-mile, 24-inch O.D. gathering pipelines, respectively, to the origin of the main slurry pipeline at the Jacobs Ranch plant. The main pipeline would extend 1664 miles from Jacobs Ranch to the delivery sites in Oklahoma, Arkansas, and Louisiana. The 46-inch diameter of the main pipeline would decrease gradually south of Pryor, Oklahoma. This would be necessary to maintain the correct rate of flow after each slurry delivery.

A pump station at the North Rawhide and North Antelope plant sites would pump slurry in the gathering lines to the main slurry pipeline. The remaining 21 pump stations would be located along the main slurry pipeline route. Their locations are shown on the maps included in Appendix A.

Each station would include a water storage pond, agitated slurry storage tank and reinjection system, slurry pump house, water pump house, cooling tower, electric substation, water well (Wyoming, Nebraska, Kansas, and Oklahoma only), and waste treatment facility. Approximately 20 to 25 acres would be required for each of the 20 slurry pump stations not located within a preparation plant boundary.

The slurry pipelines and pump stations would be constructed from 1983 through 1984. A work force of approximately 2950 organized as six construction teams, or "spreads," would work concurrently on various sections of the line (Tables 1-5 and 1-7). The principal communities likely to serve as pipeline spread headquarters are listed in Table 1-7.

Pipeline construction techniques for a coal slurry pipeline are the same as for conventional pipelines. Typically, pipelines are laid in a continuous operation by a spread, consisting of equipment and crews handling various types of construction activities for a given pipeline segment. Figures 1-4 and 1-5 illustrate these operations.

Construction activities would be confined to a 100-foot right-of-way and a storage and work area (200 x 200 feet) at periodic staging sites and at each side of river, highway, and railroad crossings. When possible, existing roads would be used to provide access to the right-of-way for materials, machinery, and construction workers. In remote areas where there are no access roads, the right-of-way would be the primary path of surface travel.

Vegetation would not necessarily be removed from the entire right-of-way but only in those areas where necessary to provide safe and efficient operation of construction equipment. Thus vegetation would be cleared from the trench line and from as much of the authorized right of-way as necessary to provide adequate room for vehicle travel and work space. Only minimal clearing would be required in grasslands, since this vegetation type does not usually impede vehicle passage. All disturbed areas would be revegetated. Exceptions would be in the case of larger trees growing directly over the pipeline. Trench depth would vary with existing conditions and local regulations. The cover from the top of the pipe to ground level would generally be a minimum of 3 feet.

The proposed route would cross 61 rivers requiring special permits and separate construction contracts (Appendix D-6). Specific construction techniques that would minimize erosion and siltation would be selected for each river or stream crossed by the pipeline. For purposes of developing a worst-case impact analysis, the trenching technique is assumed for all crossings. The pipe would be buried and would generally cross streams at right angles. Stream flow would be maintained at all times to avoid interference with downstream water users. No changes in bottom contours would occur. Any excess excavation material would be disposed of upland to comply with conditions of U.S. Department of the Army, Corps of Engineers, permits. (See Section 1.F.4 for a discussion of these permits.) Construction would occur during periods of low flow whenever possible or would be timed to eliminate conflicts with critical migration or spawning of aquatic species.

Generally, beds supporting paved roadways or railroads would be crossed by boring a hole beneath the bed rather than by ditching across the surface. Casing would be installed at crossings where required by federal, state, local, or railroad authorities.

TABLE 1-7

PIPELINE SPREAD RESPONSIBILITIES: PROPOSED ACTION

Pipeline Spread	Likely Spread Headquarters	Pipeline Segment[a]	Miles	Workers Required: Typical Spread[b]	Workers Required: Add for Rough Terrain
I	Gillette, WY Wright, WY Lusk, WY Scottsbluff, NB Ogallala, NB McCook, NB	Jacobs Ranch to PMB-367 (PMB-0 to PMB-367)	367	670	78
II	Hays, KS Kingman, KS Ponca City, OK	PMB-367 to Ponca City (PMB-367 to P-700) Ponca City to Oologah (P-700 to P-778)	333 78	670	78
III	Pryor, OK Fort Smith, AR Russellville, AR	Oologah to Pryor (P-778 to P-808) Pryor to Muskogee (P-808 to P-840) Muskogee to Atkins Junction (P-840 to PMB-997.4)	30 32 157	610	78
IV	Gillette, WY	Jacobs Ranch to North Antelope (water) North Antelope to Jacobs Ranch (slurry) Jacobs Ranch to North Rawhide (water) North Rawhide to Jacobs Ranch (slurry) Jacobs Ranch to Well Field (water)	16 16 55 55 68	260 390 260 390 390	- - - - -
V	Russellville, AR Batesville, AR Pine Bluff, AR	Atkins Junction to White Bluff (PMB-997.4 to PMB-1077.6) White Bluff to Alexandria Junction (PMB-1077.6 to PM 1315) Atkins Junction to Independence (PMB(I)-0 to PMB(I)-93)	80 238 93	550 550 260	65 65 -
VI	Monroe, LA Alexandria, LA Lake Charles, LA Baton Rouge, LA	Alexandria Junction to New Roads (PM(NW)-0 to PM(NW)-75.6) New Roads to Wilton (PM(NW)-75.6 to PM(NW)-141.5) Alexandria Junction to Boyce (PM(B)-0 to PM(B)-24) Alexandria Junction to Lake Charles (PM-1315 to PM-1404)	76 66 24 89	390 260 260 260	- - - -

Notes: Spread I would proceed from south to north. Spread IV would proceed as shown above. All other spreads would proceed from north to south.

[a] Explanation of milepost (MP) designations is included in Appendix A.

[b] Numbers represent maximum number of workers per pipeline spread.

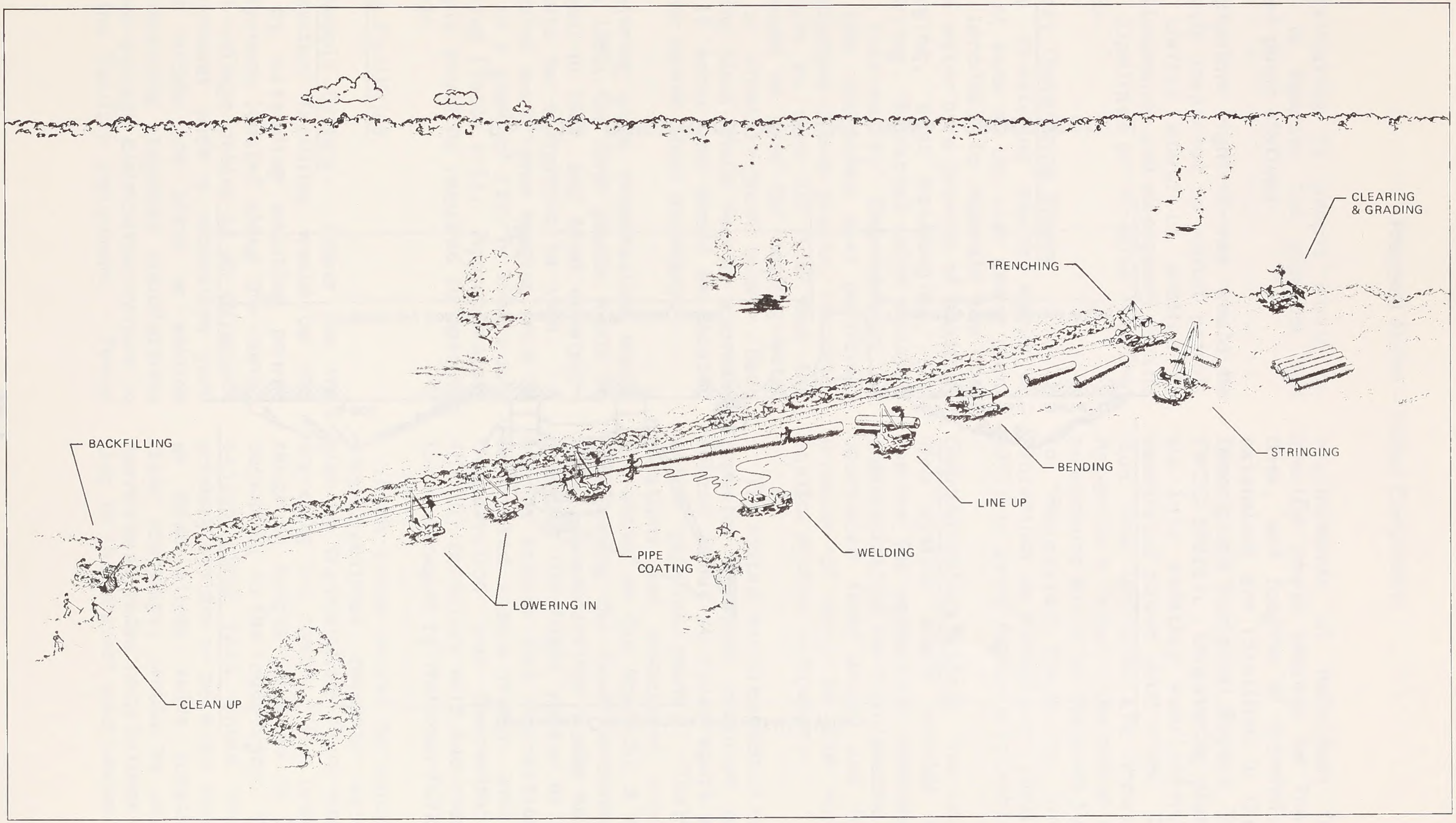


Figure 1-4. TYPICAL MAIN SLURRY PIPELINE CONSTRUCTION SPREAD

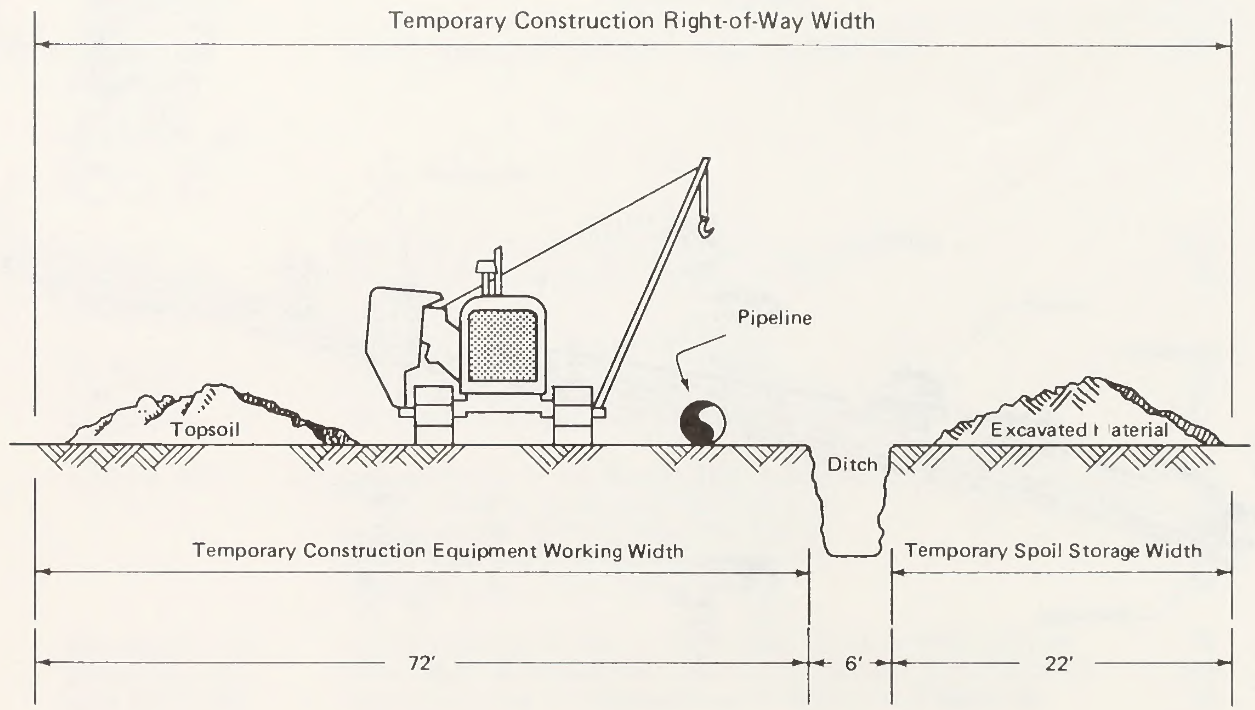


Figure 1-5. CONSTRUCTION RIGHT-OF-WAY CROSS SECTION

Approximately 75 people would be required to operate the pipeline and associated pump stations.

The pipeline right-of-way would be periodically inspected by aerial patrol. Surface traffic would be limited to valve maintenance and emergency repairs to the pipeline or erosion control structures.

Coal Slurry Dewatering Plants

Slurry dewatering plants would be located at each of the nine power plant delivery terminals to separate the coal from the water by a process of heating, centrifuging, heat exchanging, and cooler-drying. Extracted water would be further treated by flocculation to remove fine suspended coal particles. In the adjacent power plants, the dried coal would be used for fuel and the water would be used for cooling-water makeup or other in-plant uses. Each dewatering plant would require approximately 10 acres and would be located within the power plant boundary.

Dewatering plant construction would begin in 1983; the first plants would be operational in 1985, and total construction would be completed in 1989. A construction work force ranging from 58 in 1983 to a peak of 1332 in 1984 would be required (Table 1-5). Approximately 267 people would be required to operate the plants.

Ancillary Facilities

Power Supply System. Power for the slurry system facilities would be obtained by extending existing power supply systems located along the route. The high-voltage cables of an extension would connect with a substation yard (located within the plant or station site) containing stepdown transformers and a low-voltage distribution system to supply the facility equipment. Power requirements of individual facilities, specific power sources for these facilities, and lengths of transmission line extensions are identified in the Project Description Technical Report, Table 1-20 (WCC 1981a). Dewatering plants would tie into existing substations at the associated power plant sites. Transmission line locations are shown on the Appendix A maps. The power poles and conductors would be designed to conform to "Suggested Practices for Raptor Protection on Powerlines" (Miller et al. 1975) to avoid raptor electrocutions.

Communication System. The communication system would provide telephone service for operations personnel, radio communication for maintenance bases and associated field units, and for transmission of data to the supervisory control system computer.

The system would consist of microwave repeater antennas mounted on towers spaced about 30 miles apart along the entire pipeline route. Their general locations and associated access roads are shown on the Appendix A maps. In determining the exact location of each tower, consideration would be given to avoiding the flight routes of migrating birds, scenic and recreation areas, designated scenic rivers, and Heritage Conservation and Recreation Service (HCRS) inventory wild and scenic rivers (now managed by National Park Service).

Each tower would be equipped with omnidirectional receiver antennas to pick up transmissions from mobile units traveling the route. The towers would range in height from 40 to 360 feet, depending on the topography. Communication sites that would lie off the primary system or between towers, such as mine sites, valve locations, and river crossings, would be serviced by narrowband radio installations transmitting to the nearest microwave tower.

The main control center for the communication system would be located in Denver, Colorado.

Supervisory Control System. The supervisory control system would monitor the operation of all project facilities from a master control station located in the main control room in Denver. It would control all the water and slurry pipelines and would monitor selected data for the coal preparation and dewatering plants. The operation of the plants would be controlled from individual control rooms at each plant site.

In addition to the master control station, a backup control system would be provided at White Bluff, Arkansas. This system would permit continuous operation of the slurry pipeline in case of malfunction of the master control room or failure of the communication link with Denver.

1.F.3 SYSTEM ROUTINE AND NONROUTINE OPERATIONS

The pipeline operation procedures that would be used on the ETSI system have been used on existing coal slurry and mineral pipelines in operation throughout the world, such as the Black Mesa pipeline (transporting coal across Arizona to Nevada) and the Samarco pipeline (transporting iron concentrate in Brazil). These procedures-- including start-up, steady-state flow, shutdown, and restart after shutdown-- are described in detail in the Project Description Technical Report (WCC 1981a).

Each pump station would have sufficient pumping capacity so that the system could continue to operate (at reduced flow and for a short duration) with a loss of up to 40 percent of pumping capacity at any pump station.

The general operating philosophy is that the system would operate at reduced flow as necessary due to nonoperational periods and would shut down completely only in the event that reduced flow could not be maintained or that a pipeline rupture had occurred. In the event of a system shutdown, the pump stations downstream of the shutdown point would continue to pump slurry or water to maintain the downstream flow as long as possible or to flush the downstream section of pipeline. The various nonroutine operating cases--such as one or more nonoperational pump stations, a nonoperational dewatering plant, or handling nonspecification slurry-- are described in the Project Description Technical Report (WCC 1981a).

Many features of design, construction, and operation of the pipeline system would prevent or reduce the likelihood of a coal slurry spill. Others would minimize or contain coal that could possibly be released. A detailed spill contingency plan for the pipeline would be prepared prior to initiating pipeline operations. Design, construction, and operating features that would prevent or minimize spills are discussed in more detail in Appendix C-10. General spill response action guidelines to be followed in the event of a slurry spill are included in Appendix C-11.

1.F.4 AUTHORIZING ACTIONS

In order to implement ETSI's proposed action, certain federal, state, and local "authorizing actions" would have to be taken. Examples of authorizing actions are approvals of applications for right-of-way grants, stream crossing permits, and microwave communication licenses. The authorizing actions that would be necessary before ETSI could construct a coal slurry pipeline are discussed below. A summary list of the known required authorizing actions and the general conditions that would apply to the various grants and permits are included in Appendix D.

Federal

Bureau of Land Management (BLM). The BLM is responsible for issuing right of-way and other land use authorizations for the pipeline and related facilities on Public Lands administered by the agency. In order to comply with Title V of the Federal Land Policy and Management Act (FLPMA), ETSI filed a revised application with the BLM Wyoming State Office on April 28, 1978. If the project were approved the application would be revised to correspond to the project data and locations presented in this EIS. The BLM would take the following actions if the application were approved:

1. Grant a 50-foot right-of-way for construction, maintenance, and operation of a water pipeline across approximately 2.0 miles of Public Lands and a coal slurry pipeline across approximately 3.5 miles of Public Lands. The estimated 5.5 miles of combined right-of-way located between Gillette and Lusk, Wyoming, would be issued under Title V of FLPMA, as defined in the Code of Federal Regulations (CFR), 43 CFR 2800. It would be issued from the BLM Wyoming State Office in Cheyenne for a 30-year period, after which time ETSI could file for renewal.

2. Grant a temporary use permit for no more than a 50-foot width across approximately 5.5 miles of Public Lands immediately adjacent to the 50-foot water pipeline and coal slurry pipeline rights-of-way during the construction phase. This permit would be issued under Title V of FLPMA, as defined in 43 CFR 2920. It would be issued from the BLM District Office in Casper, Wyoming, for a maximum period of two years.

General conditions that would apply to the above grants are outlined in Appendix D-2. BLM responsibilities related to cultural resources legal requirements are included in Appendix D-3 and those related to Endangered Species Act Section 7 compliance are included in Appendix D-4.

Forest Service, U.S. Department of Agriculture (FS). The FS would:

1. Grant a 50-foot right-of-way for construction, operation, and maintenance of water and coal slurry pipelines across approximately 27.0 miles of federal lands administered by the FS in the Thunder Basin National Grassland in northeast Wyoming. The approximately 27.0-mile right-of-way easement would be issued under Title V of FLPMA, as defined in 36 CFR 251. (Final regulations were issued in the Federal Register, Vol. 45, No. 3, June 6, 1980, and became effective on July 7, 1980.) The right-of-way easement would be issued by the Regional Forester for an appropriate duration and would specify conditions for renewal.

2. Grant a temporary special-use permit parallel and immediately adjacent to the long-term right-of way easement. This temporary permit is for construction of water and coal slurry pipelines across approximately 27.0 miles of federal lands administered by the FS in the Thunder Basin National

Grassland in northeast Wyoming. The permit would be issued under Title V of FLPMA, as defined in 36 CFR 251, from the Forest Supervisor's Office for the Medicine Bow National Forest, Laramie, Wyoming.

General conditions that would apply to the above grants are outlined in Appendix D-5.

U.S. Army Corps of Engineers (COE). Section 10 permits under the River and Harbor Act of 1899 (33 USC 401-413) are required for crossings of navigable waters in the United States. Under Section 404 of the Clean Water Act of 1977 (40 CFR 122-123), and implemented by Corps of Engineers regulations (33 CFR 323), the placement of dredged or fill material for bedding or backfilling pipeline crossings is permitted under the nationwide permit for utility lines (33 CFR 323.4 and 323.4-3), provided that the conditions outlined in Appendix D-7 are met. However, the Corps does have discretionary authority to require individual permits for all or portions of the pipeline crossings if the District Engineer determines that the concerns of the aquatic environment indicate a need for such action (33 CFR 323.4-4).

A list of ETSI pipeline river crossings that may require individual Section 10 or Section 404 permits is presented in Appendix D-6. COE Districts would require ETSI to file one or more permit applications for Department of the Army (Section 10 and Section 404) permits for river crossings within their jurisdiction.

The COE has established the following procedures for processing applications for individual Department of the Army permits:

1. On the basis of project description information supplied by the applicant, the appropriate COE District Office or Offices determine whether an individual Department of the Army permit(s) is required.

2. The applicant must file the appropriate permit application(s), which is then reviewed by COE officials.

3. COE District Office distributes a public notice requesting comment on the permit application(s) from federal and state agencies, as well as the general public. Comments are received for a 30-day period.

4. Following the comment period, all public input is evaluated. If requested, the COE District Engineer may require a formal public hearing on the proposed action. Upon receipt of comments, the District Engineer will offer the applicant an opportunity to resolve any adverse comments.

5. If a formal public hearing is necessary, all public input and pertinent information will be reevaluated and the COE District Engineer will make a decision regarding the Department of the Army permit(s).

6. A decision on the Department of the Army permit(s) will not be made until 30 days after the Final Environmental Impact Statement is filed with the Environmental Protection Agency.

In addition, the COE would require an easement for those portions of the pipeline crossing the federal government's fee ownership. A consent to easement would be required for those portions crossing lands over which the United States acquired only an easement interest. Processing would be concurrent with that of the permit application.

Wetland crossings may be eligible for a nationwide Section 404 permit, provided they meet certain conditions outlined in Appendix D-7.

Federal Communications Commission (FCC). The FCC would issue a separate operating license for each of the approximately 66 repeater stations. ETSI would submit application Form 402 for licenses in the Operational Fixed Microwave Service. Authority for issuing the microwave licenses is contained in Volume V, Parts 90 and 94 of 47 CFR of the FCC Rules and Regulations, which govern private repeater stations.

Bureau of Indian Affairs (BIA). The BIA would:

1. Grant a 100-foot right-of-way for construction and operation across approximately 18.0 miles of allotted Indian lands in Oklahoma. The right-of-way would cross the Pawnee and Osage reservations within the Anadarko Area jurisdiction of BIA, and within the boundary of the Cherokee Nation in the Muskogee Area jurisdiction. Authority for issuance of the right-of-way would rest with the Commissioner of Indian Affairs or the Superintendent in charge of the reservation on which the lands involved are situated, in accordance with the Act of February 5, 1948, 62 Stat. 17 (25 USC 323-328), 25 CFR 161.

2. Grant right-of-way easements for construction and operation across two river beds of the Arkansas River in Oklahoma which are owned by the Cherokee Nation. The BIA would appraise the river beds prior to finalization of any right of-way easement agreements.

General conditions that would apply to the above grants are outlined in Appendix D-8.

Using the Muskogee Area Office as an example, the following procedures would generally be followed for acquiring right-of-way grants:

1. A BIA official would explain the proposed project to the Cherokee tribal officials and seek their approval. When ETSI furnishes specific segment plat locations for the Indian tracts involved, appraisals would be requested.

2. ETSI would complete a Consent Form that details the purpose of the easement and pertinent engineering and construction information. This would be supplied to the landowner to ensure he or she is thoroughly advised of all factors of the project. The right-of-way grants would be approved in the Muskogee Area Office, provided the owners have consented in writing and documentation is in order.

Federal Highway Administration (FHWA). The FHWA would:

1. Issue an unknown number of permits to cross federal highways under the authority of 23 CFR 645, subpart (b). The authorized officer would be the Regional Division Administrator.

State

Wyoming. The Wyoming Department of Environmental Quality, Division of Air Quality, has the responsibility for approving construction and granting permits for the operation of the slurry preparation plants. Pursuant to Sections 21 and 24 of the Wyoming Air Quality Standards, the following state actions would be required:

1. Approval to construct slurry preparation plants adjacent to the North Rawhide, Jacobs Ranch, and North Antelope mines in Campbell County. Approval to construct the North Rawhide, Jacobs Ranch, and North Antelope slurry preparation plants was granted on January 15, 1980 (see state permit Nos. CT-274, CT-275, and CT-276 included in Appendix D-9). These permits would have to be revised to handle the throughput increase from 25 to 37.4 MMTA of coal.

2. Permits to operate the slurry preparation plants would be required after a 120-day start-up period. Performance tests would be necessary within 90 days of the initial start-up.

The Wyoming Department of Environmental Quality, Division of Water Quality, would require:

1. Permits for septic systems located at pump station sites for disposal of sanitary wastewater

2. Permits for ponds located at pump stations or slurry preparation plants designed to store or dispose coal slurry

The following additional permits would also be required:

1. Approval from the Public Service Commission to operate the coal slurry pipeline in Wyoming

2. Permits to cross state highways

3. Permit from the State Engineer to appropriate an additional 5,000 acre-feet annually from the Madison Formation. This permit would not be required to implement the project, but would be required at some later point in the life of the project.

Nebraska. The state of Nebraska would require:

1. Special state highway crossing permits issued by the Department of Roads, Highway Access Control Officer

2. Flood plain permits issued by the Department of Water Resources

Kansas. The Kansas Department of Agriculture, Division of Water Resources, would require the following permits:

1. Permits for each stream crossing where the stream flow is greater than 5 cubic feet per second

2. Permits for each of the two water-well sites associated with the three proposed pump stations

Additionally, permits to cross state highways may be required.

Oklahoma. The Oklahoma Water Resource Board would require:

1. Waste disposal permit for water discharge within Oklahoma

2. Water use permits for ground-water wells at pump stations in Oklahoma

Additionally, permits to cross state highways would be required.

Arkansas. The state of Arkansas would require:

1. Prevention of Significant Deterioration permit from the Environmental Protection Agency

2. Water quality permit for water runoff from stored coal from the Arkansas Department of Pollution Control and Ecology

3. Permits to cross state highways

Louisiana. The Louisiana Wildlife and Fisheries Commission (LWFC) administers the Natural and Scenic Rivers System program under the authority of the Scenic Rivers System Act of 1970, Number 398. The ETSI coal slurry pipeline would cross three natural and scenic rivers in Louisiana. Therefore the Louisiana Wildlife and Fisheries Commission would grant separate "Class B Use" permits for each crossing of the following natural and scenic rivers: Little River, Spring Creek, and Bayou Bartholomew.

LWFC would conduct a thorough evaluation of the impacts of the proposed use. The parameters that would be evaluated include wilderness qualities, scenic values, ecological effects, recreation, fishing, wildlife, archeological, botanical, water quality, and other natural and physical features and resources. In addition, the Louisiana Geological Survey would evaluate geological parameters.

Other major permitting applications that would be required include:

1. Permits for water and solid waste effluents from the Louisiana Office of Environmental Affairs, Department of Natural Resources

2. Pipeline authorization from the Office of Conservation, Department of Natural Resources

3. Right-of-way authorizations from the Office of State Lands, Department of Natural Resources

4. Permits to cross state highways

1.F.5 INTERRELATIONSHIP OF PROPOSED ACTION WITH OTHER PLANNED PROJECTS

Projects that are in the planning stages in the well field and slurry preparation plant area of Wyoming were examined to determine which ones are likely to occur by 1990. Table 1-8 lists the projects that are most likely to occur.

Table 1-9 lists planned construction activities adjacent to the proposed dewatering plant sites. The schedules and manpower demands for these projects have been considered in the assessment of socioeconomic impacts.

Other planned projects in the vicinity of the proposed project include the Chicago and North Western (C&NW) coal line project in Wyoming, Interstate 49 (I-49) (Louisiana North-South Expressway) and I-630 in Arkansas.

1.G MARKET ALTERNATIVE

1.G.1 GENERAL DESCRIPTION

The market alternative would be very similar to the proposed action but would serve two different markets. Oologah, Oklahoma, and Baton Rouge, Louisiana, would be served rather than Ponca City and Muskogee, Oklahoma (Table 1-10). These changes in markets require minor changes to the main slurry pipeline

TABLE 1-8

PROJECTS PLANNED FOR WELL FIELD AND PREPARATION PLANT AREA DURING PROPOSED CONSTRUCTION PERIOD

Project	Company	Construction Period
Coal Mines		
Antelope	NERCO	1982-1983
Rawhide South	Carter-Exxon	1981-1982
East Gillette	Kerr-McGee	1982-1984
Pronghorn	Mobil Oil	1980-1982
Rojo Caballos	Mobil Oil	1981-1982
Wymo Fuels	Wymo Fuels Inc.	1982-1985
North Antelope	Peabody Coal Co.	1982-1983
Wildcat Creek	Pittsburg Midway Coal Co.	1981-1982
Rochelle	Rochelle Coal Co.	1982-1983
Coal Creek	Thunder Basin Coal Co.	1980-1981
Dry Fork	Cities Service	1983-1984
North Rochelle	Shell Oil Co.	1983-1984
Synfuels		
Panhandle Eastern	WyCoalGas	1982-1986
Uranium Operations		
Moore Ranch/Sand Rock Mill	Continental Oil Co.	1982-1983
Greasewood Creek Mine	Cleveland Cliffs Iron Co.	1985
Cleveland Cliffs In-Situ Mines	PINTEC and Thunderbird-joint venture	1981-1985
Reno Ranch	Rocky Mountain Energy Co.	1985-1987
North Butte Mine & Mill	Cleveland Cliffs Iron Co.	1983-1986
Power Plant		
Wyodak #2	Pacific Power & Light	1981-1986

TABLE 1-9

PROJECTS PLANNED OR UNDER CONSTRUCTION
AT DEWATERING PLANT SITES DURING PROPOSED CONSTRUCTION PERIOD

Dewatering Plant Site	Project	Company	Construction Period
Ponca City, OK[a]	Sooner Power Plant Units 3 and 4	Oklahoma Gas & Electric	1984-1987
Pryor, OK[a,b,c]	Grand River Dam Authority Unit 2	Grand River Dam Authority	1984-1986
Muskogee, OK[a]	Muskogee Power Plant Unit 6	Oklahoma Gas & Electric	1982-1984
Independence, AR[a,b,c]	Independence Steam Electric Station	Arkansas Power & Light	1980-1984
New Roads, LA[a,b]	Big Cajun Unit 3	Cajun Electric	Construction ongoing 1980, on-line 1983
Wilton, LA[a,b]	Wilton Power Plant Units 1 and 2	Louisiana Power & Light	1985-1988
Baton Rouge, LA[b]	Exxon Cogeneration Plant	Exxon	1983-1986

[a] Proposed action markets.

[b] Market alternative markets.

[c] Cypress Bend pipeline-barge markets.

TABLE 1-10

PROPOSED COAL DELIVERY SCHEDULE: MARKET ALTERNATIVE

Delivery Terminal	As-Mined Coal (MMTA)				
	1985	1986	1987	1988	1989
Oologah, OK	3.5	3.5	3.5	3.5	3.5
Pryor, OK	2.7	5.3	5.3	5.3	5.3
Independence, AR	5.0	5.0	5.0	5.0	5.0
White Bluff, AR	5.0	5.0	5.0	5.0	5.0
Boyce, LA	1.8	1.8	1.8	1.8	1.8
Lake Charles, LA	4.0	4.0	4.0	4.0	4.0
New Roads, LA	2.0	2.0	2.0	2.0	2.0
Baton Rouge, LA	--	5.8	5.8	5.8	5.8
Wilton, LA	--	--	2.5	2.5	5.0
Total	24.0	32.4	34.9	34.9	37.4

route, the two dewatering plant locations, and individual preparation plant throughputs (although the total project throughput of 37.4 MMTA would remain the same). The main slurry pipeline route in all states but Kansas and Oklahoma is essentially the same as the proposed action route. The differences in Kansas and Oklahoma are due to the differences in the Oklahoma markets served (Map 1-3). Maps showing the locations of all system components are provided in Appendix A.

During construction of this alternative, approximately 22,199 acres would be disturbed. Approximately 1 percent of this land is federally controlled. All of the disturbed acres would be reclaimed as outlined in Appendix C-1. These acres would be returned to their preconstruction use wherever possible. Exceptions would be in the case of large trees growing directly over the pipeline. Construction of the surface facilities would require approximately 943 acres, but only 843 acres would be utilized during the operational phase.

The total construction and annual water requirements for the market alternative would be the same as those for the proposed action (Table 1-3). However, because of the differences in pump station locations, the pump station water requirements would be slightly different, as shown in Table 1-11.

The construction schedules for the water supply system, slurry supply lines, main slurry pipeline construction spreads, communication system, and maintenance bases would be the same as those for the proposed action (Figures 1-2 and 1-3). Figures 1-6 and 1-7 present the construction schedules for the other project components.

Tables 1-12 and 1-13 show the construction work force required for the project. Table 1-14 lists the operating personnel that would be required.

The interrelationships of the market alternative with other proposed projects would be the same as those discussed for the proposed action (Section 1.F.5.).

1.G.2 PROJECT COMPONENTS

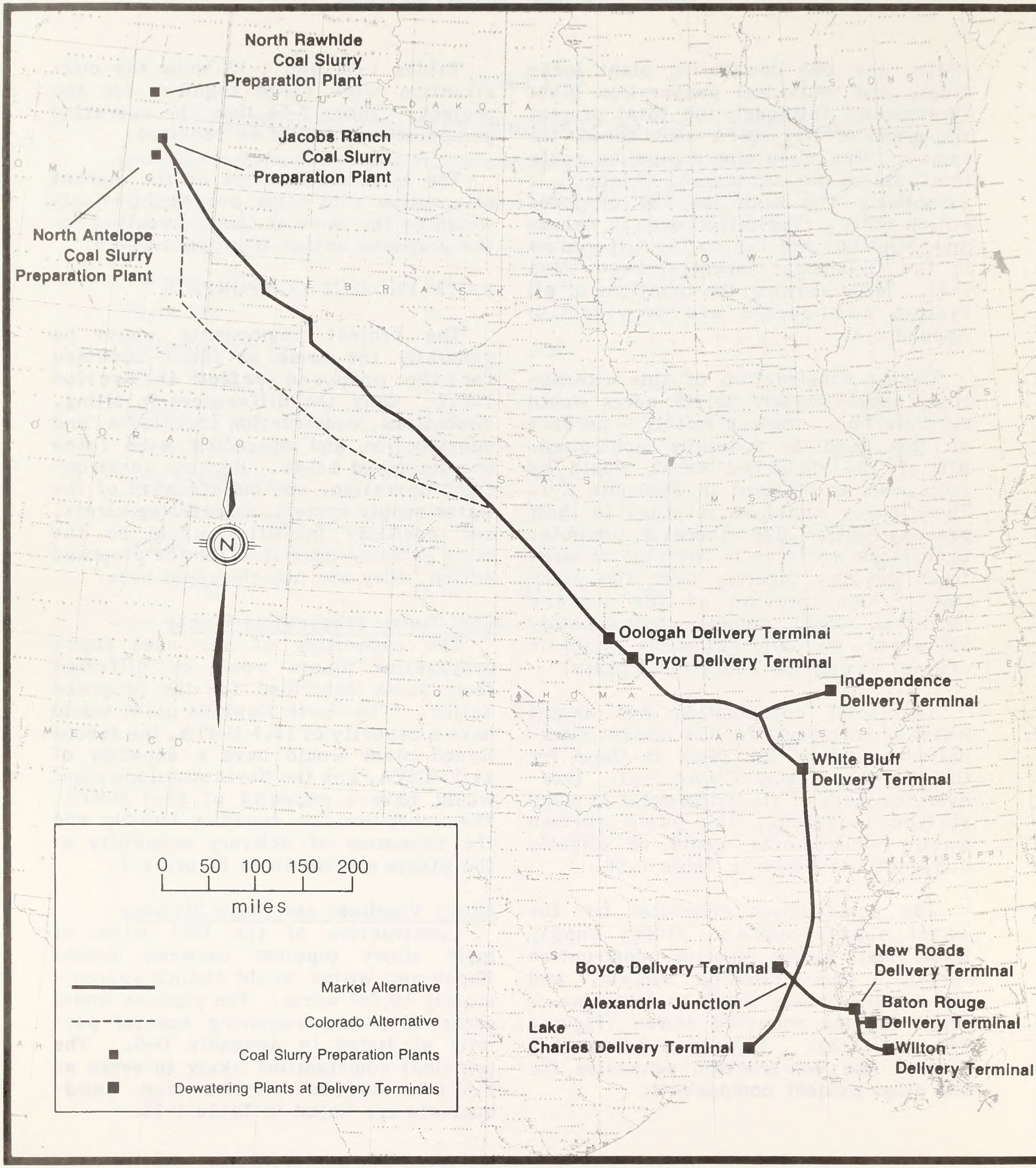
The project components would be generally the same as those discussed for the proposed action in Section 1.F.2. Only the differences in siting, dimensions, construction techniques, and construction and operating work force are described below. Because construction, operation, and maintenance of the water supply system, dewatering plants, and ancillary facilities would be the same as those described for the proposed action, they are not discussed here.

Coal Slurry Preparation Plants

The capacities of the coal slurry preparation plants would be different from those described for the proposed action. The North Rawhide plant would have a capacity of 13.1 MMTA, the Jacobs Ranch plant would have a capacity of 14.3 MMTA, and the North Antelope plant would have a capacity of 10.0 MMTA. The schedules for capacity buildup and the expansion of delivery capability at the plants are shown in Figure 1-7.

Slurry Pipelines and Pump Stations

Construction of the 1621 miles of main slurry pipeline between Jacobs Ranch and Wilton would disturb approximately 19,647 acres. The pipeline would cross 56 rivers requiring special permits as listed in Appendix D-6. The principal communities likely to serve as pipeline spread construction headquarters are listed in Table 1-13.



Map 1-3. LOCATION AND GENERAL ARRANGEMENT OF THE MARKET AND COLORADO ALTERNATIVES

TABLE 1-11

PUMP STATION WATER REQUIREMENTS:
MARKET ALTERNATIVE

State	Local Wells Required	Total Water Requirements (acre-feet/year)
Wyoming	2	60
Nebraska	1	40
Kansas	3	120
Oklahoma	2	50

FIGURE 1-6

ASSUMED PIPELINE AND PUMP STATION CONSTRUCTION SCHEDULE: MARKET ALTERNATIVE

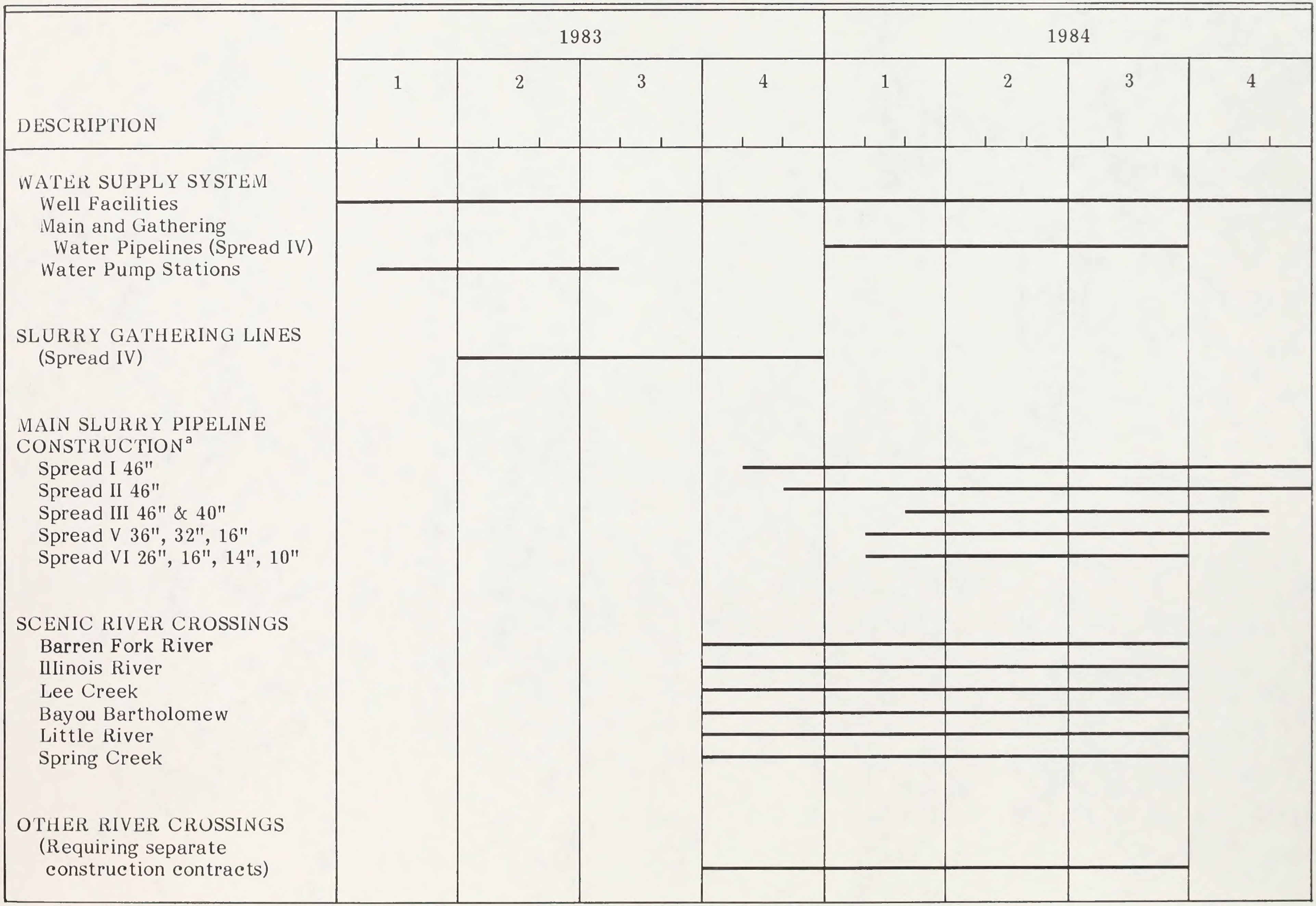
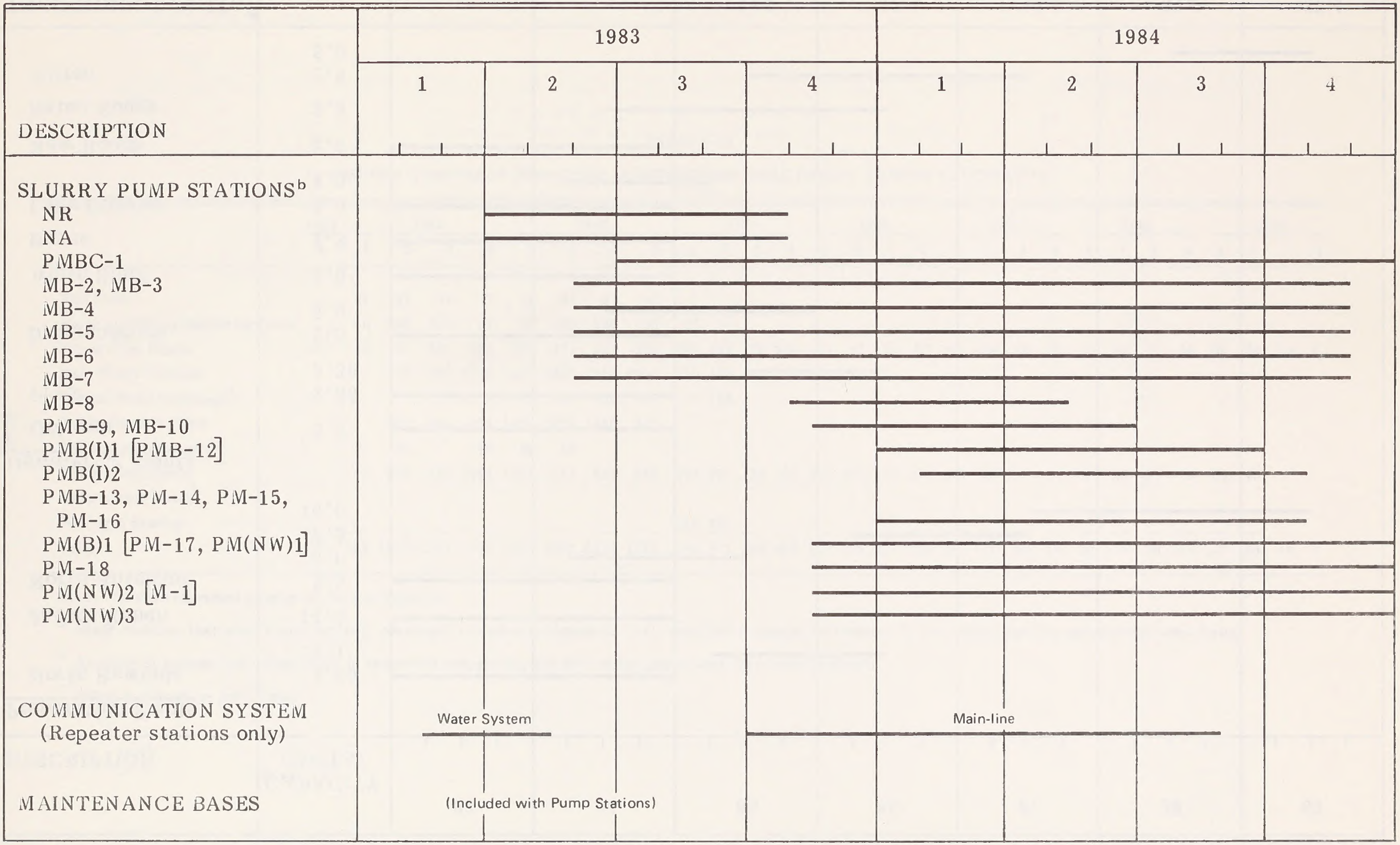


FIGURE 1-6 (concluded)

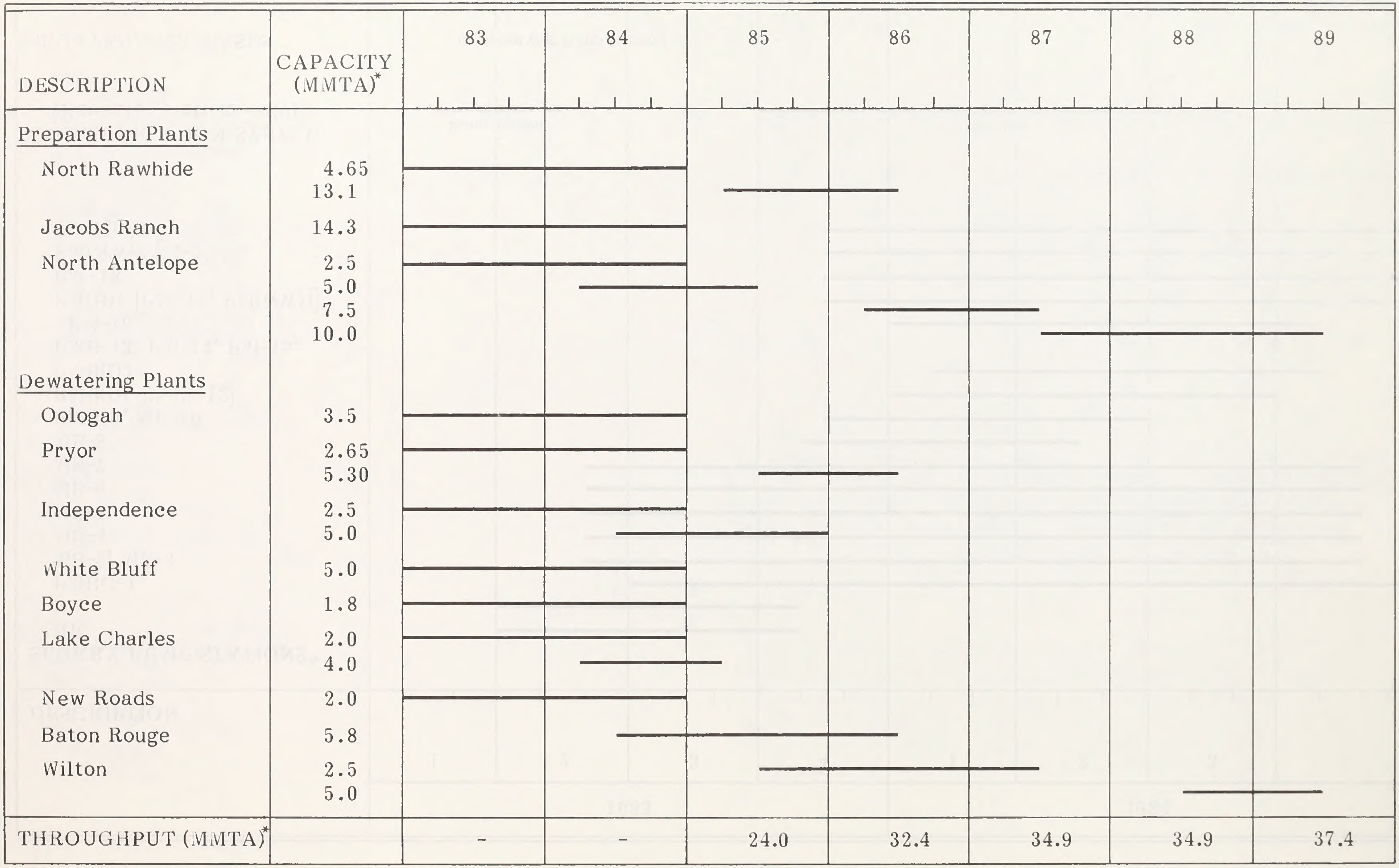


[a]See Table 1-12 for spread locations.

[b]See strip maps in Appendix A for description of symbols and locations of pump stations. There are only 22 different slurry pump station locations; pump station shown in brackets is at same location as first pump station listed in the row.

FIGURE 1-7

ASSUMED PREPARATION AND DEWATERING PLANTS CONSTRUCTION SCHEDULE: MARKET ALTERNATIVE



* Millions of (short) tons annually

TABLE 1-12

ASSUMED QUARTERLY BUILDUP OF CONSTRUCTION WORK FORCE: MARKET ALTERNATIVE

	1982	1983				1984				1985				1986				1987				1988				1989			
	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Well Field		41	41	41	41	41	41	41	41																				
Water and Slurry Gathering Lines		60	360	360	60	90	260	260	30	15																			
Preparation Plants	29[c]	96	145	206	300	380	414	387	325	165	154	72	126	105	53	56	67	62	34	40	19	5	11	21	49	56	25	18	5
Main Slurry Pipeline			100	500	2950	2950	2950	2950	2950	300	100																		
Special River Crossings[a]							150	150	150	150	150																		
Slurry Pump Stations			265	685	975	1870	1970	1680	945																				
Communication System		20	20		20	20	20																						
Dewatering Plants		52	295	587	1031	1202	1063	815	435	154	207	224	353	413	402	310	203	93	43			20	45	65	70	60	40		
Maintenance Bases[b]																													
Testing & Startup										260	260																		
Total	29[c]	269	1226	2379	5377	6553	6868	6283	4876	1044	871	296	479	518	455	366	270	155	77	40	19	25	56	86	119	116	65	18	5

Note: Numbers represent number of workers required.

[a] River crossings that may require separate construction contracts (Appendix D-6). Standard crossings are included in main slurry pipeline construction work force.

[b] Numbers of workers are incorporated in respective preparation and dewatering plants work force requirements.

[c] Initial mobilization work force.

TABLE 1-13

PIPELINE SPREAD RESPONSIBILITIES: MARKET ALTERNATIVE

Pipeline Spread	Likely Spread Headquarters	Pipeline Segment[a]	Miles	Workers Required: Typical Spread[b]	Workers Required: Add for Rough Terrain
I	Gillette, WY Wright, WY Lusk, WY Scottsbluff, NB Ogallala, NB McCook, NB	Jacobs Ranch (PMB-0) to MB-12	390	670	78
II	Russell, KS Wichita, KS Bartlesville, OK	MB-12 to Pryor (MB-407.5)	396	670	78
III	Bartlesville, OK Fort Smith, AR Russellville, AR	Pryor to Atkins Junction (MB-407.5 to PMB-997.4)	162	610	78
IV	Gillette, WY	Jacobs Ranch to North Antelope (water)	16	260	-
		North Antelope to Jacobs Ranch (slurry)	16	390	-
		Jacobs Ranch to North Rawhide (water)	54	260	-
		North Rawhide to Jacobs Ranch (slurry)	54	390	-
		Jacobs Ranch to Well Field (water)	68	390	-
V	Russellville, AR	Atkins Junction to White Bluff (PMB-997.4 to PMB-1077.6)	80	550	65
	Batesville, AR	White Bluff to Alexandria Junction (PMB-1077.6 to PM 1315)	238	550	65
	Pine Bluff, AR	Atkins Junction to Independence (PMB(I)-0 to PMB(I)-93)	93	260	-
VI	Monroe, LA	Alexandria Junction to New Roads (PM(NW)-0 to PM(NW)-75.6)	76	390	-
	Alexandria, LA	New Roads to Wilton (PM(NW)-75.6 to PM(NW)-141.5)	66	260	-
	Lake Charles, LA	Alexandria Junction to Boyce (PM(B)-0 to PM(B)-24)	24	260	-
	Baton Rouge, LA	Alexandria Junction to Lake Charles (PM-1315 to PM-1404)	89	260	-
		New Roads to Baton Rouge (M-0 to M-24.4)	24	260	-

Notes: Spread I would proceed from south to north; spread IV would proceed as shown above; the remaining spreads would proceed from north to south.

[a] Explanation of milepost (MP) designations is included in Appendix A.

[b] Numbers represent maximum number of workers per pipeline segment.

TABLE 1-14

SUMMARY OF OPERATING PERSONNEL:
MARKET ALTERNATIVE

Location	Total
Headquarters (Denver, CO)	41
Western District (Jacobs Ranch, WY)	
Administration	4
Water Supply	11
Preparation	196
Pipeline	9
Maintenance Base	23
Subtotal	243
Central District (Pryor, OK)	
Administration	3
Dewatering Plant	57
Pipeline	24
Maintenance Base	33
Subtotal	117
Eastern District (White Bluff, AR)	
Administration	3
Dewatering Plants	73
Pipeline	18
Maintenance Base	47
Subtotal	141
Southern District (New Roads, LA)	
Administration	3
Dewatering Plants	137
Pipeline	24
Maintenance Base	47
Subtotal	211
Total	753

Upon completion of construction, the pipeline right-of-way would be reclaimed as described in Appendix C-1. The affected right-of-way acreage would be returned to its preconstruction use wherever possible, except in the case of large trees growing directly over the pipeline.

The slurry pipeline system would require 22 pump stations, of which 3 are included in the preparation plant acreage. Approximately 20 to 25 acres would be required for each of the remaining 19 slurry pump stations.

1.H CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

1.H.1 GENERAL DESCRIPTION

Under the Cypress Bend pipeline-barge alternative, coal slurry would be transported by pipeline along the market alternative route from Jacobs Ranch, Wyoming, to the White Bluff, Arkansas, delivery terminal (PMB-0 to PMB-1077.6, as shown on Appendix A maps). Coal deliveries would be made at the same terminals served by the market alternative along this part of the route (Oologah and Pryor, Oklahoma; Independence and White Bluff, Arkansas). From White Bluff a lateral pipeline, with one pump station, would be constructed eastward 81 miles to a barge loading facility on the Mississippi River at Cypress Bend, Arkansas. Coal would be transported by barge down the Mississippi River to the New Roads, Baton Rouge, and Wilton, Louisiana, delivery terminals. This route is shown on Map 1-4. Table 1-15 shows the coal delivery schedule for the terminals.

This alternative would include a barge loading facility in addition to coal slurry preparation plants, water supply system, coal slurry pipelines and pump stations, and dewatering plants. Maps showing the locations of all system components are provided in Appendix A.

During construction of this alternative, approximately 17,097 acres would be disturbed. Approximately 1 percent of this land is federally controlled. All of the disturbed acres would be reclaimed as outlined in Appendix C-1. They would be returned to their preconstruction use wherever possible, except in the case of large trees growing directly over the pipeline. Construction of the surface facilities would require approximately 918 acres, but only 818 acres would be utilized during the operational phase.

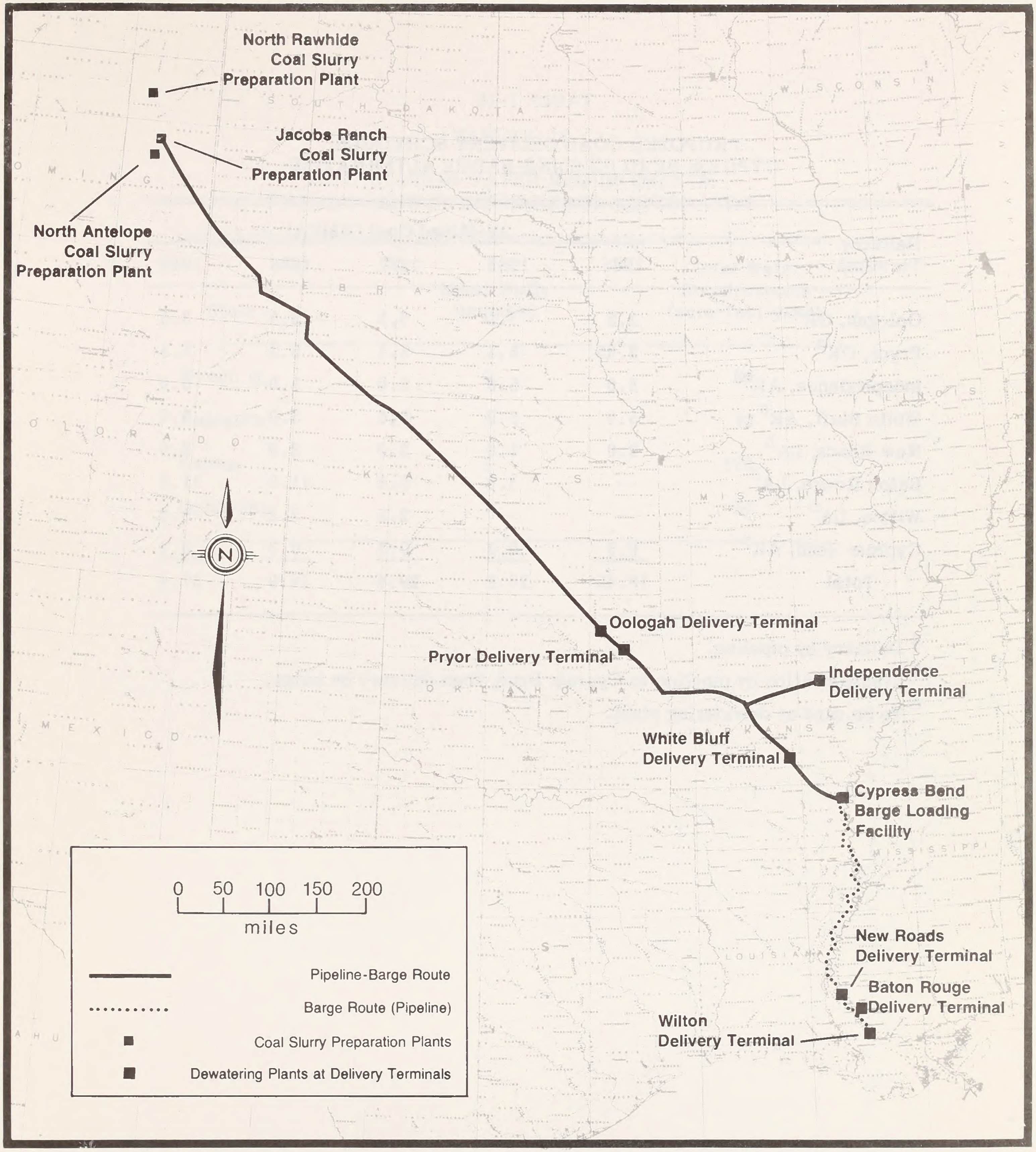
The total construction and annual water requirements would be the same as those for the proposed action (Table 1-4). However, because of the differences in the pump station locations, the pump station water requirements would be slightly different, as shown in Table 1-16.

The construction schedule for this alternative is shown on Figures 1-8 and 1-9. Table 1-17 shows the construction work force required for the project. Table 1-18 lists the operating personnel requirements.

The interrelationships of the Cypress Bend pipeline-barge alternative with other planned projects would be the same as those for the proposed action (Section 1.F.5).

1.H.2 PROJECT COMPONENTS

The Cypress Bend pipeline-barge alternative would have the same components as the proposed action, with the addition of barge loading facilities,



Map 1-4. LOCATION AND GENERAL ARRANGEMENT OF THE CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

TABLE 1-15

PROPOSED COAL DELIVERY SCHEDULE:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

Delivery Terminal	As-Mined Coal (MMTA)				
	1985	1986	1987	1988	1989
Oologah, OK[a]	3.5	3.5	3.5	3.5	3.5
Pryor, OK[a]	2.65	5.3	5.3	5.3	5.3
Independence, AR[a]	5.0	5.0	5.0	5.0	5.0
White Bluff, AR[a]	5.0	5.0	5.0	5.0	5.0
New Roads, LA[b]	2.0	2.0	2.0	2.0	2.0
Baton Rouge, LA[b]	--	5.8	5.8	11.3	11.3
Wilton, LA[b]	--	--	2.5	2.5	5.0
Cypress Bend, AR[c]	0.3	0.3	0.3	0.3	0.3
Total	18.45	26.9	29.4	34.9	37.4

[a] Delivery by pipeline.

[b] Transportation by pipeline to Cypress Bend, then delivery by barge.

[c] To be used at dewatering plant.

TABLE 1-16

PUMP STATION WATER REQUIREMENTS:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

State	Local Wells Required	Total Water Requirements (acre-feet/year)
Wyoming	2	60
Nebraska	1	40
Kansas	3	120
Oklahoma	2	50

FIGURE 1-8

ASSUMED PIPELINE AND PUMP STATION CONSTRUCTION SCHEDULE:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

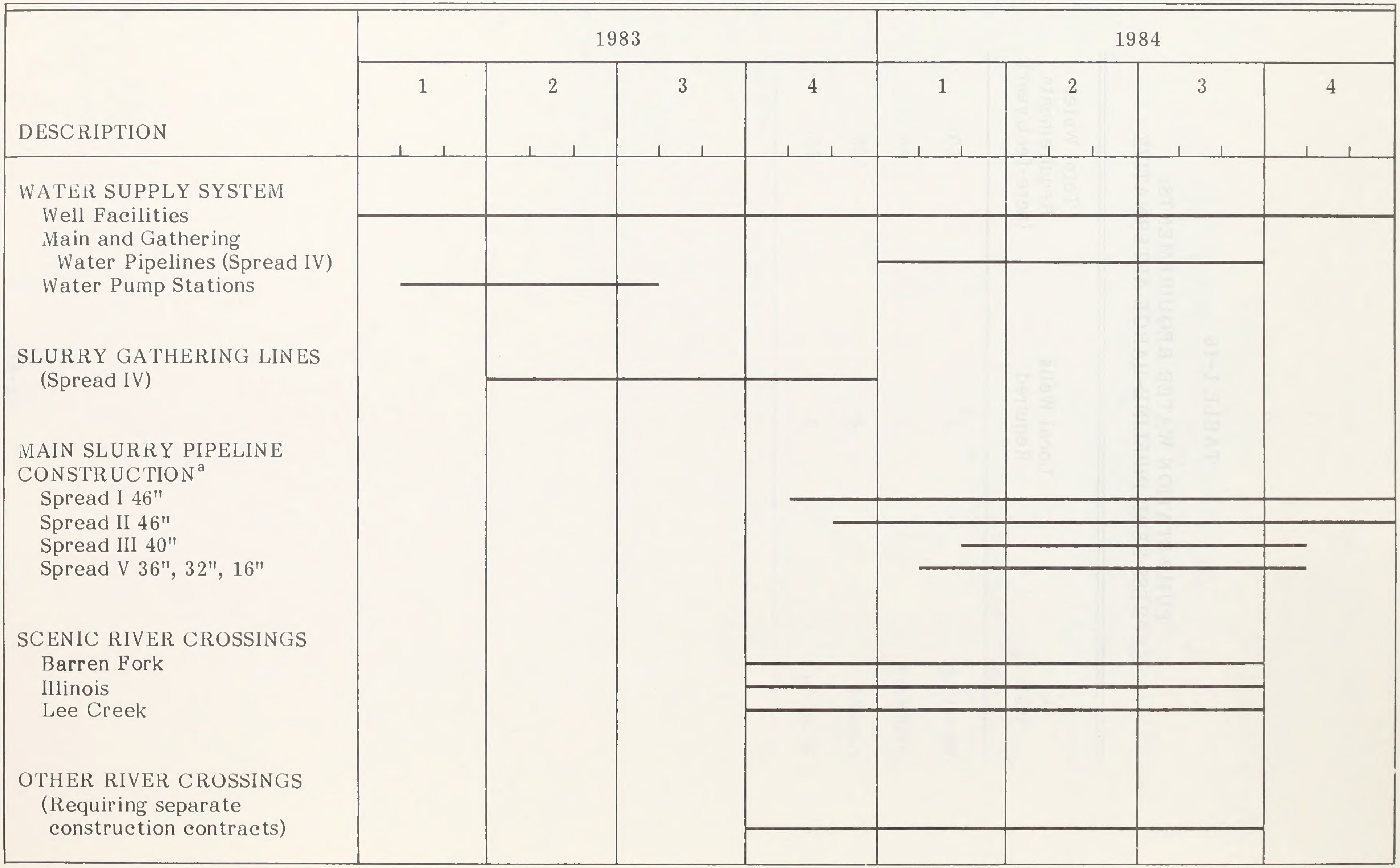
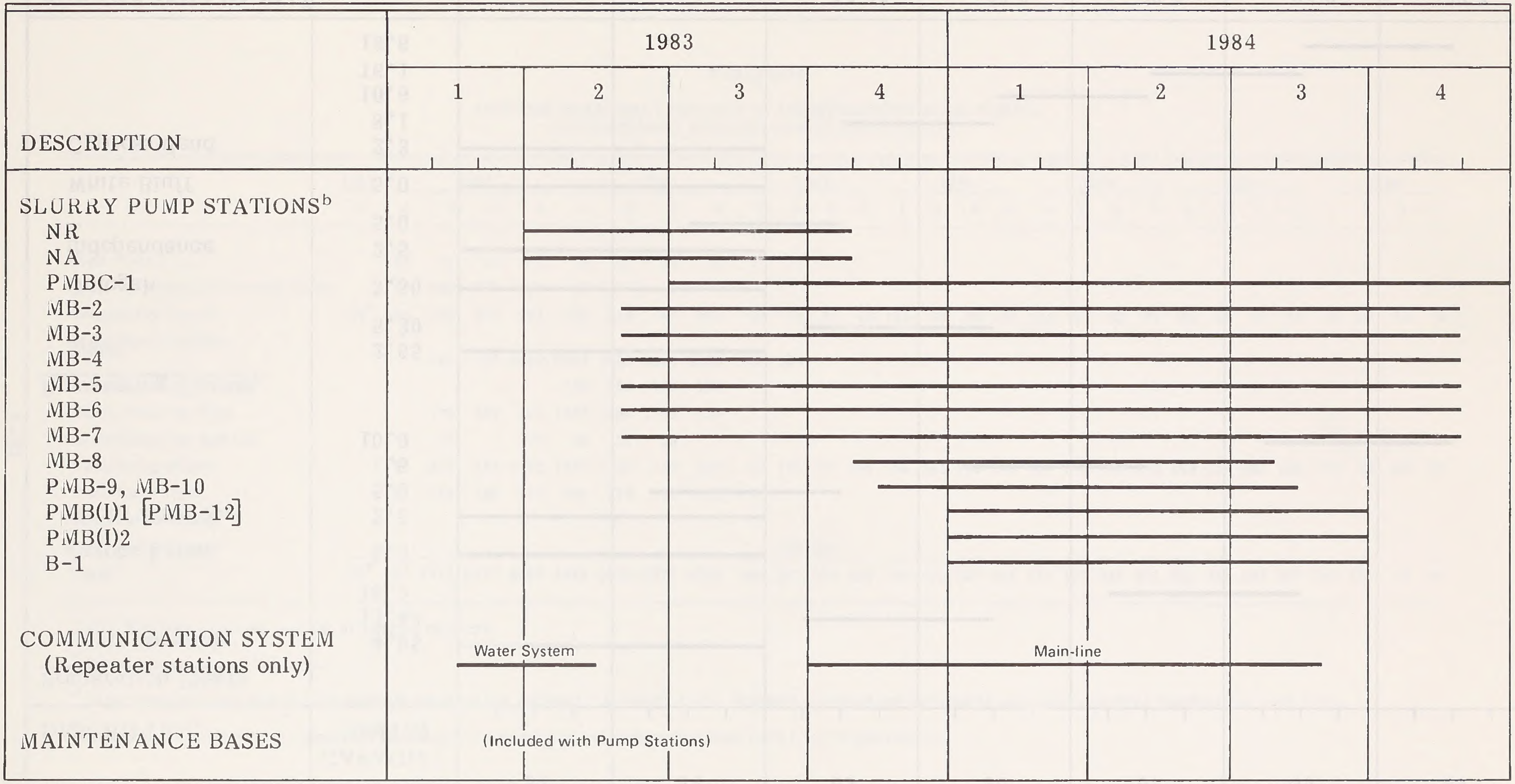


FIGURE 1-8 (concluded)

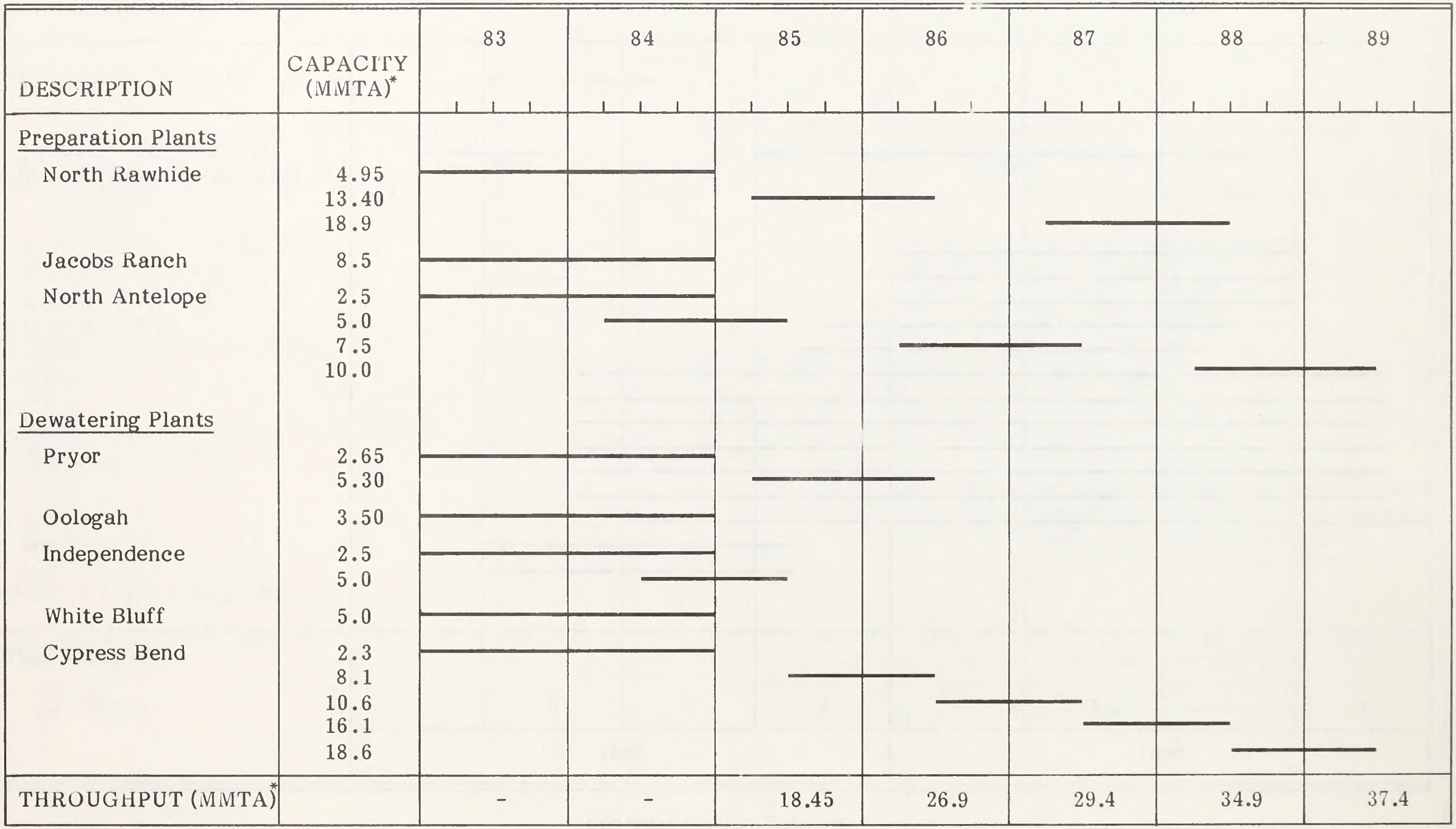


[a]See Table 1-18 for spread locations.

[b]See strip maps in Appendix A for description of symbols and locations of pump stations. There are only 15 different slurry pump station locations; pump station shown in brackets is at same location as first pump station listed in the row.

FIGURE 1-9

ASSUMED PREPARATION AND DEWATERING PLANTS CONSTRUCTION SCHEDULE:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE



* Millions of (short) tons annually

TABLE 1-17

ASSUMED QUARTERLY BUILDUP OF CONSTRUCTION WORK FORCE:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

	1982	1983				1984				1985				1986				1987				1988				1989			
	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Well Field		41	41	41	41	41	41	41	41																				
Water and Slurry Gathering Lines		60	360	360	60	90																							
Preparation Plants	31[a]	124	172	209	291	343	419	348	304	94	70	76	68	116	58	59	67	61	36	52	81	91	65	59	67	56	25	18	5
Main Slurry Pipeline			100	500	2560	2560	2560	2560	2560	300	100																		
Special River Crossings[b]						150	150	150	150																				
Slurry Pump Stations			175	452	644	1234	1300	1109	624																				
Communication System		20	20		20	20	20	20																					
Dewatering Plants		95	417	731	1102	1272	1108	839	376	92	157	197	267	266	244	190	160	110	150	190	190	190	190	190	160	110	90	60	30
Coal-Fired Plant		50	125	150	175	200	170	150	25																				
Maintenance Bases[c]																													
Testing & Startup											260	260																	
Total	31[a]	390	1410	2443	4893	5910	6028	5477	4085	486	587	533	335	382	302	249	227	171	186	242	271	281	255	249	227	166	115	78	35

Note: Numbers represent number of workers required.

[a] Initial mobilization work force.

[b] River crossings that may require separate construction contracts (Appendix D-6). Standard crossings are included in main slurry pipeline construction work force.

[c] Numbers of workers are incorporated in respective preparation and dewatering plant work force requirements.

TABLE 1-18

SUMMARY OF OPERATING PERSONNEL:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

Location	Total
Headquarters (Denver, CO)	41
Western District (Jacobs Ranch, WY)	
Administration	4
Water Supply	11
Preparation Plants	196
Pipeline	9
Maintenance Base	23
Subtotal	243
Central District (Pryor, OK)	
Administration	3
Dewatering Plants	57
Pipeline	24
Maintenance Base	33
Subtotal	117
Eastern District (White Bluff, AR)	
Administration	3
Dewatering Plants	210
Pipeline	18
Maintenance Base	47
Subtotal	278
Total	679

including a dewatering plant, at Cypress Bend. Because planned or existing barge unloading facilities owned by the coal customers would be used, they are not considered part of this alternative. The water supply system and ancillary facilities would be the same as those described for the proposed action in Section 1.F.2, so they are not discussed here. In general, the design, construction, operation, and maintenance of the preparation plants, slurry pipelines, and pump stations would also be the same as those described for the proposed action. However, specific capacities, dimensions, and similar details would be different. These are described below.

Coal Slurry Preparation Plants

For this alternative, the North Rawhide plant would process 18.9 MMTA, the Jacobs Ranch plant would process 8.5 MMTA, and the North Antelope plant would process 10.0 MMTA. The schedules for capacity buildup and the expansion of delivery capabilities of the plants are shown in Figure 1-9. Acreage requirements would be 110 for North Rawhide, 70 for Jacobs Ranch, and 65 for North Antelope.

Slurry Pipelines and Pump Stations

Construction of the 1202 miles of slurry pipeline between Jacobs Ranch and Cypress Bend would disturb approximately 14,568 acres. The pipeline would cross 37 rivers requiring special permits as listed in Appendix D-6. The principal communities likely to serve as pipeline spread construction headquarters are listed in Table 1-19.

Upon completion of construction, the pipeline right-of-way would be reclaimed as described in Appendix C-1. The affected right-of-way acreage would be returned to its preconstruction use wherever possible, except in the case of large trees growing directly over the pipeline.

Approximately 20 to 25 acres would be required for each of the 12 slurry pump stations not located within a preparation plant boundary. The main water pump station (Niobrara well field) would require approximately 3 acres.

Dewatering Plants

The dewatering plants for this alternative would be similar to those described for the proposed action, except for the plant at the Cypress Bend barge loading site. Since no power plant would be at this location, a coal-fired boiler would be required to supply the necessary heat. This boiler would burn coal supplied by the pipeline at a rate of 300,000 tons per year (Table 1-15). A pit would be provided for disposal of the coal ash (Map 1-5). The residual water would be treated as necessary and discharged into the Mississippi River as described in Section 1.M.

Barge Loading Facility

The Cypress Bend loading facility would be sized to load 18.3 MMTA of coal for delivery to downstream customers. This facility, including the associated 18.3-MMTA dewatering plant described above, would occupy a 205-acre fenced plot.

A conveyor would transfer coal from the dewatering plant to two stockpiles at the barge loading facility. The terminal would provide for two 100-foot-long staging areas for full and empty barges, in addition to the loading area. The terminal dock would be constructed by driving the sheet piles from a barge operation. No dredging would be required. The layout for the barge loading facility is shown on Map 1-5.

Barges would be loaded on a round-the-clock schedule at a rate of 2 barges per hour. Fifteen to 20 barges pulled by one tugboat would make up each tow. An average of two tows would leave the

TABLE 1-19

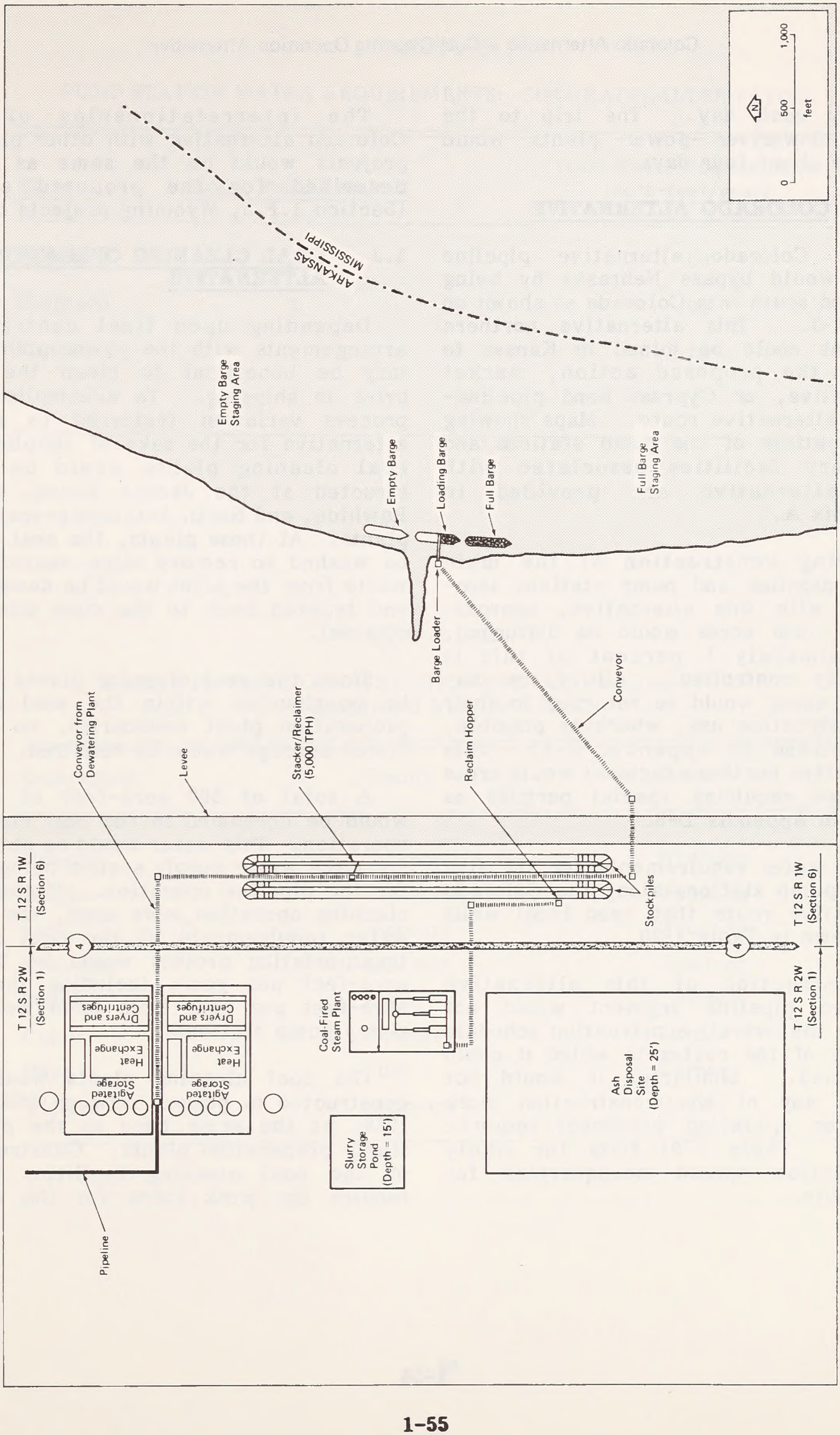
PIPELINE SPREAD RESPONSIBILITIES:
CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

Pipeline Spread	Likely Spread Headquarters	Pipeline Segment[a]	Miles	Workers Required: Typical Spread[b]	Workers Required: Add for Rough Terrain
I	Gillette, WY Wright, WY Lusk, WY Scottsbluff, NB Ogallala, NB McCook, NB	Jacobs Ranch (PMB-0) to MB-12	390	670	78
II	Russell, KS Wichita, KS Bartlesville, OK	MB-12 to Pryor (MB-407.5)	396	670	78
III	Bartlesville, OK Fort Smith, AR Russellville, AR	Pryor to Atkins Junction (MB-407.5 to PMB-997.4)	162	610	78
IV	Gillette, WY	Jacobs Ranch to North Antelope (water)	16	260	-
		North Antelope to Jacobs Ranch (slurry)	16	390	-
		Jacobs Ranch to North Rawhide (water)	55	260	-
		North Rawhide to Jacobs Ranch (slurry)	55	390	-
		Jacobs Ranch to Well Field (water)	68	390	-
V	Russellville, AR Batesville, AR Pine Bluff, AR Dumas, AR	Atkins Junction to White Bluff (PMB-997.4 to PMB-1077.6)	80	550	65
		White Bluff to Cypress Bend (PMB-1077.6 to B-80.6)	81	550	65
		Atkins Junction to Independence (PMB(I)-0 to PMB(I)-93)	93	260	-

Notes: Spread I would proceed from south to north; spread IV would proceed as shown above; all remaining spreads would proceed from north to south.

[a] Explanation of milepost (MP) designations is included in Appendix A.

[b] Numbers represent maximum number of workers per pipeline segment.



Map 1-5 BARGE FACILITY

facility each day. The trip to the three downriver power plants would require about four days.

1.I COLORADO ALTERNATIVE

The Colorado alternative pipeline route would bypass Nebraska by being directed south into Colorado as shown on Map 1-3. This alternative northern segment could be joined in Kansas to either the proposed action, market alternative, or Cypress Bend pipeline-barge alternative route. Maps showing the locations of the pump stations and ancillary facilities associated with this alternative are provided in Appendix A.

During construction of the main slurry pipeline and pump stations associated with this alternative, approximately 7446 acres would be disturbed. Approximately 1 percent of this is federally controlled. All of the disturbed acres would be returned to their preconstruction use, wherever possible, as outlined in Appendix C-1. This alternative northern segment would cross 3 rivers requiring special permits as listed in Appendix D-6.

The water requirements for the five slurry pump stations along the Colorado alternative route that need local wells are shown in Table 1-20.

Construction of this alternative northern pipeline segment would not change the overall construction schedule for any of the routes to which it could be joined. Similarly, it would not change any of the construction work force or operating personnel requirements. Table 1-21 lists the likely construction spread headquarters for this route.

The interrelationships of the Colorado alternative with other planned projects would be the same as those described for the proposed action (Section 1.F.5, Wyoming projects only).

1.J COAL CLEANING OPERATION ALTERNATIVE

Depending upon final contractual arrangements with the power plants, it may be beneficial to clean the coal prior to shipping. To accomplish this process variation (referred to as an alternative for the sake of simplicity), coal cleaning plants would be constructed at the Jacobs Ranch, North Rawhide, and North Antelope preparation plants. At these plants, the coal would be washed to remove mine waste. All waste from the plant would be dewatered and trucked back to the mine sites for disposal.

Since the coal cleaning plants would be constructed within the coal slurry preparation plant boundaries, no additional acreage would be required.

A total of 300 acre-feet of water would be consumed in the coal cleaning operation. This water would be obtained from the water supply system being used for the pipeline operation. If the coal cleaning operation were used, the total water requirements of the coal slurry transportation project would be 20,800 acre-feet per year, including the 300 acre-feet per year from local wells at slurry pump stations.

The coal cleaning plants would be constructed in phases between 1983 and 1989, at the same time as the phased slurry preparation plants. Construction of the coal cleaning facilities would require the work force for the slurry

TABLE 1-20

PUMP STATION WATER REQUIREMENTS: COLORADO ALTERNATIVE

State	Local Wells Required	Total Water Requirements (acre-feet/year)
Wyoming	2	60
Colorado	2	90
Kansas	1	70

TABLE 1-21

LIKELY PIPELINE CONSTRUCTION SPREAD HEADQUARTERS: COLORADO ALTERNATIVE

Community	County	State
Gillette	Campbell	Wyoming
Wright	Campbell	Wyoming
Lusk	Niobrara	Wyoming
Cheyenne	Laramie	Wyoming
Sterling	Logan	Colorado
Colby	Thomas	Kansas
Hays	Ellis	Kansas
Wichita	Sedgwick	Kansas

preparation plants to be increased by one-fourth. The total work force required for construction of the combined facilities is shown in Table 1-22. Similarly, the operating staff for the combined facilities would be one-fourth more than for the preparation plants alone. Thus the total number of personnel required would be 245.

The interrelationships of the coal cleaning alternative with other planned projects would be the same as those described for the proposed action (Section 1.F.5, Wyoming projects only).

1.K CROOK COUNTY ALTERNATIVE WATER SUPPLY SYSTEM

The Crook County alternative water supply system is an alternative to the Niobrara County well field, the primary water source for the proposed action. Implementation of this alternative would require ETSI to obtain new well permits from the Wyoming State Engineer. Under this alternative, the main water source for the coal slurry transportation project would be a well field drilled into the Madison Formation northeast of Gillette in Crook County, Wyoming, as shown on Map 1-2. A test well (Cole No. 41 at NE1/4 NE1/4, Sec. 28, T56N, R57W) has been drilled and results of pump testing will be available by mid-1981. This water supply system would require a total of approximately 770 acres during construction and 15 acres during operation.

Most aspects of the Crook County water supply system would be the same as those described for the Niobrara County well field in Section 1.F.2 under Water Supply System. The construction schedule and construction and operating procedures would be the same as outlined in that section. Due to the amount of flow volume expected in wells at this site, approximately 24 wells would be required; hence, only about 150 construction and operation personnel would be required.

Because of the more northerly location of the well field, the distribution system for the well-field water would be different from that described for the Niobrara County well field. The well-field pump station would pump water through 47 miles of buried, 26-inch O.D. main water pipeline to a distribution head tank at the North Rawhide preparation plant. The tank would supply the preparation plant at North Rawhide and the water pipeline to the Jacobs Ranch distribution head tank. This tank similarly would supply the Jacobs Ranch preparation plant and the water pipeline to North Antelope. Should this alternative water system be constructed, the Gillette reserve water supply would be used, if needed, as described for the proposed action in Section 1.F.2, Water Supply System.

The interrelationships of the Crook County alternative water supply system would be the same as those described for the proposed action (Section 1.F.5, Wyoming projects only).

1.L COMBINED WELL FIELD ALTERNATIVE WATER SUPPLY SYSTEM

With this alternative, both the Niobrara County and Crook County well fields would be constructed similar to the proposed action (Section 1.F.2) and the Crook County alternative water supply systems (Section 1.K).

The only difference would be that 22 production wells plus 5 monitoring wells would be constructed at the Niobrara

TABLE 1-22

QUARTERLY BUILDUP OF CONSTRUCTION WORK FORCE:
COAL CLEANING OPERATION ALTERNATIVE

Year	Quarter	Workers
1982	4	43
1983	1	161
	2	236
	3	324
	4	428
1984	1	503
	2	550
	3	298
	4	253
1985	1	83
	2	104
	3	119
	4	71
1986	1	101
	2	134
	3	114
	4	115
1987	1	116
	2	76
	3	73
	4	41
1988	1	25
	2	33
	3	26
	4	61
1989	1	70
	2	31
	3	23
	4	6

County well field and 9 production wells plus 3 monitoring wells would be constructed at the Crook County well field. This would result in a corresponding reduction in the number of miles of gathering pipelines and access roads from 93 miles to about 46 miles.

The same number of construction workers would be used to construct both well fields (see Table 1-5 and Section 1.K), but construction would only take about 1 year for the Niobrara well field and 6 months for the Crook well field.

Instead of pumping up to 20,200 acre-feet per year from just one well field, this alternative would pump 10,100 acre-feet per year from the Niobrara County well field and 10,100 acre-feet per year from the Crook County well field.

1.M OAHE ALTERNATIVE WATER SUPPLY SYSTEM

The Oahe alternative water supply system is an alternative to the Niobrara County well field, the primary water source of the proposed action. Under this alternative, the Oahe Reservoir on the Missouri River near Pierre, South Dakota, would be the major water source for the coal slurry transportation project. There are two options for implementing this alternative: (1) Oahe Reservoir water could be purchased from the state of South Dakota; or (2) Oahe Reservoir water could be purchased from Water and Power Resources Service, a federal agency. The engineering details of the two options would be different, as discussed in the following sections.

1.M.1 WATER PURCHASE FROM SOUTH DAKOTA

The aqueduct that would supply water under this alternative could be built by ETSI or the states of South Dakota and Wyoming. According to an unissued Draft EIS prepared by the state of South Dakota (1980) on the West River Aqueduct, "South Dakota and Wyoming could construct and operate the aqueduct for less than private enterprise due to tax savings and lower interest cost inherent and industrial revenue bonds."

According to the South Dakota Department of Water and Natural Resources (1981), the state would charge ETSI for delivering water from the reservoir to the point of delivery (North Rawhide preparation plant). This charge would be set by a contract between the state and ETSI.

It would be necessary for ETSI to obtain a water right from the state of South Dakota to implement this alternative. The State Board of Water Management, in accordance with South Dakota Compiled Laws 46-5-20.1, would have to present ETSI's appropriation request to the legislature for its approval (South Dakota Department of Water and Natural Resources 1981).

In addition to the actions required of ETSI, the state of South Dakota would need to take certain steps before it could sell water to ETSI. The state would be required to negotiate a master contract with the United States through the Water and Power Resources Service to obtain the right to sell Oahe Reservoir water (South Dakota Department of Water and Natural Resources 1981). Use of the reservoir water is managed by this federal agency. Although a previous contract, No. 7-07-60-WS-001, for 300,000 acre-feet annually was executed on January 11, 1977, the contract was never approved by the state legislature as required.

Under this alternative, a 276-mile pipeline, would be constructed, with eight pump stations, across western South Dakota into Wyoming (Appendix A, Maps A-55 through A-59). The system would be designed for a throughput of

27,200 acre-feet per year, of which 7,125 acre-feet per year would be for designated urban and rural areas in South Dakota, generally along the pipeline route, and 20,000 acre-feet per year would be for ETSI's use (South Dakota 1980; Kallemeyn 1981).

The 7,125 acre-feet represents the current demands of the towns and rural users listed on Table 1-23 (South Dakota 1980; Kallemeyn 1981). The laterals and treatment facilities required for delivery to these towns and rural users would all be financed and constructed through a single bond issue by the South Dakota state agency charged with developing the project. (South Dakota Department of Water and Natural Resources 1981). The construction of the laterals and treatment facilities are beyond the scope of this EIS and any required environmental analysis would be prepared by the appropriate South Dakota agency.

Because the state would make available to ETSI only 20,000 acre-feet of water annually, ETSI would need to obtain the 200 additional acre-feet required for preparation plant (inplant) uses from another source. This amount could be purchased from the city of Gillette, as discussed in Section 1.F.2, Water Supply System.

Table 1-23 lists the names of communities and areas to be served and the drop-off quantities and locations. For small quantities, the pipeline would be directly tapped; in other cases, lateral lines from the pipeline would supply a number of drop-off points. However, as discussed earlier, the taps and laterals would not be constructed by ETSI and would not be part of the ETSI system.

The intake structure at the reservoir would be placed at or below elevation 1540 feet and would be screened to avoid entrainment of fish and aquatic animals. It would be located approximately 7 miles west of the dam on the south shore of the reservoir (CH_2M Hill, Inc. and Francis-Meador-Gellhaus, Inc. 1980). A U.S. Army Corps of Engineers permit would be required for the intake structure. The reservoir pump station located at the site of the intake structure would monitor intake flow.

The main water pipeline would terminate at the distribution head tank at the North Rawhide preparation plant. This head tank would supply the North Rawhide preparation plant and the water pipeline to the Jacobs Ranch head tank. The Jacobs Ranch tank similarly would supply the Jacobs Ranch preparation plant and the water pipeline to North Antelope. Should this alternative be constructed, the Gillette reserve water supply would be used, if needed, as described for the proposed action in Section 1.F.2, Water Supply System.

During construction of this alternative, approximately 3353 acres of land would be disturbed. Approximately 2 percent of this land is federally controlled. All of the disturbed acres would be reclaimed as outlined in Appendix C-1 and returned to their preconstruction use wherever possible, except in the case of large trees growing directly over the pipeline. The pipeline would cross 12 rivers requiring special permits as listed in Appendix D-6.

A staff of 12 would be required to operate and maintain the water supply system. The pump stations would operate automatically.

1.M.2 WATER PURCHASE FROM WATER AND POWER RESOURCES SERVICE

Under this alternative, ETSI would develop a water supply system for its exclusive use. This would require negotiation of a water service contract with the Water and Power Resources

TABLE 1-23

DISTRIBUTION OF WATER FROM OAHE ALTERNATIVE WATER SUPPLY SYSTEM[a]

Distribution Points			Towns/Facilities Served	
Milepost	Pump Station Location	Water Distributed (ac-ft/yr)	Location	Water Delivered (ac-ft/yr)
O-0		27,200.0	(Received from Oahe Reservoir)	
O-20	Cheyenne	1,378.0	Cheyenne (RWS)	1378.0
O-96	Philip	2,247.2	Philip	134.0
			Wall	239.9
			Wasta	22.0
			Cedar (water association)	35.0
			Kadoka	135.8
			Belvedere	11.0
			Okaton	6.0
			Murdo	66.3
			White River	157.0
			Draper	20.3
			Lyman-Jones (RWS)	1153.0
			Vivian	29.2
			Presho	116.0
			Kennebec	80.5
			Reliance	41.2
O-138	New Underwood	452.8	New Underwood	21.8
			Box Elder	280.0
			Hermosa	45.0
			Hermosa (water users district)	106.0
O-163	Alkali	1,226.0	Alkali (RWS)	22.0
			Sturgis	1204.0
O-174	Whitewood	303.0	Whitewood	269.0
			Butte-Meade (RWS)	34.0
O-196	Belle Fourche	1,518.0	Belle Fourche	1518.0
			Unaccounted	75.0
O-287	North Rawhide	20,000.0	North Rawhide preparation plant	

RWS = rural water supply.

[a]Only applicable to the Oahe option involving water purchase from South Dakota (see Section 1.M.1).

Service (WPRS), a federal agency, and compliance with South Dakota water right statutes. Water availability from the Oahe Reservoir was covered in the Water and Power Resources Service final environmental impact statement, Water for Energy, Missouri River Reservoirs (WPRS 1977).

The design of such a system would be similar to that of the Oahe option described in Section 1.M.1; however, it would be sized for only a 20,200 acre-foot annual throughput. A 28-inch buried steel pipeline would be installed over a 276-mile route as shown for the other Oahe alternative. Five pump stations would be required, located at milepost (MP) 0-0 (Oahe Reservoir) MP 0-43, 0-96, 0-161, and 0-207 (Appendix A Addendum, Maps A-60 through A-64). Operating power for 20,200 acre-feet/year throughput would require 28,600 kW.

A single spread of 420 workers would be required to construct the pipeline over a 220-day period. Each pump station would require a work force of 30 for construction over a 6-month period.

Construction and operating procedures and methods would be as described in Section 1.M.1.

1.N TREATED WASTEWATER ALTERNATIVE WATER SUPPLY SYSTEM

Under this alternative, treated (reclaimed) wastewater would be transported by pipeline from ten locations in South Dakota to the North Rawhide preparation plant (Map 1-2 and Appendix A Addendum Maps A-62 through A-64.) This alternative has been evaluated as the Wastewater Effluent Transport (WET) system by the Sixth District Council of Governments (1979 and as updated 1981). Table 1-24 lists the wastewater sources and amounts available for the proposed WET system.

At the present time, several communities (Rapid City, Ellsworth Air Force Base, Whitewood, Spearfish, and Belle Fourche) are in the process of upgrading their wastewater treatment facilities in order to be in compliance with National Pollutant Discharge Elimination System (NPDES) requirements. These upgradings would have to be completed, and approved NPDES permits granted to each wastewater source to ensure that emergency or contingency discharge could still occur at each wastewater source location should shutdown of the system occur.

Use of this water source would probably require development of a contract between ETSI and each discharger for the use and out-of-state transport of their treated wastewater. Since it is probable that this use is a change in the use that has already been permitted by the state of South Dakoka Board of Water Management, each discharger would have to apply to the Board for a change in permit status prior to entering into a contract with ETSI. The Board would then have to determine whether this change was in the public interest. If this determination was made, the permit could be revised to allow each of the dischargers to enter in a contract with ETSI for the use of the treated wastewater. (South Dakota Department of Water and Natural Resources 1981a).

The other problem which would have to be resolved before this alternative could be implemented is the question of downstream water rights and appropriations. The solution to this problem could possibly require court action. However, it is South Dakota's opinion (South Dakota Department of Water and Natural Resources 1981a) that "the water supplies of the proposed wastewater dischargers are derived from developed water sources. Developed waters are generally defined by out-of-state case

TABLE 1-24

LOCATIONS AND AMOUNTS OF WASTEWATER AVAILABLE FOR THE PROPOSED WET SYSTEM

Location	Wastewater (acre-feet/year)
Rapid City	8512
Ellsworth Air Force Base	1434
Box Elder	459
Rapid Valley	459
Lead/Deadwood Area	2577
Homestake	4032
Whitewood	101
Spearfish	605
Spearfish Area	112
Belle Fourche	975
	19,266

Source: Sixth District Council of Governments 1981 authority to include subsurface water brought to the surface for use there, waters physically transported from another source, captured flood waters, or waters which normally would not find their way into a stream. Developed water is not covered by the normal rules of water use in South Dakota and downstream water users have no defensible right to the return flows of developed water users." Based on the uncertainties involved with this water source, it is not possible to predict the time frame that implementation of this alternative could require.

To develop this alternative, it would be necessary to construct approximately 160 miles of asbestos concrete pipe, beginning at Box Elder, South Dakota, through Spearfish, South Dakota, to Gillette, Wyoming. Four spur lines would connect Ellsworth Air Force Base, Rapid City, Lead/Deadwood, and Belle Fourche to the main line (Appendix A Addendum, Maps A-62 through A-64). The route follows Interstate 90 and is basically similar to the Oahe alternative route except for several connecting spur lines. The pipeline would be 36 inches in diameter and would be designed for a throughput of 19,270 acre feet for 1985. Flows beyond 1985 are projected to be greater.

Six main pumping stations and three booster pump stations would be required, each with a pumping capacity of 2000 to 3000 horsepower. Existing holding ponds at Box Elder, Whitewood, and Belle Fourche and an additional holding pond at Gillette would be included to collect and equalize flows.

A central monitoring and control system would include flow monitoring for leak detection and all operation controls. To provide electric power, it would be necessary to upgrade the existing utility system with additional substations and line extensions, to be constructed along existing power line corridors.

During construction of this alternative, approximately 2900 acres of land would be disturbed. The pipeline corridor would be approximately 100-feet wide with the pipeline buried beneath a minimum of three feet of cover. All right-of-way acres would be reclaimed as outlined in Appendix C-1 and returned to their preconstruction use wherever possible, except in the case of large trees growing directly over the pipeline.

A work force of approximately 280 persons would be required to construct the system, which is estimated to take approximately two years to complete. A staff of 7 professionals, plus support staff, would be required to operate and maintain the system. The pump stations would operate automatically.

1.0 SLURRY PIPELINE WATER DISCHARGE ALTERNATIVE

According to plans for the proposed action, residual water from the slurry dewatering facilities would be used by the power plants at each coal delivery terminal. Under this alternative, residual water would be treated as necessary and discharged into nearby rivers or streams.

Table 1-25 lists the potential points of discharge, the streams or rivers involved, and the approximate volumes of water to be discharged.

On the basis of laboratory investigations completed to date, which simulated the proposed slurry transport of coal, residual water from the dewatering

TABLE 1-25

ALTERNATIVE DISCHARGE OF DEWATERING PLANT EFFLUENT INTO LOCAL RECEIVING WATERS

Site	Receiving Water	Discharge Quantity[a] (acre-feet per year)
Ponca City, OK[b]	Arkansas River, 29 miles downstream of Ponca City	3540
Oologah, OK[c,d]	Verdigris River, 1 mile downstream of Oologah Dam	1820
Pryor, OK[b,c,d]	Neosho River (Grand River), 40 miles upstream of confluence with Arkansas River	2845
Muskogee, OK[b]	Arkansas River, 4 miles downstream of confluence with Neosho River (Grand River)	2660
Independence, AR[b,c,d]	White River, between mouth and Lock & Dam 3, 20 miles downstream from Lock 4, Dam 1 at Batesville	2685
White Bluff, AR[b,c,d]	Arkansas River, 25 miles downstream of Little Rock, between Lock & Dam 5 & 6	2685
New Roads, LA[b,c]	Mississippi River, 35 miles upstream of Baton Rouge	1065
Baton Rouge, LA[c]	Mississippi River, Baton Rouge	2685
Wilton, LA[b,c]	Mississippi River, 13 miles downstream of Donaldsonville	2685
Boyce, LA[b,c]	Red River, 3 miles upstream of Boyce	940
Lake Charles, LA[b,c]	Calcasieu River, Lake Charles	2150
Cypress Bend, AR[d]	Mississippi River, upstream from Arkansas City	10,000

[a] All possible markets for the proposed action and alternatives are listed. Depending on the final market configuration (see footnotes b, c, and d), the total discharge from all sites would not exceed about 20,000 acre-feet per year, representing a 37.4-MMTA system.

[b] Potential proposed action site.

[c] Potential market alternative site.

[d] Potential Cypress Bend pipeline-barge alternative site.

plant would require treatment prior to discharge at some locations. To meet established state standards, these facilities would reduce the levels of total dissolved solids (TDS), sulfate (SO_4), and biochemical oxygen demand (BOD_5) in the effluent.

To reduce the biochemical oxygen demand in the dewatering plant effluent, two alternative treatment processes are under investigation: aeration lagoons and the activated sludge process. In an aeration lagoon, the effluent would be temporarily detained in a holding basin with mechanical aeration facilitating the microbiological (bacterial) breakdown of organic matter present in the effluent. The activated sludge process would also reduce the organic content of the effluent by bacterial action, in this method by "seeding" treatment tanks with actual bacterial populations (hence the term "activated" sludge). Both of these methods are widely used in the treatment of municipal wastewater.

To reduce the level of dissolved minerals (TDS and SO_4) in the effluent, three candidate treatment processes are being studied: ion exchange, reverse osmosis, and electrodialysis. In the ion exchange process, a recyclable resin is used to displace minerals (ions) present in the effluent. Reverse osmosis and electrodialysis both operate by forcing specific minerals across permeable or semi-permeable membranes either by high pressure or an electrical charge. These three processes are used in water treatment and numerous industrial applications.

Before this alternative could be adopted, ETSI would be required to obtain National Pollutant Discharge Elimination System (NPDES) and state permits from the Environmental Protection Agency (EPA) and the respective state offices for all potential discharge sites. This permit would specify the terms and conditions under which discharge could occur, including the quality of the discharge water. Water treatment facilities would be constructed at dewatering plant sites where necessary to meet the NPDES requirements.

In order to obtain an NPDES permit, ETSI would have to file an application with EPA Region 6, Dallas, Texas. EPA staff would review the application and make a tentative decision to issue or deny the permit. Should the decision be to issue, a draft permit would be prepared by EPA, with the assistance of the appropriate state water division office for public review and comment. Following a public review period, usually 30 days, EPA would make a final decision to issue or deny the permit on the basis of public comments received. EPA has the option to hold public hearings on the permit application during the public review period.

1.P FORT SMITH, ARKANSAS ROUTE-VARIATION ALTERNATIVE

A short alternative reroute of the proposed slurry pipeline is presented as an alternative to a short segment of the proposed action (MP P-892 to P-920). This short alternative avoids a water impoundment in the lower portion of the drainage basin of Lee's Creek that the city of Fort Smith, Arkansas, proposes to construct. The relationship of the reroute to the proposed action and to the proposed water impoundment is shown in Appendix A Addendum, Map A-19.

This alternative would not increase the overall slurry pipeline system length, and no changes in any of the other project components would be required.

1.Q NO-ACTION ALTERNATIVE

The proposed coal slurry transportation project represents a new method of transporting Wyoming coal to power plants in Oklahoma, Arkansas, and Louisiana. No-action alternatives are options available if neither the proposed action nor any of its alternatives are approved. In this case, the 37.4 million tons annually (MMTA) of coal would be transported by either an all-railroad transportation system or a railroad-barge transportation system. The information presented here is summarized from the more detailed No-Action Technical Report (WCC 1981i), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228; telephone (303)-234-6737.

1.Q.1 ALL-RAIL ALTERNATIVE

The all-rail alternative would involve transportation of 37.4 MMTA of coal to the proposed action markets shown on Map 1-1. Coal would leave the Wyoming mines and be carried south over track owned jointly by Burlington Northern (BN) and Chicago and North Western (C&NW) to a junction northwest of Shawnee, Wyoming. From there the traffic would move over the BN system to Kansas City, Missouri, where it would be transferred to a connecting railroad: Missouri-Pacific; Kansas City Southern; Atchison, Topeka, and Santa Fe; or Missouri-Kansas-Texas.

The coal would be transported in unit trains. The typical coal unit train would be made up of 100 to 110 cars, each carrying 100 tons of coal, plus three to five locomotives, depending on the grades and curves of the track. The unit train would operate continuously between the mine and the generating plant, with intermediate stops only for servicing or crew changes but not for delivery or receipt of other freight. Table 1-26 shows the all-rail system buildup for the proposed action markets.

Acreage Requirements and Land Status

At present, there is rail access to each coal mine and also to each of the power plants. All track between these points, except for the interchange in Kansas City, has been designated as mainline track (category A or B) by the Federal Railroad Administration (DOT 1977c). No additional acreage would be required for new rail routes, and the railroads have all the rights-of-way necessary for any upgrading of track capacity.

General Construction and Operation Procedures

Operation of unit trains depends upon equipment specifications and operating parameters. Equipment specifications include the number of trains and the number, size, and type of cars and locomotives in each train. The operating parameters are cycle time, crew changes, fueling needs, and maintenance needs. All of these are established from the fuel-use analysis, which considers total amount of coal to be hauled; amount per day; contract period; mine location; mine loading facilities; power plant location; and power plant unloading, material handling, and storage facilities.

On the basis of the above considerations, the railroads involved have provided their equipment specifications and operating assumptions. These are summarized in Table 1-27, which shows for each minemarket combination the originating railroad, delivering railroad, distance, cycle time, and number

TABLE 1-26

PROPOSED SYSTEM BUILDUP SCHEDULE:
NO-ACTION ALL-RAIL ALTERNATIVE

Delivery Terminal [a]	As-Mined Coal (MMTA)												
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Ponca City, OK	—	—	1.6	3.3	3.3	3.3	3.3	3.3	3.3	4.9	6.6	6.6	6.6
Pryor, OK	—	—	—	—	1.5	1.5	1.5	1.5	1.5	3.0	3.0	3.0	3.0
Muskogee, OK	1.6	3.3	3.3	3.3	3.3	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Independence, AR	—	—	—	—	—	—	2.5	2.5	5.0	5.0	5.0	5.0	5.0
White Bluff, AR	—	—	—	2.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Boyce, LA	—	—	—	—	—	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Lake Charles, LA	—	—	—	—	—	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0
New Roads, LA	—	—	—	—	—	—	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Wilton, LA	—	—	—	—	—	—	—	—	—	—	2.5	2.5	5.0
Total	1.6	3.3	4.9	9.1	13.1	16.9	23.1	23.1	27.6	30.7	34.9	34.9	37.4

[a] Terminals correspond to those of the proposed action.

TABLE 1-27

OPERATING PARAMETERS: NO-ACTION ALL-RAIL ALTERNATIVE

Market[a]	Receiving Railroad	Delivering Railroad	Round Trip Distance (miles)	Cycle Time (hours)	Number of Trains Assigned to Market[b]
Pryor, OK	BN	MKT	2076	122.25	4
Ponca City, OK	BN	AT&SF	2200	124.45	5
Muskogee, OK	BN	MP	2242	133.25	4
White Bluff, AR	BN	MP	2730	158.25	3
Independence, AR	BN	MP	2433	151.45	4
Boyce, LA	BN	MP	3303	187.45	3
Lake Charles, LA	BN	KCS	3148	200.75	9
New Roads, LA	BN	MP	3448	237.75	2
Wilton, LA	BN	KCS	3273	217.95	11

Sources: Burlington Northern 1980; Kansas City Southern 1980; Missouri-Kansas-Texas Railroad Co. 1980; Missouri-Pacific Railroad Co. 1980.

BN = Burlington Northern
MKT = Missouri-Kansas-Texas
AT&SF = Atchison, Topeka, and Santa Fe
MP = Missouri-Pacific
KCS = Kansas City Southern

[a] Markets correspond to those of the proposed action.

[b] Number of trains is the equipment specification for the delivering railroad, indicating the number of unit trains to be used on a particular route. It should not be confused with train trips. The railroad specification of number of trains is a function of the individual railroad's operating parameters, amount of coal to be delivered to each market, and the assumed cycle time for the route. In addition, eight trains would be required by BN (the receiving railroad) for operating between the mines and Kansas City (the point where the coal would be transferred to the delivering railroad).

of trains assigned to serve a particular market. The tonnages that would be carried over various portions of the route and the associated number of trains per day are shown in Table 1-28.

Time Frame

According to railroad construction plans, all new track, additions of siding, and new control systems necessary to carry the additional 37.4 MMTA will be in place prior to the proposed start of pipeline delivery in 1985 (Boyce 1979). Because it provides direct access to the coal mines, the most critical link in the route is the segment of new track in Wyoming that connects Donkey Creek and Orin, which was completed in 1979. The track runs through Campbell and Converse counties in the southern Powder River Basin and provides the only rail access to the six mines.

Work Force

Estimates of the work force required to operate the no-action railroad system of delivery to the proposed action markets are presented in Table 1-29.

Project Components

Project components include the unit train, track, and signal systems, as well as in-place facilities such as maintenance yards and offices for centralized traffic control. Figure 1-10 is an overview of a unit coal train transportation system.

Unit trains of 100 to 110 hopper cars, each carrying 100 tons of coal, would transport the coal from the mines to the power plants. The trains would be moved by special high-horsepower locomotives. Depending on the need for heavy haul capacity, portions of the track would be 136-lb/yd continuous welded rail, the heaviest in use on railroads today. In addition, portions of the route would be double-tracked, as a means of increasing the number of trains that could travel the route. Major maintenance facilities already exist in Alliance, Nebraska, and Kansas City, Missouri.

Interrelationship of All-Rail Alternative with Other Planned Projects.

The most important planned project affecting the no-action all-rail alternative is the C&NW Coal Line Project. The Interstate Commerce Commission (ICC) has made an initial decision to approve this project (October 7, 1980), and an application for guaranteed loans is pending before the Federal Railroad Administration. A final decision by ICC is scheduled for the spring of 1981. Completion of this project would provide an alternative means of moving coal by rail out of the Powder River Basin to Kansas City and other interchange points for delivery to connecting railroads (Nesbitt 1980).

The project, shown on Map 1-6, has four components: construction of a line jointly owned by BN and C&NW; rehabilitation of an existing line; construction of a new connecting line; and construction of various maintenance and operating facilities. Under this routing, coal would be moved from the mines to Shawnee, Wyoming, over the joint line. From there it would move east over the 45-mile rehabilitated line to Crandall, Wyoming, and then south via the proposed 56-mile connector line to Joyce Station, Nebraska, for interchange with Union Pacific (UP) at South Morrill, Nebraska. Union Pacific would then carry the coal to Kansas City, Missouri; Council Bluffs, Iowa; or other interchange points for delivery to the connecting railroads that would carry the coal to

TABLE 1-28

TONNAGE AND NUMBER OF TRAINS, BY ROUTE SEGMENT: NO-ACTION ALL-RAIL ALTERNATIVE

Route Segment	Annual Tonnage (MMTA)	Approximate Number of Trains Daily[a]
Wyoming mines to Kansas City, MO	37.4	20
Kansas City to Ponca City,OK	6.6	4
Kansas City to Independence,AR	5.0	3
Kansas City to Pryor, OK	3.0	2
Kansas City to Muskogee, OK	13.8	8
Muskogee to White Bluff, AR	8.8	5
White Bluff to Alexandria, LA	3.8	2
Alexandria to Boyce, LA	1.8	1
Alexandria to New Roads, LA	2.0	1
Kansas City to Shreveport, LA	9.0	5
Shreveport to Lake Charles, LA	4.0	2
Shreveport to Wilton, LA	5.0	3

[a] Approximate number of daily trains needed to carry 37.4 MMTA of coal is estimated using a factor of 1.848 tons per year per train per day. Estimate includes loaded and empty trains.

MMTA = million (short) tons annually.

TABLE 1-29

OPERATIONS PERSONNEL ESTIMATES:
NO-ACTION ALL-RAIL ALTERNATIVE

Destination	Rail-road	Number of Crews[a]	Inspections		Total Personnel			
			500-mi Brake[a]	Pull-by[a]	Crew[b]	Brake Inspec.[c]	Pull-by Inspec.[d]	Operations[e]
Kansas City, MO	BN	12	3	2	48	12	2	398
Boyce, LA	MP	14	3	16	56	12	16	196
Independence, AR	MP	6	1	11	24	4	11	111
New Roads, LA	MP	15	4	16	60	16	16	152
Muskogee, OK	MP	5	0	4	20	0	4	24
White Bluff, AR	MP	16	2	8	64	8	8	208
Lake Charles, LA	KCS	14	3	4	56	12	4	520
Wilton, LA	KCS	15	4	4	60	16	4	680
Ponca City, OK	AT&SF	5	2		20	8		108
Pryor, OK	MKT	4	1	1	16	4	1	69
								2466

Note: MMTA = million (short) tons annually; BN = Burlington Northern; MP = Missouri Pacific; KCS = Kansas City Southern; AT&SF = Atchison, Topeka, and Santa Fe; MKT = Missouri-Kansas-Texas.

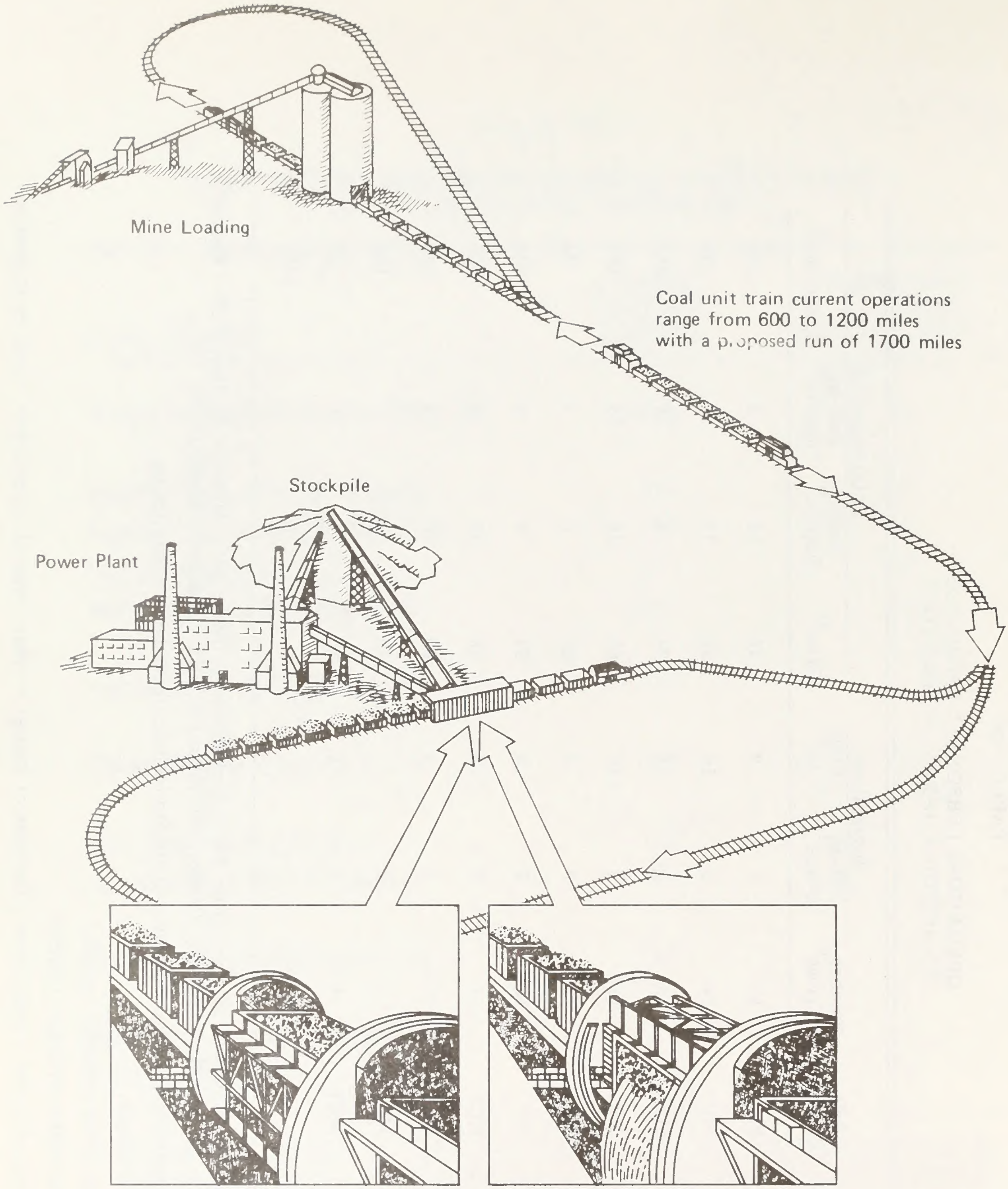
a Information supplied by involved railroads. Estimate includes loaded and empty trains.

b Each crew has 4 people.

c Each brake inspection averages 4 people.

d Each pull-by inspection averages 1 person.

e Total operations personnel = total crew x (number of trains) + brake inspection personnel + pull-by inspection personnel.

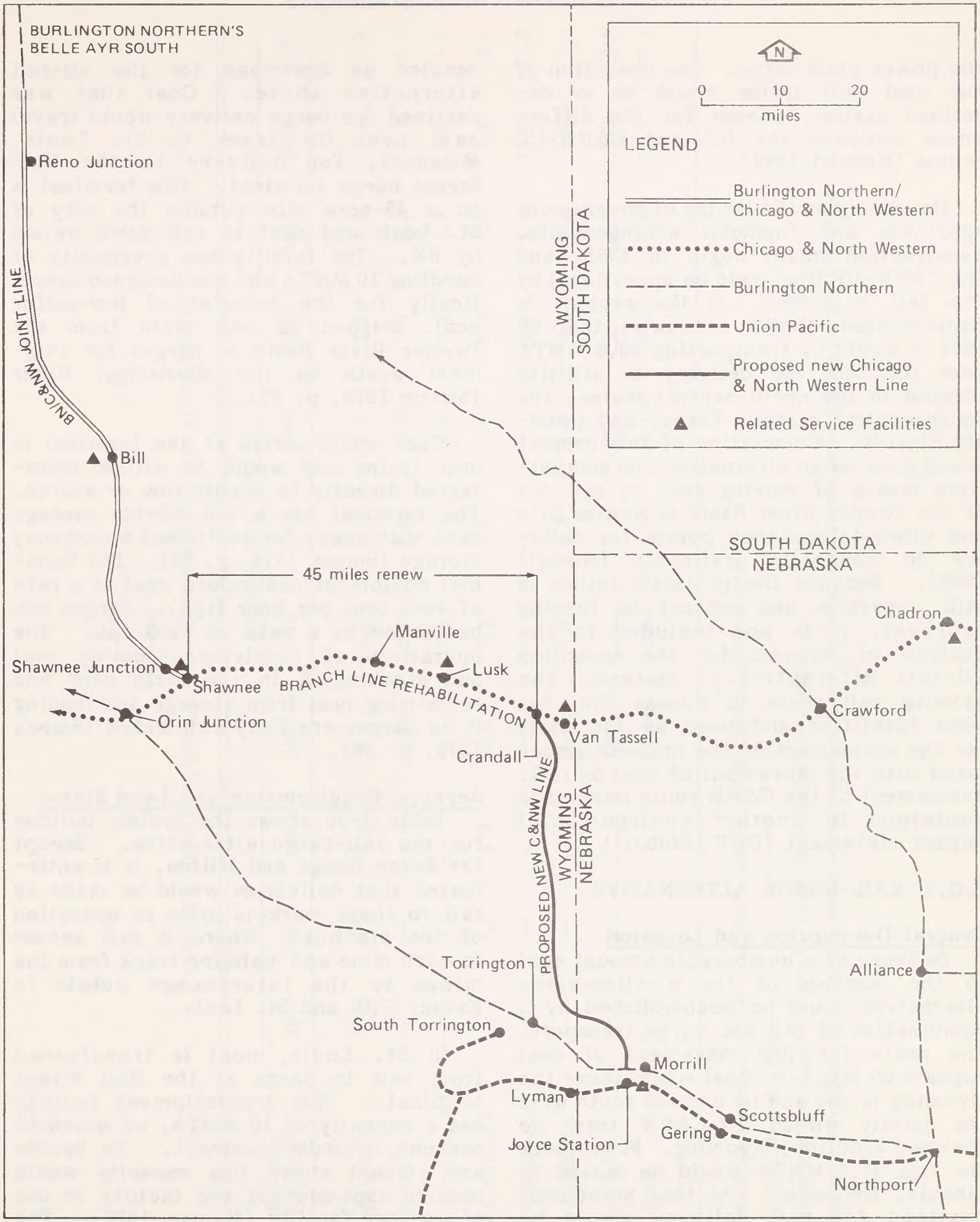


As train arrives at unloading area, the car locked in the dumping cradle ...

...rotates 180° to empty contents. Rotary coupler allows cars to remain coupled as a unit.

Source: U.S. House of Representatives, 1977.

Figure 1-10. COAL UNIT TRAIN TRANSPORTATION SYSTEM



Map 1-6 CHICAGO & NORTH WESTERN COAL LINE PROJECT

the power plant sites. The operation of the coal unit trains would be as described earlier, except for the differences between the BN and C&NW-UP routes (Nesbitt 1980).

Depending on the timing of government approvals and financial arrangements, construction could begin in 1981, and the C&NW-UP line could be operational by the fall of 1982. If the project is implemented, C&NW estimates that by 1991 it would be transporting 40.3 MMTA over this line for delivery to utilities located in the north-central states, the south-central states, Texas, and possibly Florida. Completion of this project would provide an alternative and competitive means of moving coal by rail out of the Powder River Basin to Kansas City and other interchange points for delivery to connecting railroads (Nesbitt 1980). Because the project's future is still uncertain and subject to funding approval, it is not included in the analysis of impacts for the no-action all-rail alternative. Instead, the existing rail route to Kansas City has been identified and used as the basis for the assessment of the impacts associated with the movement of coal by rail. Assessment of the C&NW route impacts is contained in another environmental impact statement (DOT 1980b).

1.Q.2 RAIL-BARGE ALTERNATIVE

General Description and Location

Delivery of a comparable amount coal to the markets of the pipeline-barge alternative could be accomplished by a combination of rail and barge transport. The route for this movement of coal appears on Map 1-1. Coal would leave the Wyoming mines and be carried south over the jointly owned BN-C&NW track to Shawnee Junction, Wyoming. From there the full 37.1 MMTA would be moved to Lincoln, Nebraska. At that point coal destined for rail delivery would be handled as described for the all-rail alternative above. Coal that was destined for barge delivery would travel east over BN track to St. Louis, Missouri, for delivery to the Hall Street barge terminal. This terminal is on a 45-acre site outside the city of St. Louis and next to rail yards owned by BN. The facility has a capacity of handling 10 MMTA and was designed specifically for the transfer of low-sulfur coal, shipped by unit train from the Powder River Basin to barges for shipment south on the Mississippi River (Smock 1978, p. 29).

Coal would arrive at the terminal in unit trains and would be either transferred directly to a unit tow or stored. The terminal has a 500,000-ton storage yard with space for additional emergency storage (Smock 1978, p. 29). The terminal equipment can unload coal at a rate of 4000 tons per hour (tph). Barges can be loaded at a rate of 6000 tph. The operations of receiving incoming coal and stacking it in the main yard and reclaiming coal from storage and loading it on barges are fully automated (Smock 1978, p. 29).

Acreage Requirements and Land Status

Table 1-30 shows the system buildup for the rail-barge alternative. Except for Baton Rouge and Wilton, it is anticipated that deliveries would be made by rail to these markets prior to operation of the pipeline. There is rail access to each mine and mainline track from the mines to the interchange points in Kansas City and St. Louis.

In St. Louis, coal is transferred from rail to barge at the Hall Street terminal. This transshipment facility has a capacity of 10 MMTA, of which 60 percent is under contract. To handle any amount above this capacity would require expansion of the facility or use of another facility (Mankus 1980). The

TABLE 1-30

SYSTEM BUILDUP SCHEDULE: NO-ACTION RAIL-BARGE ALTERNATIVE

Delivery Terminal[a]	As-Mined Coal (MMTA)										
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1988
Oologah, OK[b]	1.75	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Pryor, OK[b]	—	—	2.65	2.65	2.65	2.65	2.65	5.3	5.3	5.3	5.3
Independence, AR[b]	—	—	—	—	2.5	2.5	5.0	5.0	5.0	5.0	5.0
White Bluff, AR[b]	—	2.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Baton Rouge, LA[c]	—	—	—	—	—	—	—	5.8	5.8	11.3	11.3
New Roads, LA[c]	—	—	—	—	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Wilton, LA[c]	—	—	—	—	—	—	—	—	2.5	2.5	5.0
Total	1.75	6.0	11.15	11.15	15.65	15.65	18.15[d]	26.6[d]	29.1[d]	34.6[d]	37.1[d]

[a] Terminals correspond to those of the Cypress Bend pipeline-barge alternative.

[b] Delivery by unit train.

[c] Transportation by unit train to St. Louis, then delivery by barge.

[d] Tonnages correspond to those that would be delivered to power plants by the Cypress Bend pipeline-barge alternative.

Hall Street terminal is the only rail-barge transshipment facility in St. Louis. It is located on 45 acres of a 70-acre site and could be expanded to handle up to 18.3 MMTA (Mankus 1980).

General Construction and Operation

Table 1-31 summarizes the operation of the rail-barge alternative, showing for each mine-market combination the originating railroad, delivering railroad or barge, and the distance, cycle time, and number of trains and barge tows assigned to serve a particular market. The tonnages that would be carried over the various portions of the route and the associated number of trains per day and barge tows per day are shown in Table 1-32.

Time Frame

All new track, additions to sidings, and new control systems necessary to move 18.8 MMTA of coal to Kansas City (for subsequent rail delivery) and 18.3 MMTA to St. Louis (for subsequent barge delivery) will be in place prior to the proposed start of pipeline coal delivery in 1985. While rail capacity will be adequate, transshipment facilities in St. Louis are not now capable of handling the full 18.3 MMTA. The existing transshipment facility capacity is 10 MMTA; 60 percent is under contract, including 2 MMTA for the New Roads market. Hence, 4 MMTA capacity is currently available, but 16.3 (18.3 total less the 2 MMTA for New Roads) must be delivered. Thus, considering current capacities and current commitments, there is a capacity shortage of 12.3 MMTA. Studies are underway for construction of new terminals and expansion of existing terminals that could meet this future demand (Mankus 1980).

Work Force

Transshipment of coal from rail to barge is not a labor-intensive activity. At present, approximately 30 to 40 people operate the Hall Street terminal, and increased traffic up to the terminal's capacity would not affect the number (Mankus 1980). It is estimated that another 30 to 40 people would be needed to staff a facility meeting the 12.3 MMTA shortfall.

Each barge tow is assumed to involve 15 people. Table 1-33 summarizes the numbers of people, for both rail and barge, associated with this alternative.

Project Components

Project components unique to this alternative are those associated with the rail-barge transshipment facility. They include the material-handling equipment at the terminal: a rotary car dumper and train positioner, a rail-mounted stacker/reclaimer, a radial stacker, a tunnel reclaim system, a stationary luffing boom-type barge loader, a barge-haul system, and interconnecting conveyors (Smock 1978, p. 29).

Barges 195 feet long and 35 feet wide, with a 9-foot draft and 1500-ton capacity, would be used (Rieber and Soo 1977a, p. 4-9) Each tow would use 15 barges, for a total of 37,500 tons per tow. Travel downstream would average approximately 10 miles per hour; movement upstream would be at a rate of 5 miles per hour (Eickhorst 1980).

Interrelationship of Rail-Barge Alternative with Other Planned Projects

In addition to the C&NW Coal Line Project discussed in Section 1.Q.1, this alternative would also be affected by Corps of Engineers' plans to rebuild the Alton Lock and Dam facility north of St. Louis, on the Mississippi River. Delays as long as 72 hours are affecting traffic using the existing facility (Mankus 1980). Construction of a new 1200-foot lock would decrease this delay and increase daily tow traffic from 39 to 66

TABLE 1-31

OPERATING PARAMETERS: NO-ACTION RAIL-BARGE ALTERNATIVE

Mine	Market[a]	Receiving Railroad	Delivering RR or Barge	Round-Trip Distance	Round-Trip Time (hours)	Number of Trains Assigned to Market[b]	Number of Barge Tows Assigned to Market
North Rawhide	Pryor, OK	BN	MKT	2076	122[c]	1	
Jacobs Ranch	Oologah, OK	BN	MP	2112	129[c]	1	
Jacobs Ranch	White Bluff, AR	BN	MP	2730	158[c]	3	
North Antelope	Independence, AR	BN	MP	2433	152[c]	4	
Buckskin	New Roads, LA	BN	Barge	4050	371	4	2
North Rawhide	Baton Rouge, LA	BN	Barge	4070	380	4	8
Antelope	Wilton, LA	BN	Barge	4194	401	4	4

Note: BN = Burlington Northern; MKT = Missouri-Kansas-Texas; MP = Missouri Pacific.

[a]Markets correspond to those of the Cypress Bend pipeline-barge alternative.

[b]Number of trains is the equipment specification for the delivering railroad, indicating the number of unit trains to be used on a particular route. It should not be confused with train trips. The railroad specification of number of trains is a function of the individual railroad's operating parameters, amount of coal to be delivered to each market, and the assumed cycle time for the route. In addition, eight trains would be required by BN (the receiving railroad) for operating between the mines and Kansas City (the point where the coal would be transferred to the delivering railroad).

[c]Boyce 1980; BN.

TABLE 1-32

TONNAGE AND NUMBER OF
TRAINS AND BARGES, BY ROUTE SEGMENT

Route Segment	Tonnage (MMTA)	Number of Trains Daily[a]	Number of Barge Tows Daily[a]
Wyoming mines to Lincoln, NB	37.1	20	0
Lincoln to Kansas City, MO	18.8	10	0
Kansas City to Independence, AR	5.0	3	0
Kansas City to Pryor, OK	5.3	3	0
Kansas City to Oologah, OK	8.5	5	0
Kansas City to White Bluff, AR	5.0	3	0
Lincoln to St. Louis, MO	18.3	10	0
St. Louis to New Roads, LA	18.3	0	3
St. Louis to Baton Rouge, LA	16.3	0	2
St. Louis to Wilton, LA	5.0	0	1

MMTA = million (short) tons annually.

[a] Calculation of daily trains (round trips) assumes 1.848 million net tons per year per train per day (Peat, Marwick, Mitchell & Co. 1979, p. II-4). Estimate includes loaded and empty trains. Daily barge calculation assumes 25 barges per tow and 37,500 tons per tow.

TABLE 1-33

OPERATIONS PERSONNEL ESTIMATES: NO-ACTION RAIL-BARGE ALTERNATIVE

Destination	Railroad/ Barge	Number Personnel	Number 500-mi Brake Inspections	Number Pull-by Inspections
Kansas City, MO	BN	48	3	2
Pryor, OK	MKT	16	1	1
Oologah, OK	MP	16	0	4
White Bluff, AR	MP	64	2	8
Independence, AR	MP	24	1	11
St. Louis, MO	BN	48	3	2
New Roads, LA	Barge	45	NA	NA
Baton Rouge, LA	Barge	240	NA	NA
Wilton, LA	Barge	120	NA	NA

BN = Burlington Northern.
MKT = Missouri-Kansas-Texas.
MP = Missouri Pacific.
NA = Not applicable.

[a] Estimate includes loaded and empty trains.

units by the year 2035 (Dutt 1980). Without this improved facility, St. Louis would be the major transshipment point for tows entering the river southbound. This would increase shoreside activity in the city, and land use pressure, particularly to build more transshipment facilities, would be likely to increase (U.S. Department of the Army 1976, p. 36).

1.R ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

1.R.1 OTHER PIPELINE OR PIPELINE-BARGE ROUTES

Pipeline

An alternative pipeline route through Arkansas and Louisiana was studied. This route was to the east of the proposed action route but was eliminated from further consideration in order to avoid potential impacts to the federally listed endangered red-cockaded woodpecker, whose habitat has been identified as mature pine forests. Several miles of mature pine forests were located during aerial surveys along the eastern route in Arkansas. The proposed action route was selected to avoid mature pine forests, and the eastern route was eliminated from further consideration.

Pipeline-Barge

Another pipeline-barge alternative was initially studied. This alternative would have delivered coal to a proposed market near Penton, Mississippi, and would have included a barge loading facility on the east side of the Mississippi River. This alternative was eliminated because siting of the proposed power plant at Penton has been postponed indefinitely by Mississippi Power and Light (Eiserman 1980). The elimination of this market also eliminated the need for further consideration of a barge loading facility at this location.

Arkansas River Barge

The Arkansas River provides a potential barge route for transporting ETSI coal but was excluded from further consideration for the following reasons: (1) This alternative would require a barge loading facility at the port of Catoosa east of Tulsa, Oklahoma, and barge unloading facilities for the Muskogee and White Bluff terminals, the only terminals that could be served by barges on the Arkansas River. (2) This alternative could not be used to provide coal shipments to the Ponca City, Oologah, and Pryor terminals, which are all served prior to reaching the port of Catoosa, nor to the Independence terminal, which is not on the Arkansas River. In addition, the Muskogee terminal is only 30 miles from the port of Catoosa, which is too short a distance to make barge shipment feasible.

The Arkansas River channel has inadequate capacity to handle the large volume of coal ETSI is proposing to transport, because locks on the river would be unable to handle the congestion generated by approximately 3000 trips of the large barge units (Walker 1980).

1.R.2 OTHER SLURRY TRANSPORT MEDIA

Hydrocarbons

Replacement of water as a transporting fluid with other candidate liquids such as methanol, crude oil, fuel oil, or liquefied petroleum gas was studied as an alternative. These liquids were eliminated from consideration because of their unavailability in sufficient volumes at the coal preparation plant sites. Although hydrocarbons can be produced from coal, this process also requires large volumes of water. Processing plants are not presently operating or scheduled to be operating in the preparation plant vicinity by 1985 when the coal slurry transportation project is scheduled to begin operation.

Carbon Dioxide

Carbon dioxide (CO_2) is becoming increasingly in demand for use in tertiary oil recovery processes; and according to the National Petroleum Council (1976), there exists a potential need for CO_2 in Louisiana. Thus its use as a transporting fluid was evaluated.

The estimated slurry loading would be 47 percent as-mined coal; therefore 42.3 MMTA of CO_2 would be required to transport 37.4 MMTA of as-mined coal. This is equivalent to about 112 billion standard cubic feet of CO_2 annually. Carbon dioxide is not available from other sources in sufficient quantities in the area and there are no known plans to produce any CO_2 in the area within the time frame of the proposed project.

The alternative was eliminated because of the undeveloped technology of such a slurry mixture. In addition, any research being done is considered to be proprietary information and therefore is unavailable.

1.R.3 OTHER METHODS OF TRANSPORT

Trucks

Truck transport was evaluated but was eliminated as being impractical for the large quantities considered here. Such a scheme would require 40,000 twenty-ton trucks to be on the road at all times, with a truck loading operation required every 45 seconds at each of the coal preparation plants.

1.R.4 OTHER MEANS OF NO-ACTION ALTERNATIVE LOCOMOTION

Electric Railroad

Electrification of unit train rail lines would require construction of an electrified third-rail or an overhead catenary for power and the construction of transmission lines and substations for the supply of energy.

This concept was evaluated and eliminated, because although technically possible and more energy efficient than locomotion by diesel locomotive (see Appendix E-3), it is not feasible for operation by the time the proposed action is scheduled to begin operation in 1985. At this time the railroads have not made a decision to use electric lines for rail traffic between Wyoming and the markets ETSI proposes to serve (Boyce 1981a).

Coal-Fired Locomotives

This concept was evaluated and eliminated, because although technically possible, it is not feasible to begin operation by 1985 when the proposed action would become operational. Very few coal-fired locomotives are presently in use, and the railroads have not made any decision to convert to this mode of operation by 1985 (Boyce 1981). In addition, this method of railroad locomotion was determined to be less energy efficient than locomotion by diesel locomotive (see Appendix E-3).

1.R.5 OTHER WATER SUPPLY SOURCES

Slurry Water Recycle

Recycling the water available at each delivery point after the coal has been dewatered would provide an alternative source of water for slurry transport. Thus, rather than discharge this water to the environment or provide it to the power plants, it would be necesary to construct return water lines from each delivery point to the coal slurry preparation plants. The return water lines would be installed adjacent to the slurry pipelines, and the required pump stations would be located at the slurry pipeline pump stations. This concept was eliminated from detailed analysis because of the larger amount of energy that would be consumed compared to the other water sources in order to pump the water back to Wyoming for release. For example, when used in conjunction with the proposed action pipeline, it is estimated that transportation energy would be consumed at the rate of 933,000 Btu/ton of coal for the proposed action configurations and 1,012,000 Btu/ton of coal for the pipeline-barge alternative (see Appendix E-1 and E-4).

Coal Mine Dewatering

Coal mines in the preparation plant area may produce a surplus of water above and beyond that required for mine operations and fugitive dust control. This surplus can evolve if the mine seams are in a subsurface aquifer, thus requiring dewatering of the pits during coal removal. In order to use this water, a complex network of pipelines and pump stations to deliver the water from candidate mines to the slurry prepartion plants would be required.

This potential source of water was considered but eliminated because of the inability to estimate available quantities and the questionable reliability of obtaining such water from existing and future mining operations over the life of the project.

Mississippi River Water Supply System

Water from the Mississippi River could be transported to the coal preparation sites for use in the slurry pipeline system. A water pipeline would have to be constructed adjacent to the slurry line, and centrifugal water pumps would have to be installed at the slurry pump station sites. The Mississippi River system was eliminated from detailed analysis, because when used in conjunction with the proposed action pipeline system, it is estimated that transportation energy would be consumed at the rate of 850,000 Btu/ton of coal (see Appendix E-1 and E-4) and would require an additional commitment of approximately 1090 acres to construct the water pipeline. This would result in additional disturbance and environmental damage.

Keyhole Reservoir Water Supply System

The Keyhole Reservoir in Crook County, Wyoming, was considered as an alternative water supply source. It was eliminated from detailed analysis, since the availability of the required amount of water is presently questionable. For example, negotiations are presently underway wherein the Belle Fourche Wyoming Water Association would purchase all Wyoming's remaining entitlement to storage in Keyhole Reservoir. The balance of storage (90 percent) is allocated to South Dakota.

1.S COMPARISON OF PROPOSED ACTION AND ALTERNATIVES

The key facts pertaining to the descriptions of the proposed action and major alternatives are summarized in Tables 1-34 and 1-35.

TABLE 1-34

COMPARISON OF PROPOSED ACTION AND ALTERNATIVES

	Proposed Action	Market Alternative	Cypress Bend Pipeline-Barge Alternative	No-Action Alternative[a]
Water Requirements				
Construction (total)	4,297 ac-ft	4,297 ac-ft	4,297 ac-ft	0 ac-ft
Operation				
Well Field	20,200 ac-ft/yr	20,200 ac-ft/yr	20,200 ac-ft/yr	NA
Pump Stations				
Wyoming	60 ac-ft/yr	60 ac-ft/yr	60 ac-ft/yr	NA
Colorado	NA	NA	NA	NA
Nebraska	85 ac-ft/yr	40 ac-ft/yr	40 ac-ft/yr	NA
Kansas	105 ac-ft/yr	120 ac-ft/yr	120 ac-ft/yr	NA
Oklahoma	50 ac-ft/yr	50 ac-ft/yr	50 ac-ft/yr	NA
Total Operation	20,500 ac-ft/yr	20,470 ac-ft/yr	20,470 ac-ft/yr	NA
Land Requirements				
Construction	22,730 ac	22,199 ac	17,097 ac	0 ac
Operation of Surface Facilities	853 ac	843 ac	818 ac	no new acres required
New Right-of-Way Required	1,828 mi	1,785 mi	1,366 mi	no new miles required
Land Ownership/Management of Right-of-Way				
Bureau of Land Management	6 mi	6 mi	6 mi	0 mi
Forest Service	27 mi	27 mi	27 mi	0 mi
Indian	18 mi	18 mi	18 mi	0 mi
State	68 mi	68 mi	58 mi	0 mi
Private	1,709 mi	1,666 mi	1,257 mi	all miles
Work Force Requirements				
Construction (total)	38,747 worker-quarters[b]	38,940 worker-quarters[b]	36,054 worker-quarters[b]	0 worker-quarters[b]
Operation				
Headquarters	41 workers	41 workers	41 workers	NA
Western District	243 workers	243 workers	243 workers	NA
Central District	124 workers	117 workers	117 workers	NA
Eastern District	178 workers	141 workers	278 workers	NA
Southern District	164 workers	211 workers	NA	NA
Total	753 workers	753 workers	679 workers	5,800 workers (1,290 workers)[a]
Water Distribution[c] and Slurry Gathering Pipelines[d]	71 mi	71 mi	71 mi	NA
Main Water Pipeline[c]	68 mi	68 mi	68 mi	NA
Main Slurry Pipeline	1,664 mi	1,621 mi	1,202 mi	NA
River Crossings Requiring Federal Permits	57	54	35	NA
Preparation Plants	3	3	3	NA
Slurry Pump Stations	23	22	15	NA
Dewatering Plants	9	9	5	NA
Length of Time to Deliver Coal[e]	17 days	17 days	17.5 days	5 days (8.5 days)

TABLE 1-34 Concluded

	Colorado Alternative[f]	Comparable Proposed Action Segment[f]	Colorado Alternative[f]	Comparative Market and/or Pipeline-Barge Alternative Segment[f]
Water Requirements				
Construction (total)	*	*	*	*
Operation				
Well Field	NA	NA	NA	NA
Pumping Stations				
Wyoming	60 ac-ft/yr	60 ac-ft/yr	60 ac-ft/yr	60 ac-ft/vr
Colorado	90 ac-ft/yr	NA	90 ac-ft/yr	NA
Nebraska	NA	85 ac-ft/yr	NA	40 ac-ft/yr
Kansas	70 ac-ft/yr	55 ac-ft/yr	70 ac-ft/yr	80 ac-ft/yr
Oklahoma	NA	NA	NA	NA
Total Operation	220 ac-ft/yr	200 ac-ft/yr	220 ac-ft/yr	180 ac-ft/yr
Land Requirements				
Construction	6,440 ac	6,028 ac	7,446 ac	6,931 ac
Operation of Surface Facilities	*	*	*	*
New Right-of-Way Required	519 mi	485 mi	602 mi	560 mi
Land Ownership/Management of Right-of-Way				
Bureau of Land Management	3 mi	2 mi	3 mi	2 mi
Forest Service	30 mi	14 mi	30 mi	14 mi
Indian	0 mi	0 mi	0 mi	0 mi
State	21 mi	33 mi	21 mi	33 mi
Private	465 mi	436 mi	548 mi	511 mi
Work Force Requirements				
Construction (total)	*	*	*	*
Operation				
Headquarters	NA	NA	NA	NA
Western District	*	*	*	*
Central District	NA	NA	NA	NA
Eastern District	NA	NA	NA	NA
Southern District	NA	NA	NA	NA
Total	NA	NA	NA	NA
Water Distribution[c] and Slurry Gathering Pipelines[d]	NA	NA	NA	NA
Main Water Pipeline[c]	NA	NA	NA	NA
Main Slurry Pipeline	519 mi	485 mi	602 mi	560 mi
River Crossings Requiring Federal Permits	2	3	2	4
Preparation Plants	NA	NA	NA	NA
Slurry Pump Stations	*	*	*	*
Dewatering Plants	NA	NA	NA	NA
Length of Time to Deliver Coal[e]	NA	NA	NA	NA

[a] Figures given apply to both all-rail and rail-barge alternatives; exceptions for rail-barge are included in parentheses.
[b] Worker-quarter is a measure of the amount of work done by 1 worker in a quarter of a year.
[c] Main water and water distribution pipelines would be adjacent to slurry pipelines except for about 31 miles.
[d] Both pipelines would lie within the same right-of-way.
[e] Represents length of time to transport coal to most distant terminal.
[f] Comparison pertains only to main slurry pipeline route(s) between Jacobs Ranch and intersection point(s) in Kansas.
[g] Numbers represent change from proposed action.
*Amount is approximately the same.
NA=Not applicable.

TABLE 1-35

COMPARISON OF PROPOSED AND ALTERNATIVE WATER SUPPLY SYSTEMS[a]

	Proposed Action (Niobrara County Well Field)	Crook County Well Field Alternative	Combined Well Field Alternative	Oahe Alternative	Treated Wastewater Alternative
Construction Water Requirements[b]	112 ac-ft	112 ac-ft	112 ac-ft	0 ac-ft	0 ac-ft
Land Requirements					
Construction (Disturbed Area)	880 ac	770 ac	1,296 ac	3,345 ac	2,900 ac
Operation of Surface Facilities	216 ac	109 ac	155 ac	8 ac	9 ac
Number of Water Pump Stations	1	1	2	8	9
Well Field Gathering Pipelines	62 mi	31 mi	44 mi	NA	NA
Main and Distribution Water Pipelines	139 mi	118 mi	186 mi	347 mi	160 mi
River Crossings Requiring Federal Permits	0	0	0	12	9
Construction Work Force Requirements (Peak)	301	150	450	200[c] (420)[d]	280

NA = not applicable

[a] Refer to Project Description Technical Report (WCC 1981a) for source of these data.

[b] Water required for fugitive dust control, concrete, and pipeline hydrotesting not included.

[c] Required for the option of purchasing water from the state of South Dakota (2-year construction period).

[d] Required for the option of purchasing water from Water and Power Resources Service (7-month construction period).

CHAPTER 2

COMPARATIVE ANALYSIS OF THE PROPOSED ACTION AND ALTERNATIVE

The energy efficiencies and environmental impacts of the proposed action and alternatives (component and system alternatives and process variations) are compared in this chapter. The system alternatives are the no-action all-rail and no-action rail-barge alternatives, the market alternative, and the Cypress Bend pipeline-barge alternative. Various component alternatives and process variations can be assembled into a wide range of complete system alternatives. The component alternatives compared in this chapter are: Crook County well field, combined well field, Oahe Reservoir, treated wastewater, Colorado route, and Fort Smith, Arkansas route-variation. The process variations are coal cleaning and slurry pipeline water discharge.

2.A **ENERGY EFFICIENCY**

Transportation of coal requires energy. The different scenarios being considered amounts of energy in transporting a certain amount of coal to the specified destinations. These comparative amounts of energy have been estimated for the more viable scenarios and are presented in an energy consumption table (matrix) for comparison purposes (Table 2-1).

The transportation efficiencies of these major scenarios are also presented in a table similar to the energy consumption matrix, but showing percentages (Table 2-2). These percentages show the comparative amount of estimated energy that would be delivered after allowing for the estimated energy consumed in transportation.

It must be noted here that the numbers in Tables 2-1 and 2-2 are not true total figures stating that so much energy is consumed in getting the coal to a power plant boiler, because all of the energy debits have not been included, such as grinding and mining energies. Hence the numbers are comparative energy consumption and percentage figures, dealing with transportation energy components only.

Also, it must be recognized that the numbers presented are estimates. Although great care was taken to ensure that these estimates are as accurate as possible, some reasonable omissions, assumptions, and contingencies were necessary. The degree of precision shown in Table 2-1 was chosen to allow differentiation between the various scenarios. In many cases the numbers are so similar that one cannot state with confidence that one scenario is more, less, or equal to another in energy efficiency, because some of the estimates used have a great influence on the final values. (For instance, a good estimate of windage losses of coal from unit trains is not available, although most knowledgable people agree that some losses occur. A 0.1% windage loss is used in the analysis, which equals 16.7×10^3 Btu/ton. Figures as high as 1% are found in the literature. (See Appendix E-3, Railroad Windage Losses.) Use of a higher estimate would change the ranking of the scenarios without improving their accuracy.)

2.A.1 ENERGY CONSUMPTION AND EFFICIENCY MATRICES

The common measure of transportation energy consumption is the ratio of energy consumed in transportation per unit of commodity transported. When the commodity transported is coal, this

TABLE 2-1

COMPARATIVE TRANSPORTATION ENERGY CONSUMPTION MATRIX

Scenario	Annual Delivered Throughout[a] (MMTA)	Comparative Energy Consumed in Transport (10^3 Btu/ton)[a]	Water Supply System: Niobrara Well Field	Crook Well Field	Oahe Reservoir (Purchase from SD) (ETSI & SD users)	Oahe Reservoir (Purchase from WPRS) (ETSI only)	Treated Wastewater[f]	Combined Well Field[e]
1. Proposed action	37.4	NA	665	672	710	721	679	650
2. Proposed action - Colorado route	37.4	NA	670	677	714	726	684	654
3. Market alternative	37.4	NA	680	677	714	726	684	663
4. Market alternative - Colorado route	37.4	NA	688	684	722	733	691	670
5. Pipeline-barge alternative	37.1[b]	NA	791 (855)[c]	781 (846)[c]	819 (883)[c]	831 (895)[c]	788 (853)[c]	771 (835)[c]
6. Proposed action with coal cleaning alternative	37.4	NA	1100[d]	1107[d]	1145[d]	1156[d]	1114[d]	1085[d]
7. No-action (all-rail) alternative	37.4	650 (1185)[c]	NA	NA	NA	NA	NA	NA
8. No-action (rail-barge) alternative	37.1[b]	744 (1366)[c]	NA	NA	NA	NA	NA	NA

Notes and footnotes for this table are found on page 2-4.

TABLE 2-2

COMPARATIVE TRANSPORTATION ENERGY EFFICIENCY MATRIX

Scenario	Annual Delivered Throughput[a] (MMTA)	Percentage of Energy Effectively Delivered[b]	Water Supply System: Niobrara Well Field	Crook Well Field	Oahe Reservoir (Purchase from SD) (ETSI & SD users)	Oahe Reservoir (Purchase from WPRS) (ETSI only)	Treated Wastewater[f]	Combined Well Field[e]
1. Proposed action	37.4	NA	96.0	96.0	95.7	95.7	95.9	96.1
2. Proposed action - Colorado route	37.4	NA	96.0	96.9	95.7	95.7	95.9	96.1
3. Market alternative	37.4	NA	95.9	95.9	95.7	95.7	95.9	96.0
4. Market alternative - Colorado route	37.4	NA	95.9	95.5	95.7	95.6	95.9	96.0
5. Pipeline-barge alternative	37.1[b]	NA	95.3 (94.9)[c]	95.3 (94.9)[c]	95.1 (94.7)[c]	95.0 (94.6)[c]	95.3 (94.9)[c]	95.4 (95.0)[c]
6. Proposed action with coal cleaning alternative	37.4	NA	93.4[d]	93.4[d]	93.1[d]	93.1[d]	93.3[d]	93.5[d]
7. No-action (all-rail) alternative	37.4	96.1 (96.9)[c]	NA	NA	NA	NA	NA	NA
8. No-action (rail-barge) alternative	37.1[b]	95.5 (91.8)[c]	NA	NA	NA	NA	NA	NA

Notes and footnotes for this table are found on page 2-4.

NOTES AND FOOTNOTES TO TABLES 2-1 AND 2-2

Notes:

NA=Not applicable

*These values do not represent the total energy consumption in getting the coal from the mine to the power plant boiler. Equivalent and minor components have been deleted; e.g., grinding energy and mining energy. Only components related to differences in transportation energy are included. These numbers are estimates and are only for internal comparison between the alternatives.

*These values are calculated at the raw energy level. They are based on the use of coal for generating electricity and the use of crude oil for manufacturing diesel fuel for locomotives and barges, except where noted by parentheses and footnotes.

*All slurry pipeline scenarios (1 through 6) include energy consumption for water treatment at the dewatering plants. Water treatment only contributes less than 1×10^3 Btu/ton, which is relatively insignificant, and would have little effect if treated as a separate alternative.

*City of Gillette water supply is not included, because it is designed as a reserve water source only.

Footnotes:

[a] These are on an as-mined coal basis 29.49% moisture and 11,814 Btu/lb of bone-dry coal) or equivalent.

[b] Because 0.3 MMTA of coal are consumed at Cypress Bend (within the system) in the pipeline-barge alternative, only 37.1 MMTA are delivered to market. In order to get a direct comparison between the pipeline-barge alternative and the rail-barge alternative, 37.1 MMTA was also used for the rail-barge alternative.

[c] These values are calculated assuming the diesel fuel consumed by rail diesel locomotives and barge tugboats is made from coal, not crude oil. (Coal-fired and electrified tugboats for barges were not included, because they are unlikely considerations within the lifetime of the ETSI project).

[d] These large values in Table 2-1 (small percentages in Table 2-2) are due to 427×10^3 Btu/ton in Table 2-1 (2.6% in Table 2-2) lost in the coal cleaning refuse. The rationale is debatable, but this energy was considered irretrievable. See Appendix E-2 for discussion.

[e] Half the water obtained from the Niobrara County well field and half from the Crook County well field.

[f] Water supply energy consumption figures are based solely on the conceptual informtaion given in the "Wastewater Reuse Alternatives for the Black Hills Region" draft copy report of August 1979, by the Sixth District Council of Local Governments of South Dakota. If this alternative is chosen, it must be evaluated in detail before implementation.

energy consumption is expressed as British thermal units (Btu) per ton of as-mined specification coal. (A Btu is defined as the amount of heat (energy) required to raise the temperature of 1 pound of water 1 degree Fahrenheit.)

The comparative energy consumption estimates shown in Table 2-1 are expressed in this common measure. These figures were calculated at the raw energy level. For electric power, it is the amount of energy from coal required to enter a power plant to generate the necessary electricity. This takes into account the energy losses encountered in the power plant boilers and turbines. For diesel fuel, the figures are based on the amount of raw energy from crude oil to produce the required diesel fuel energy. Calculating the energy consumptions in this way gives a truer picture of the amount of raw resources consumed in generating the required power. This dual basis (i.e., coal for electric power and crude oil for diesel fuel) was chosen because no concrete evidence stating that diesel fuel would be primarily made from coal over the lifetime of the ETSI project could be found, although the technology does exist.

It should be noted here that coal conversion to electricity (main energy source for slurry pipeline scenarios) is only about 33% efficient through the power plant, whereas diesel fuel made from crude oil (main energy source for rail scenarios) is 85% efficient through the refinery. However, coal is an indigenous source of energy, whereas at least part of the crude oil would be from foreign sources.

The dual basis does not allow a direct raw energy consumption comparison, though. Hence, for the alternatives involving the use of diesel fuel (scenarios 5, 7, and 8), other bases were explored to bring all scenarios onto a common basis of using coal as the main energy source.

Another means of stating transportation energy efficiencies is to express them in terms of percentages, as shown in Table 2-2. In this case, the percentages express the ratio of the amount of energy contained in the coal minus the comparative energy consumed in transporting the coal to the amount of energy contained in the coal; in other words, the estimated effective amount of energy to be delivered after subtracting the comparative energy required to transport it. (Likewise one could also state the estimated comparative energy consumed in transport as a percentage, which represents the ratio of the energy consumed to the energy contained in the coal times 100.)

The methodology, components that comprise each of the scenarios, and sources of data for developing the information in Tables 2-1 and 2-2 are shown in Appendix E.

All of the possible permutations have not been listed in these matrices, because they would become too large for making a practical comparison. Upon inspection of these results, it can be seen that many of the alternative scenarios need not be listed for decision-making or comparison purposes. In particular, water treatment at the dewatering plants has been included in all of the slurry pipeline scenarios and not treated separately, which would have generated many more combinations. It consumes less than 1000 Btu/ton of energy, which is an insignificant amount compared with the totals shown in Table 2-1.

Also, all the possible coal cleaning scenarios have not been included, because it can be seen that they would yield very high energy consumptions. Upon comparison of scenarios 1 through 5, it can be seen that other combinations employing coal cleaning would yield even higher consumption figures than scenario 6 (with the pipeline-barge Colorado route with coal cleaning alternative yielding the highest energy consumption of all).

In addition, the figures for some of the scenarios not mentioned can be derived by arithmetic inspection, such as the energy consumption of the pipeline-barge-Colorado route alternative, which would be higher than the pipeline-barge alternative by an amount equivalent to the difference between the market alternative and the market alternative-Colorado route scenarios.

Based on the parameters described, but bearing in mind the level of accuracy, the following conclusions are drawn:

1. The most energy-efficient scenarios are the no-action all-rail alternative and the proposed action using the combined well field water supply system, each with an estimated comparative energy consumption of 650 x 10^3 Btu/ton of delivered as-mined coal. (Some 3.9% (comparative) of the total energy transported would be consumed, with a resulting comparative efficiency of 96.1%.)

   In order to put these figures in further perspective, it must be noted that the no-action all-rail alternative primarily uses crude oil as an energy source, while the proposed action can use either coal or crude oil as a source. If the no-action all-rail alternative were to derive its diesel fuel from coal, the comparative consumption would be 1185 x 10^3 Btu/ton, or 7.1% of the energy transported, with a resulting comparative efficiency of 92.9%.

2. The least efficient slurry pipeline scenario is the pipeline-barge alternative combined with the Colorado route and coal cleaning alternative (can be determined from Table 2-2 by inspection).

3. The most efficient water supply system is the combined well field system. The least efficient is the Oahe Reservoir (water purchase from Water and Power Resources Service) system.

2.B **ENVIRONMENTAL IMPACTS**

For comparison of environmental impacts, it is useful to group the alternatives into four categories: process variations, water supply systems, slurry pipeline systems, and no-action systems. Alternatives within each of these categories will be compared and then the categories will be compared. Some comparisons are difficult, especially between the slurry pipeline system alternatives and the no-action alternatives because of the basic differences between them. For example, pipeline systems require major construction and no-action alternatives do not. The significant impacts that can be quantified for the proposed action and the various alternatives are shown in Tables 2-3, 2-4, and 2-5.

2.B.1 PROCESS VARIATIONS

The facilities required for the coal cleaning operation would be located within the boundaries of the coal slurry preparation plants, so this variation would not result in any additional land disturbance or land requirements than the proposed action. The cleaning

TABLE 2-3

IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

Impacts	Proposed Action	Market Alternative	Cypress Bend Pipeline-Barge Alternative	Colorado Alternative	Other Comparable Segments: Proposed Action	Other Comparable Segments: Market Alternative	No-Action Alternatives[a]
Surface Water[b]							
River/Stream Crossings Requiring Federal Permits	58	54	35	3	5	4	0
Socioeconomics							
Wyoming Region							
1984 Peak Construction Employment[c]	1,624	X	X	X	X	X	NA
1984 Peak Construction Population Increase[c]	2,609	X	X	X	X	X	NA
1984 Peak Housing Unit Requirements[c]	1,396	X	X	X	X	X	
Operation Employment[c]	243	X	X	X	X	X	5,800
Operation Population Increase[c]	728	X	X	X	X	X	NA
Annual Property Tax Revenues ($1000)	$3,298	X	X	X	X	X	NA
Pipeline and Pump Station Areas							
Peak Construction Employment (Direct)	4,992	4,992	3,932	797	NA	NA	NA
Peak Construction Population Increase	2,232	2,232	2,833	1,948	NA	NA	NA
Dewatering Plant Areas							
Peak Construction Employment	1,332	1,063	1,272	NA	NA	NA	NA
Peak Construction Construction Population Increase	1,555	1,555	1,217	NA	NA	NA	NA
Operation Employment[c]	1,054	959	893		NA	NA	NA
Operation Population Increase[c]	2,353	2,155	1,995	NA	NA	NA	NA
Vegetation							
Land Temporarily Disturbed by Construction	21,877 ac	21,356 ac	16,279 ac	7,296 ac	5,878 ac	6,281 ac	0
Land Permanently Removed from Production	853 ac	843 ac	818 ac	150 ac	150 ac	150 ac	0
Agriculture							
Prime Farmland Permanently Removed From Production	375 ac	305 ac	385 ac	25 ac	75 ac	75 ac	0
Wildlife							
Federal Threatened & Endangered Species That Could Be Affected	4	4	4	3	2	2	0
Recreation Resources							
Designated State Scenic Rivers	3	3	3	0	0	0	0
Rivers Under Study For Possible Inclusion Into State Scenic Rivers Program	9	1	2	0	0	0	0
Rivers identified under the HCRS Nationwide Rivers Inventory Phase 1 program[d]	7	5	5	1	0	1	0
Visual Resources							
Visual Resource Impact Areas	36	33	23	2	7	10	0
Noise							
Distance from source to 55 decibel contour (ft)	< 100	X	X	X	X	X	< 1500

[a] Figures for an all-rail system are given. Impacts for a rail-barge system would be roughly equivalent.
[b] See Table 2-1 for ground-water impacts resulting from well field pumping.
[c] Includes construction and service sectors.
[d] Some of these rivers are either under existing state scenic river programs, or under study for possible inclusion in a state scenic rivers program.
NA Not applicable
X Same as for the proposed action.

TABLE 2-4

SUMMARY OF WATER SUPPLY SYSTEM HYDROLOGIC IMPACTS

Environmental Element	Niobrara Well Field (Plan 1)[a] Cumulative[b]	Crook Well Field (Plan 3)[a] Cumulative[b]	Combined Well Field (Plan 5)[a] Cumulative[b]	Oahe Reservoir[c] Cumulative[b]	Treated Wastewater Cumulative[b]
Hydrology[d]					
Decline in Potentiometric Surface					
>25 ft	7,100 sq mi (4,700 sq mi)	23,600 sq mi (7,800 sq mi)	18,400 sq mi (7,800 sq mi)	0 sq mi (0 sq mi)	0 sq mi (0 sq mi)
>100 ft	3,400 sq mi (1,600 sq mi)	5,200 sq mi (290 sq mi)	3,700 sq mi (330 sq mi)	0 sq mi (0 sq mi)	0 sq mi (0 sq mi)
>200 ft	2,100 sq mi (260 sq mi)	970 sq mi (0 sq mi)	530 sq mi (0 sq mi)	0 sq mi (0 sq mi)	0 sq mi (0 sq mi)
>400 ft	460 sq mi (0 sq mi)	0 sq mi (0 sq mi)	4 sq mi (0 sq mi)	0 sq mi (0 sq mi)	0 sq mi (0 sq mi)
Counties Affected by Decline > 25'	10 (7)	19 (8)	17 (10)	0 (0)	0 (0)
Number of Industrial and Public Water Supplies Affected by Decline > 25'	29 (Unknown)	33 (Unknown)	35 (Unknown)	0 (0)	0 (0)
Potentiometric Surface Decline in areas with Madison and Inyan Kara wells					
Devils Tower, WY	-65 ft (<1 ft)	-200 ft (<1 ft)	-130 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Lusk, WY	-6 ft (-18 ft)	-1 ft (<1 ft)	-4 ft (-11 ft)	0 ft (0 ft)	0 ft (0 ft)
Sundance, WY	-36 ft (<1 ft)	-65 ft (<1 ft)	-50 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Upton, WY	-67 ft (-31 ft)	-100 ft (-41 ft)	-85 ft (-36 ft)	0 ft (0 ft)	0 ft (0 ft)
Osage, WY	-76 ft (-32 ft)	-93 ft (-36 ft)	-85 ft (-34 ft)	0 ft (0 ft)	0 ft (0 ft)
Newcastle, WY	-32 ft (<1 ft)	-35 ft (<1 ft)	-34 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Gillette Well Field, WY	-140 ft (<1 ft)	-230 ft (<1 ft)	-190 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Bell Creek, MT	-18 ft (-15 ft)	-170 ft (-86 ft)	-92 ft (-51 ft)	0 ft (0 ft)	0 ft (0 ft)
Belle Fourche, SD	-12 ft (-2 ft)	-55 ft (-11 ft)	-33 ft (-14 ft)	0 ft (0 ft)	0 ft (0 ft)
Edgemont, SD	-300 ft (-45 ft)	-8 ft (<1 ft)	-140 ft (-19 ft)	0 ft (0 ft)	0 ft (0 ft)
Provo, SD	-330 ft (-120 ft)	-8 ft (<1 ft)	-160 ft (-54 ft)	0 ft (0 ft)	0 ft (0 ft)
Hot Springs, SD	-8 ft (<1 ft)	-1 ft (<1 ft)	-4 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Cascade Springs, SD	-34 ft (<1 ft)	-3 ft (<1 ft)	-17 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Spearfish, SD	-6 ft (<1 ft)	-32 ft (<1 ft)	-19 ft (<1 ft)	0 ft (0 ft)	0 ft (0 ft)
Maximum Stream flow Reduction for any one stream	-4 cfs	-4 cfs	-4 cfs	0 cfs	-12 cfs
Total number of stream, springs affected by flow reductions >1 cfs	7	6	9	0	4

NOTE: First figure listed refers to Madison Formation impact. Figure in parentheses refers to Inyan Kara Formation impact.

[a] See Table 4-3 for explanation of pumping plans.

[b] Refers to impacts due to pumping by ETSI plus existing and planned Madison users.

[c] Impacts shown are for either Oahe alternative option (water purchase from South Dakota or purchase from Water and Power Resources Service).

[d] Based on pumping for 50 years at a rate of 20,500 ac-ft/yr, which represents a worst-case analysis (see Section 5.A.1). ETSI only proposes to withdraw 20,200 ac-ft/yr.

TABLE 2-5

SUMMARY OF WATER SUPPLY SYSTEM VEGETATION, AGRICULTURE, AND WILDLIFE IMPACTS[a]

Environmental Element	Niobrara Well Field (Plan 1)	Crook Well Field (Plan 3)	Combined Well Field (Plan 5)	Oahe Reservoir	Treated Wastewater
Vegetation					
Acres Temporarily Disturbed by Construction	880	770	1296	3,345	2,900
Acres Permanently Removed by Surface Facilities	216	109	155	8	9
Agriculture					
Prime Farmland Permanently Removed from Production (acres)	0	0	0	2	Unknown
Potential Impact on Irrigated Croplands from Ground-water Draw-downs and Streamflow Reductions	YES	YES	YES	NO	YES
Wildlife					
Federal Threatened and Endangered Species that Could Be Affected	1	1	1	2	Unknown
Potential Impact on Aquatic Resources	YES	YES	YES	NO	YES
Potential Impact on Terrestrial Wildlife	YES	YES	YES	NO	NO

[a] Impacts due to ETSI construction only.

operation would require 300 acre-feet of water annually, which would be in addition to that required under the proposed action. The use of this amount of water was included in the analysis of the hydrologic impacts of the proposed action so as to ensure that the worst-case analysis portrayed the total water use that might result from project implementation. The difference in hydrologic impact between using and not using this amount of water is unmeasurable. This alternative would require approximately one-fourth more construction workers at the preparation plant sites. No additional personnel would be required for operation. The additional construction workers would not significantly increase the preparation plant construction impacts (Section 4.E.1).

Facilities for the slurry pipeline water discharge variation would be located at the dewatering plant sites. This variation would not cause additional land disturbance than created by the proposed action. There also would be no increase in construction workers or operation personnel required.

Treatment of the slurry effluent prior to discharge would be required. Even though the water quality of the receiving streams may be slightly modified, there would be no impacts on the current designated beneficial uses, because the discharge would have to meet the applicable state water quality standards and National Pollutant Discharge Elimination System (NPDES) permit standards set by the Environmental Protection Agency (EPA) (Section 4.J.1).

These two processing variations are not considered further in this comparison, because they would not cause significant impacts, and no other features exist which form a comparative basis.

2.B.2 PROPOSED ACTION AND WATER SUPPLY SYSTEM ALTERNATIVES

The major issue raised during the scoping process (Appendix B) concerned potential ground-water impacts that would be caused by the proposed action (Niobrara County well field). Thus four water supply component alternatives were studied: a well-field site in Crook County, Wyoming; a combined well field system (half of needed water from Niobrara well field and half from Crook well field); an Oahe Reservoir (South Dakota) system involving two options (purchase from state of South Dakota or purchase from U.S. Water and Power Resources Service); and treated wastewater from South Dakota. Impacts of the proposed action well field (Niobrara County) and the other water supply alternatives are shown in Table 2-4. The Oahe alternatives are the same in location, so only one column is shown for the Oahe system. The only difference in the two systems is that for water purchased from Water and Power Resources Service, the pipeline would be smaller and not have the capacity to supply water to towns and communities along the pipeline route.

The water supply system impacts can be compared in terms of land disturbed during construction, land required for operation of surface facilities, areas potentially affected by ground-water drawdowns, spring and stream flow reductions, and socioeconomic-related construction impacts.

Construction of the Niobrara County well field would temporarily disturb 880 acres; 216 acres would be permanently removed from production by the system's surface facilities for the life of the project (50 years). The Crook County well field would temporarily disturb 770 acres; 109 acres would be permanently removed from production for the life of the project. The combined well field would temporarily disturb 1296 acres; 155 acres would be permanently removed for the life of the project. The Oahe alternative would not require a well field, but 3345 acres would be temporarily disturbed by the main water pipeline; 8 acres would be permanently removed for the life of the project. The treated wastewater lines would temporarily disturb 2900 acres; 9 acres would be permanently removed for the life of the project.

None of the land that would be permanently removed from production by the Niobrara or Crook County well field is prime farmland. About 2 acres of prime farmland would be removed by Oahe alternative facilities. Because of the uncertaintities as to where the pump stations would be located for the treated wastewater system, it is not known whether any prime farmland acreage would be removed from production.

The Niobrara County water supply system may affect one federally listed endangered species. The Crook County system may affect one species, and the Oahe system may affect two. Since the exact location of the laterals for the treated wastewater alternative are not known, the potential impact on federally listed threatened or endangered species is unknown. The main wastewater pipeline follows the same route as the Oahe line and would affect the same number of species as the Oahe line.

Construction of the Oahe pipeline (water purchase from South Dakota option) could make it feasible to supply 24 South Dakota communities with additional domestic water. None of the other water supply systems would have this capability.

There would be no ground-water impacts with either Oahe alternative option or the treated wastewater alternative. The major impacts of the various well field systems would be the impact on ground water and stream and spring flows, and the resulting impacts on the aquatic and agricultural resources.

The hydrologic impacts shown for the various well field systems on Table 2-4 are cumulative impacts at the end of the 50-year project life. By definition, cumulative impacts include the impact of the ETSI project plus existing Madison water users and planned Madison users.

Of most concern is the impact on the Inyan Kara aquifer because of its closeness to the surface and because it is used more extensively than the Madison aquifer. The Crook well field alternative would have the least impact on the Inyan Kara aquifer in terms of the area affected. The Crook well field's greatest effect on the Inyan Kara would be the occurrence of drawdowns greater than 100 feet over a 290-square-mile area. The combined well field would affect 330 square miles with Inyan Kara drawdowns greater than 100 feet, and the Niobrara well field would affect 1600 square miles. The Niobrara well field is the only system which would affect the Inyan Kara aquifer with drawdowns in excess of 200 feet (260 square miles would be affected by this drawdown).

The combined well field would have the least overall effect on the Madison aquifer. Even though it would affect a 4 square-mile area with drawdowns in excess of 400 feet, this affected area would be localized around the Niobrara well field. While the Crook well field would have no drawdowns in this range, it would affect a much greater area with drawdowns greater than 200 feet. It should be noted though that the effect on the Madison is on a deep aquifer which is not readily accessible for agricultural use.

None of the well field sources would result in impacts being localized in Wyoming. The Niobrara well field would affect the least number of counties, 10 for the Madison aquifer and 7 for the Inyan Kara aquifer.

It is not possible to draw an accurate comparison among the well field alternatives of number of industrial and public water users that would be affected by drawdown in the Inyan Kara. The number of users of Inyan Kara water is unknown. They are probably numerous because of the ease of obtaining water from this aquifer.

The number of industrial and public water users of Madison water is known (Section 3.A.1), so a comparison among alternatives can be made. The Niobrara well field would affect the least number of Madison aquifer users (29).

The level of decline in the potentiometric surface of the Madison and Inyan Kara aquifers at various towns and locations would vary, as shown on Table 2-4. Because of this variance, it is difficult to draw any conclusions as to which well field system would have the least impact on towns or communities. The two towns which would have the greatest impact under the proposed action (pumping from the Niobrara well field) is cited for illustrative purposes. The predicted drawdown at Edgemont, South Dakota, with Niobrara well field pumping is 300 feet. It would be 140 feet with pumping from the combined well field; 8 feet with the Crook well field. The wells at Edgemont are currently free flowing. Pumping from the Niobrara field would eliminate the free flowing condition; the combined well field might eliminate that condition. Pumping from the Niobrara well field is predicted to reduce the level of the wells at Provo, South Dakota, by 330 feet. Pumping from the Crook well field would result in a reduction of 8 feet and the combined well field a reduction of 160 feet. The greatest impact on any one location would occur with pumping from the Niobrara well field, 330 feet at Provo, South Dakota. The greatest impact of the Crook well field would be 230 feet at the site of the Gillette well field. This also would be the site of the greatest impact (190 feet) with pumping from the combined well field.

The treated wastewater alternative would result in the largest single stream flow reduction (12 cfs). The Oahe alternative would not result in any stream or spring flow reductions. There is no difference in maximum amount of stream or spring flow reduction that would be caused by the well field alternatives. All would cause a maximum reduction of 4 cfs for any one location. The wastewater alternative, although causing the largest flow reductions, would affect the fewest number of streams (4) (except for the Oahe alternative which would not affect any). The well field alternative that would affect the fewest streams or springs is Crook County (6).

Regardless of the well field alternative considered, little or no change would occur in water quality at water wells, other than those at the ETSI well field that would be pumping. The Gillette well field is the only location outside the ETSI well fields where a water quality change would be expected to occur. At the Gillette site, the total dissolved solids concentration would be expected to increase by 20 mg/l with pumping from either the Crook well field or the Niobrara well field. The Oahe alternative would not cause any impact on water quality. The treated wastewater alternative has the potential for improving the water quality in the four streams that would be affected.

The use of treated wastewater could have a greater impact in a slurry spill situation than any of the other water supply systems. The actual impact cannot be determined at this time. Simulation tests would be required to determine whether significant levels of toxic pollutants would be present.

The main construction impacts for all water supply systems would result from the influx of construction workers. The impacts for both the well fields would be similar. Although more workers would be required to construct the Oahe or treated wastewater alternatives, these workers would be spread over a long pipeline right-of-way and would not have any significant impacts on any local community (Sections 4.H.2 and 4.J.1). The Crook County water supply system would require half the number of workers required by the Niobrara system. This would result in slightly less overall impact. The impact of the combined well field system would be less than a sum of the impacts from each individual well field. For the combined well field alternative although the impacts on Lusk would be the same as for constructing the Niobrara well field, they would occur over a much shorter time period, 1 year as opposed to 2 to 3 years.

2.B.3 PROPOSED ACTION AND SLURRY PIPELINE SYSTEM ALTERNATIVES

As shown in Table 2-3, there are very few differences in the impacts of the various slurry pipeline systems (proposed action, market alternative, Cypress Bend pipeline-barge alternative, and Colorado alternative). The major impacts of these alternatives would be related to ground-water withdrawal and construction; few impacts would result from operation. This contrasts with the no-action alternatives (all-rail and rail-barge transportation), which would have no water or construction impacts and many operation impacts. The Fort Smith route-variation alternative is not included in this comparative analysis, because it is only a short pipeline alignment variation that would not increase the length of the proposed action or any of the pipeline system alternatives or their engineering details. It would not cause any adverse impacts, but would avoid a proposed water impoundment area near Fort Smith, Arkansas.

In the Wyoming region, construction impacts (including construction and service-sector employees) would be essentially the same for the proposed action and the various slurry pipeline alternatives. This is because the impacts are primarily due to construction of the preparation plants and well field. In all cases, Wyoming construction would provide for a peak construction employment of 1624 for a period of 1 to 2 years. Population would increase in the area for this same period by 2609 workers and family members. Operation figures would be less: 534 permanent jobs (construction and service), with an associated population increase of 1064. Property tax revenues from the Wyoming facilities would generate about $3,298,000 annually (Section 4.A.2).

The employment and population increases for the remainder of the pipeline, including pump station and dewatering plant areas, would be different for the proposed action and each of the slurry pipeline alternatives. This is because of differences in the length of the main slurry pipeline. However, differences between the employment and population increases for the different systems have little meaning, because the increases would be scattered over such a long right-of-way. The impact analyses for the proposed action, market alternative, and Colorado alternative did not indicate any significant impacts on any one locality. For the Cypress Bend pipeline-barge alternative, however, construction of the dewatering plant and barge loading facility at Cypress Bend, Arkansas, would create a significant localized impact during the construction phase. The impact would be due to a peak population increase of 1593 for less than 2 years, which would affect housing and some public services in the towns of Arkansas City, McGehee, Dermott, and Dumas, Arkansas (Section 4.C.2).

There would be some differences between the biological impacts of the proposed action and the pipeline system alternatives. The proposed action would temporarily disturb 21,877 acres; the market alternative, 21,356 acres; and the Cypress Bend pipeline-barge alternative, 16,279 acres. The amounts of vegetation permanently removed from production by surface facilities for the life of the project would not vary significantly, however. The proposed action would remove 853 acres; the market alternative, 843 acres; and the Cypress Bend pipeline-barge alternative, 818 acres. The acreage removed would be widely scattered and does not include a large area in one place. The proposed action facilities would remove 375 acres of prime farmland; the market alternative, 305 acres; and the Cypress Bend pipeline-barge alternative, 365 acres. The Colorado alternative would remove 25 acres, which would be less than equivalent sections of the proposed action, market alternative, or pipeline-barge alternative. There would be no differences in the number of federally listed threatened or endangered animal species that may be affected by the proposed action, market alternative, or Cypress Bend pipeline-barge alternative. The Colorado alternative would affect one more species than equivalent sections of the proposed action or other alternatives.

There are differences in the number of areas that would have significant visual impacts: 36 for the proposed action, 33 for the market alternative, and 23 for the Cypress Bend pipeline-barge alternative.

Of some concern, but of relatively minor impact, are the numbers and types of river crossings. The proposed action would cross 58 rivers requiring Department of Army (Corps of Engineers) permits; the market alternative, 54; and the Cypress Bend pipeline-barge alternative, 35. Some of these rivers have special classifications because of their scenic or recreation qualities. The proposed action would cross 3 rivers included in state scenic river systems; the market alternative would cross 3; and the Cypress Bend pipeline-barge alternative would cross 3. The Heritage Conservation and Recreation Service has recently identified Phase I Inventory Rivers. The proposed action would cross 7; the market alternative, 5; and the Cypress Bend pipeline-barge alternative, 5.

2.B.4 NO-ACTION ALTERNATIVES

Two no-action alternatives were considered: all-rail transportation of coal, and rail-barge transportation. Unlike the proposed action and pipeline system alternatives, the major impacts of the no-action alternatives would result from operation instead of construction. There would be no construction required for the all-rail alternative. Although barge loading facilities would have to be expanded for the rail-barge alternative, no significant impacts would result (Section 4.L.1).

In general the two no-action alternatives would have the same operation impacts, because no significant impacts would be caused by the barge segment of the railroad-barge alternative. To facilitate the impact discussion, only figures for the all-rail no-action alternative are given below.

The number of people required for rail operation including related functions such as rail maintenance and supporting services is 5,800. Whether this would result in the same number of new jobs would be a function of overemployment at some of the railroads as well as expected future gains in productivity.

The all-rail no-action alternative would require an estimated 20 daily trains between Wyoming and Kansas City. Because coal would be delivered via many different routes south of Kansas City, the maximum number of daily trains would be much less in this part of the system. The largest daily number is 8 trains on the Kansas City to Muskogee route.

To illustrate the possible operation impacts of a no-action alternative, a case example is used. There would be 20 trains required through Torrington, Wyoming. The town is divided by the tracks. About 85 percent of the population and all services, including schools, police, and fire, lie north of the tracks. Thus this traffic would aggravate existing problems for the 15 percent of the population lying south of the tracks. These problems include delays for police, fire, and emergency equipment; traffic congestion; and potential accidents.

This case typifies possible impacts that might occur in the 500 communities along the railroad route. This is contrasted with the proposed action and slurry pipeline system alternatives, which would not result in these types of socioeconomic impacts after construction is completed.

It is important to consider the source of the power required for the no-action alternatives and the slurry pipeline systems because of the national energy policy. A goal of this policy is to decrease our dependence on foreign sources of energy by promoting the use of coal over oil. Railroads would be powered by diesel fuel, an oil derivative. The pipeline systems would use electricity produced by coal-fired power plants.

2.B.5 SLURRY PIPELINE AND NO-ACTION (RAILROAD) SYSTEMS

The major environmental differences between the slurry pipeline system impacts and the railroad system impacts are summarized below in a highly simplified form.

Pipelines

Many ground-water impacts
Many construction impacts
Few operation impacts
High construction employment
Low operation employment
Power requirements provided by coal-fired power plants

Railroads

No ground-water impacts
No construction impacts
Many operation impacts
No construction employment
High operation employment
Power requirements provided by diesel fuel, an oil derivative

CHAPTER 3

AFFECTED ENVIRONMENT

The affected environment is that portion of the existing environment that would be affected by the proposed action or alternatives. The affected environment for the proposed action and alternatives was analyzed for all of the following resources:

- Geology (including geologic hazards)
- Mineral resources
- Soils
- Water resources (including 100-year floodplains)
- Socioeconomic considerations
- Vegetation
- Wildlife
- Aquatic biology
- Cultural resources and paleontology
- Agriculture (including prime and unique farmlands and livestock grazing lands)
- Climate, air quality, and noise
- Recreation resources (including designated "scenic rivers")
- Transportation networks
- Wilderness
- Visual resources

Existing land use plans, controls, and constraints were also reviewed for potential conflicts with the proposed action and alternatives. This chapter provides information about only the environment that would be affected as determined by the impact analysis in Chapter 4. The analyses indicated that several resources would not be affected, therefore descriptions of the following resources were not included:

- Geology. Geologic conditions are discussed where pertinent to the well-field hydrology analysis (see Section 3.A.1).
- Mineral resources.
- Soils. Information concerning soil types is not presented but is available from the Bureau of Land Management. This information was used in assessing impacts on vegetation and agriculture.
- Climate and noise.
- Wilderness. No federally designated wilderness areas are present in the vicinity of any component of the proposed action or alternatives. This includes Wilderness Study Areas (WSA) designated by the Bureau of Land Management, and Roadless Area Review and Evaluation (RARE II) areas designated by the Forest Service.

Baseline data were collected for each resource topic from the pipeline right-of-way or surface facility sites shown on the strip maps in Appendix A to a distance where impacts could no longer be identified with the project. This area is defined as the affected area. For some resources such as vegetation and soils the affected area is confined to the immediate vicinity of the construction sites. For other resources, such as socioeconomics, the affected area may extend a considerable distance

(10 to 20 miles or more) beyond construction sites. For cultural resources a corridor concept was utilized. Baseline data for known cultural sites were obtained for a 10-mile-wide corridor centered on the pipeline right-of-way shown on the strip maps in Appendix A.

Various component alternatives, such as the coal cleaning process alternative and the Fort Smith, Arkansas, route-variation alternative, can be assembled into a wide range of system alternatives. Many of these component alternatives occupy the same or nearly the same area as the proposed action. In accordance with the Council on Environmental Quality (CEQ) regulations to reduce the size of an environmental impact statement and avoid duplication, the affected environment is not described again for these alternatives. These affected areas in common are summarized in this chapter at the beginning of the discussion for the proposed action or the pertinent alternative.

3.A **PROPOSED ACTION**

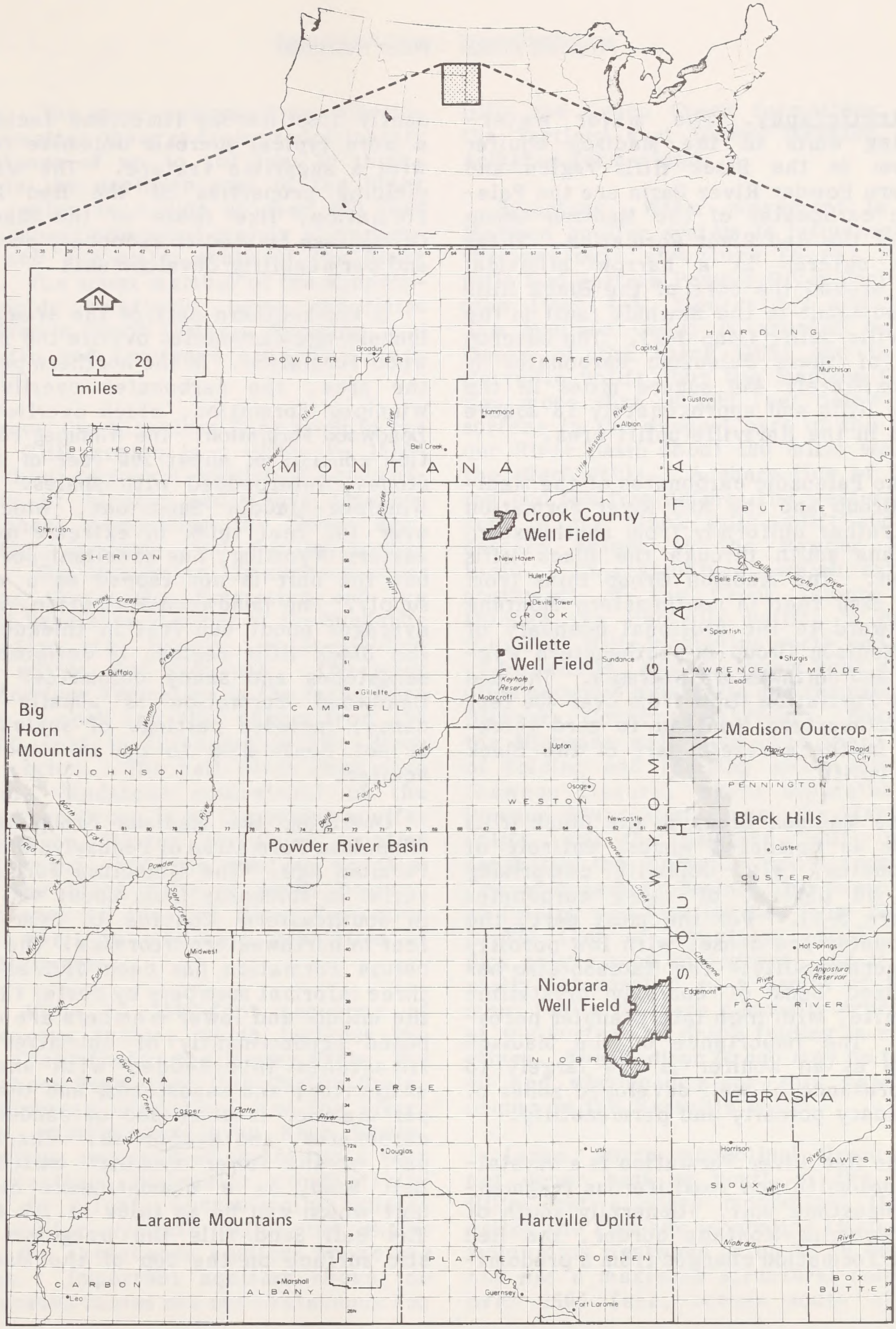
3.A.1 WATER RESOURCES

Ground Water

Studies were made of available geologic and hydrologic information on the Madison aquifer system, including earlier attempts to assess potential impacts caused by pumping from the proposed Niobrara County well field. A conceptual model was developed from these studies that explains the hydraulic behavior of the Madison aquifer system. Based upon the conceptual model, a numerical model was designed to simulate the behavior of the Madison aquifer system in the vicinity of the proposed ETSI developments. This numerical model was used to calculate future water-level declines, water-quality changes, and spring flow and stream flow reductions caused by withdrawals of ground water by present (Section 3.A.1) and planned (Section 5.A.1) Madison aquifer users, as well as by ETSI (Section 4.A.1). The city of Gillette's well field, which would be the source of ETSI's reserve water supply, was not considered as a presently operating well field but as a planned well field (Section 5.A.1). The hydrogeology of the Madison aquifer system is discussed in more detail in the Well-Field Hydrology Technical Report (WCC 1981b), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228.

Hydrogeology of the Madison Aquifer System. The Madison aquifer system is defined for purposes of this study as a regional system composed of geologic units from the Precambrian-age basement rocks to the Cretaceous-age shales. The most important aquifer within this system is the Mississippian-age Madison Group (also called the Madison Limestone, Madison Formation, Pahasapa Formation, or Guernsey Formation) and adjacent hydraulically connected strata. Major physiographic features in the area are shown on Map 3-1.

The Madison Group is found in parts of Wyoming, Montana, North and South Dakota, and Canada, covering an area of over 180,000 square miles. It is composed largely of limestone and dolomite. In the area of interest, the Black Hills region of South Dakota and Wyoming and the eastern part of the Powder River Basin of Wyoming and Montana (Map 3-1), the Madison Group has not been fully developed but is the potential source of water supply for large-scale energy development, as well as other developments that require less water (USGS 1975).



Map 3-1. PHYSIOGRAPHIC FEATURES NEAR THE NIOBRARA, GILLETTE, AND CROOK COUNTY WELL FIELDS

Stratigraphy. The major water-bearing units in the Madison aquifer system in the Black Hills region and eastern Powder River Basin are the Paleozoic carbonates of the Madison Group and of the Red River Formation. These units outcrop in a narrow elliptical band around the core of the Black Hills and adjacent to the Rawhide fault in the Hartville uplift (Map 3-2). The outcrop area of these Paleozoic carbonates is approximately 480 square miles in the Black Hills and approximately 13 square miles in the Hartville uplift area.

The Paleozoic carbonates of the Madison Group and the Red River Formation thin rather uniformly from southeastern Montana south through the Black Hills region. The Madison Group thins from over 1200 feet in southeastern Montana southward to the erosional boundary of the Madison Group in southeastern Wyoming and northwestern Nebraska. The Red River Formation thins from over 400 feet in southeastern Montana to zero thickness in the northern part of the Black Hills uplift.

The Madison Group in the Black Hills region is composed almost entirely of carbonates, with dolomite comprising over 50 percent of these carbonates (Figure 3-1). For the most part, the carbonates are dense, with low porosity and permeability. The Madison also has localized beds of coarsely crystalline dolomite, with high intergranular porosity. The importance of the Madison Group as an aquifer is due largely to the presence of well-developed zones of secondary porosity and permeability.

The Red River Formation is a crystalline dolomite and fossiliferous fragmental limestone unit. Generally south of the Wyoming-Montana border, the Red River Formation changes from a predominantly fossiliferous limestone facies to a more typical sucrosic dolomite facies with a sugarlike texture. The water-yielding properties of the Red River Formation, like those of the Madison Group, are related to secondary porosity and permeability development.

In the southern part of the area, Paleozoic-age carbonates overlie the Deadwood Formation. In the northern part of the area, the carbonates overlie the Winnipeg Formation, which overlies the Deadwood Formation. The Winnipeg Formation consists of about 200 feet of sandstones, interbedded with shales. The Winnipeg-Aladdin Sandstone, which is over 100 feet thick in extreme northeastern Wyoming, has excellent porosity but the unit is not tapped as a water supply. The Deadwood Formation, which averages about 400 feet in thickness in the Black Hills region, is composed of sandstones and sandy dolomites. The Deadwood Formation is usually very dense, includes partings of shale, and is not considered to be an important aquifer.

Overlying the Madison Group is the Minnelusa Formation of Pennsylvanian and Permian age. The Minnelusa Formation varies in thickness from about 400 feet in southeastern Montana to over 1400 feet in northwestern Nebraska. The Minnelusa Formation has been divided into three informal members by Foster (1958): the middle and lower members are composed predominantly of dolomites and limestones interbedded with shales, evaporites, and sandstones; and the upper member is composed of sandstone, carbonates, and evaporites. The basal part of the lower member, called the Bell Sand, is a discontinuous clastic unit which can be as thick as 200 feet. The Bell Sand fills the irregular karstic surface on the top of the Madison

Group. The upper member of the Minnelusa Formation changes from predominantly sandstones of up to 400 feet in thickness in the northern part of the Black Hills region to a unit of over 600 feet in thickness composed mainly of carbonates and evaporites south of the Black Hills. The upper member of the Minnelusa yields relatively large quantities of water in Crook County, Wyoming, and in Butte and Lawrence counties, South Dakota.

Above the Minnelusa Formation in the Black Hills region is a 1000- to 1500-foot-thick sequence consisting predominantly of clastic sediments (mainly siltstones) comprising the Goose Egg, Spearfish, Sundance, and Morrison formations. The Minnekahta Limestone member of the Goose Egg Formation and the Hulett Sandstone member of the Sundance Formation are, locally, water-yielding units within this sequence. Overlying the Morrison Formation is the Inyan Kara Group, a rock unit that ranges from 150 to 400 feet in thickness in the Black Hills region. The Fall River Formation (Dakota Sandstone equivalent) of the Inyan Kara Group is an important aquifer in Niobrara, Weston, and Crook counties in Wyoming, and the western counties near the Black Hills of South Dakota. Wells open to the Fall River Formation yield small to moderate quantities of potable water.

A 4000- to 5500-foot sequence of Cretaceous shales, which includes the Skull Creek Shale, the Mowry Shale, the Greenhorn Formation, the Carlile Shale, the Niobrara Formation, and the Pierre Shale, overlies the Inyan Kara Group. This thick sequence of shales has a very low vertical hydraulic conductivity that, in effect, hydraulically isolates the aquifer systems below the shales from the Cretaceous aquifers above the shales. Important aquifers above the Cretaceous shales are the Cretaceous Fox Hills and Lance Creek formations, and the Tertiary Fort Union, Wasatch, and Arikaree formations.

Structure. Water movement in the Madison aquifer system is influenced by the geologic structure in the Black Hills and eastern Powder River Basin region (Map 3-3, Figures 3-2 and 3-3). The Madison Group is exposed on the flanks of the Black Hills and in the Hartville uplift, but the Madison Group lies more than 10,000 feet below land surface in the deepest part of the Powder River Basin about 100 miles west of the Black Hills. A sharp line of folding and faulting defines the western extent of the Black Hills uplift and the eastern extent of the Powder River Basin. This structure, which extends southwest of the Crook County site through the Hartville uplift, is called the Black Hills monocline north and west of Newcastle, and the Fanny Peak monocline between Newcastle and the proposed Niobrara County well field. South of the Niobrara well field, the sharp zone of folding and faulting splits into the Shawnee flexure, which separates the Powder River Basin from the Hartville uplift, and the Rawhide fault, which separates the Hartville uplift from the Denver-Julesberg Basin. This sharp zone of folding and faulting has from 2000 to 10,000 feet of structural relief, with dips as great as 90 degrees, and is generally interpreted as a series of basement faults that are generally expressed at the surface as drape folding in monoclines. The Madison Group may be faulted and displaced along this zone, as occurs in the Hartville uplift.

Large, sharp monoclinal flexures do not occur east or north of the Black Hills, but a sharp monoclinal flexure called the Cascade monocline (Map 3-2), which dips westward at up to 70 degrees and has a maximum structural relief of over 1600 feet, occurs south of the

Black Hills. Several large Madison aquifer or Minnelusa aquifer springs occur at the apex of the Cascade anticline.

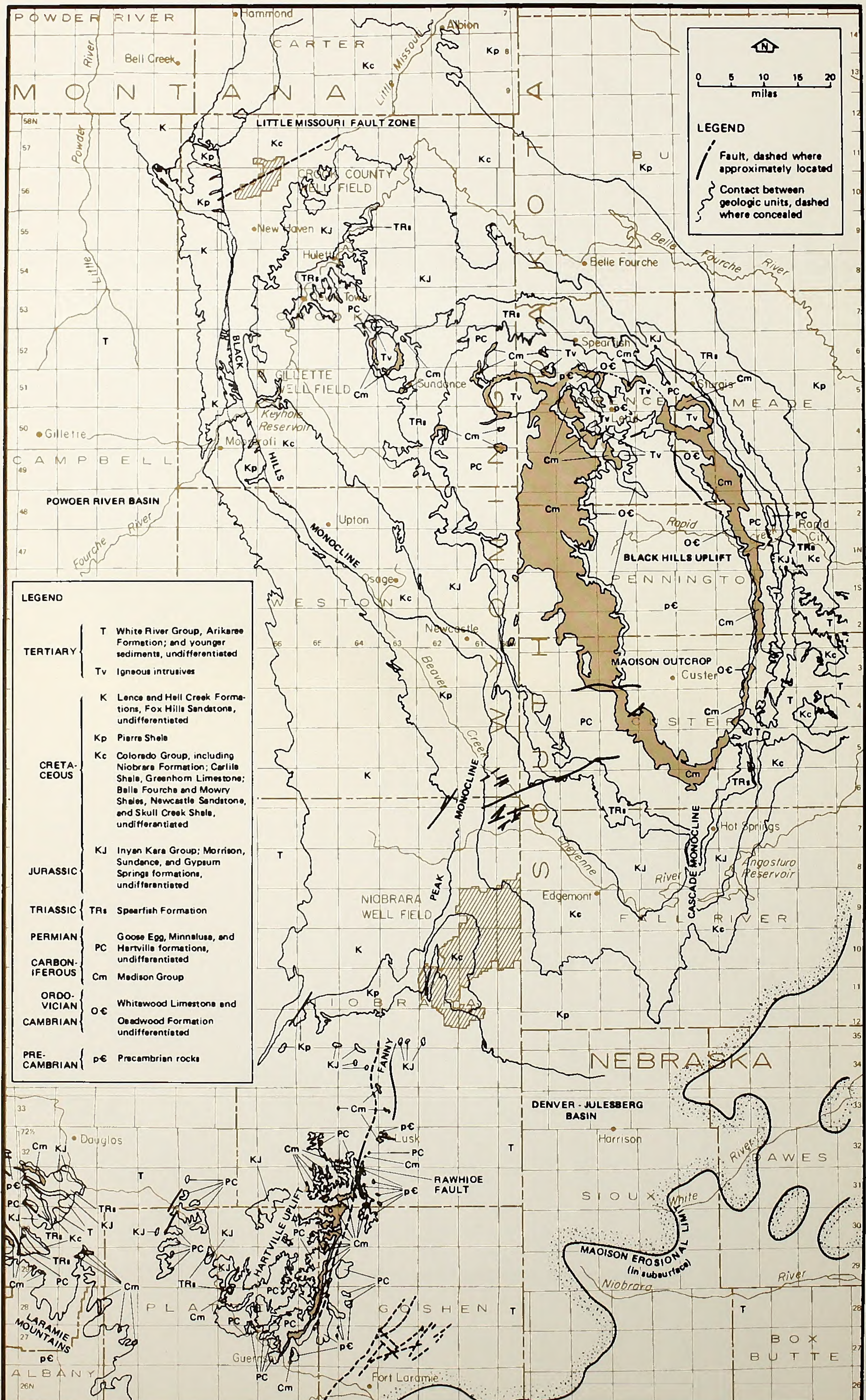
Prominent zones of faulting in which little displacement of strata occurs also may influence water movement in the Madison aquifer. The Little Missouri fault zone, a zone several miles wide in which many faults with displacements of less than 30 feet occur, parallels the Little Missouri River near the Crook County well field in northeastern Wyoming and southeastern Montana (Map 3-2). The Dewey fault zone, located northeast of the proposed Niobrara well field, is a zone of small faults running from the Madison outcrop area in the Black Hills to the Fanny Peak monocline. North of the Black Hills region a structure trending along the strike of the Lake Basin fault zone (a major structure mapped to the northwest in central Montana) apparently influences ground-water movement in the Madison aquifer system, since hydraulic properties appear to change north and south of this trend.

<u>Ground-water Movement</u>. The potentiometric surface of the Madison aquifer has been recently mapped by Miller and Strausz (1980) (Map 3-4). The potentiometric surface of the Madison aquifer in the vicinity of the Black Hills has also been mapped by Swenson and others (1976) and Eisen and others (1980). The contour maps prepared by the three groups are similar, except that Eisen and others (1980) also mapped the Madison aquifer potentiometric surface within the Madison Group outcrop area of the Black Hills. Potentiometric data are abundant near the Black Hills where there are many wells and springs, but data points are few outside the Black Hills uplift area.

The vertical flow out of (or into) the Madison aquifer can be inferred or qualitatively described by the relationship between potentiometric heads in the Madison aquifer and land surface elevations (Figure 3-4). The potentiometric surface of the Madison aquifer is above land surface in most of the area north, east, and south of the Black Hills and in the larger stream valleys west and northwest of the Black Hills. The potentiometric surface of the Madison aquifer is generally below land surface outside major stream valleys west of the Black Hills and in the Powder River Basin south of the Wyoming-Montana state line.

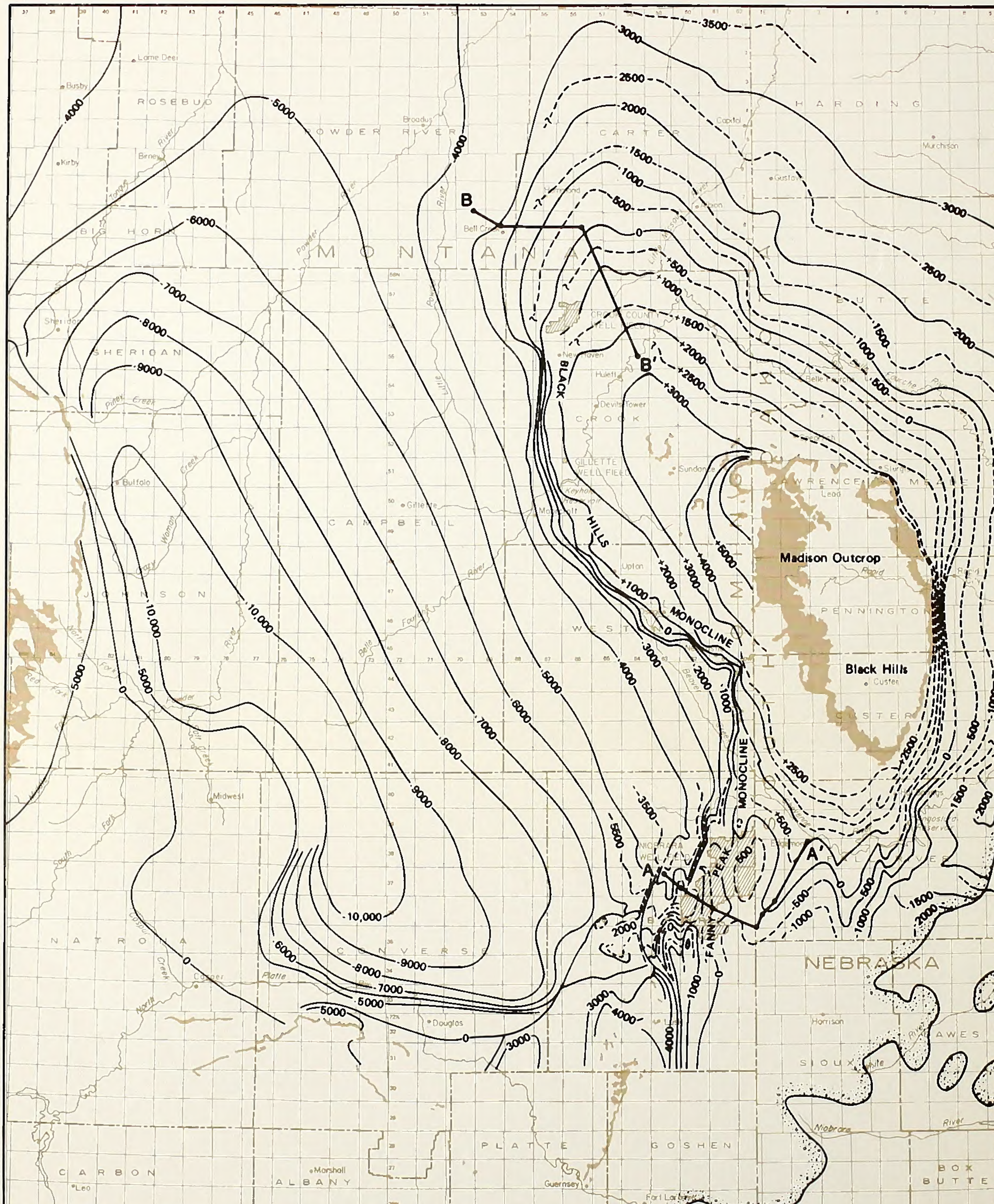
The potentiometric gradients in the Madison aquifer indicate that water recharges the Madison aquifer system at outcrop areas in the Black Hills and in the Hartville and Laramie uplifts, and then flows away from these outcrop areas (Figure 3-4). Water infiltration at the Madison outcrop area may discharge locally as springs and seeps, or it may continue downdip (downgradient) toward the Powder River Basin. The difference between the amount of water infiltrating the aquifer and the amount of water rejected from the aquifer as discharge to the land surface in the outcrop area constitutes the amount of recharge to the Madison aquifer. Thus the Madison outcrop area may act as a recharge area, a discharge area, or both. Ground water that recharges the Madison aquifer on the northern and eastern flanks of the Black Hills moves toward the northeast. The major discharge area for this water is probably the Missouri River valley, as hypothesized by Swenson (1968). Water that recharges the Madison aquifer in the Hartville uplift also moves toward the east and northeast. The water that recharges the Madison aquifer on the western flanks of the Black Hills and in the Laramie uplift flows toward the Powder River Basin (Figure 3-2).

The steep monoclinal flexures that define the western, southern, and eastern sides of the Powder River Basin are



Source: Darton, 1951;
Love, Weitz, and Hose, 1952;
Ross, Andrews, and Witkind, 1955.

Map 3-2. GENERALIZED SURFICIAL GEOLOGY OF THE BLACK HILLS AND EASTERN POWDER RIVER BASIN



LEGEND

Structure contour on top of Madison Group, elevation in feet (Mean Sea Level). Dashed where approximately located; queried where uncertain.

B ——— B' Location of geologic cross section

0 5 10 15 20
miles

Source: Adapted from DeGolyer and MacNaughton, 1974; Gott and others, 1974; Head and Merkel, 1977; Horton, 1953; Keefer, 1974; Keene, 1973; Lisenbee, 1979; Northrup, 1939; Old West Regional Commission, 1976; Petroleum Information Service, 1980; Stafford, 1979; Swenson and others, 1976; Whitcomb, 1965; Wulf, 1963; Wulf, 1974; Pierce and Girard, 1952.

NOTE: The structure contours on this map were constructed by adapting the shape of structure contours prepared by various source authors on higher stratigraphic units such as the Fall River Sandstone, the top of the Minnelusa, and the Minnelusa Red Shale Marker. The depth interval between the higher stratigraphic unit and the Madison at oil well control points was determined and used to adjust the contours.

Map 3-3. STRUCTURAL GEOLOGY OF THE MADISON GROUP IN THE BLACK HILLS AND POWDER RIVER BASIN AND LOCATIONS OF CROSS SECTIONS

SYSTEM	SERIES	STRATIGRAPHIC UNIT		THICKNESS (FEET)	DESCRIPTION
Quaternary	Recent and Pleistocene		Alluvium and stream terraces		Silt, sand, and gravel.
			Unconformity		
Tertiary	Oligocene		White River Formation	0 - 150	Light-gray medium- to coarse-grained sandstone at base overlain by light brownish-gray claystone and siltstone.
			Unconformity		
Tertiary	Eocene		Wasatch Formation	300 +	Grayish-yellow sandstones and gray shale, numerous coal beds; thick extensively burned coal bed (Roland bed of U.S. Geol. Survey Bull. 796-A) at base.
Tertiary	Paleocene	Fort Union Formation	Tongue River member	500 - 800 ±	Yellowish-gray massive sandstone and light-gray shale; numerous coal beds: thickest in Montana; thins southward.
Tertiary	Paleocene	Fort Union Formation	Lebo shale member	200 - 250	Medium- to dark-gray shale, light-gray sandstone, and a few thin coal beds.
Tertiary	Paleocene	Fort Union Formation	Tullock member	500 - 1,100	Light-gray and light-brown sandstone, gray shale, and numerous thin coal beds: thinnest in Montana; thickens southward.
Cretaceous	Upper Cretaceous		Lance Formation	500 - 1,600	Gray to yellowish-gray sandstone and gray shale; a few thin beds of carbonaceous shale; thinnest in Montana; thickens southward.
Cretaceous	Upper Cretaceous	Montana Group	Fox Hills Sandstone: Colgate member, 50-100 ft.	125 - 200	Brown sandy shale and siltstone, light-gray sandstone, and brown ferruginous sandstone concretions; the Colgate member, a prominent massive white sandstone, at top in Montana.
Cretaceous	Upper Cretaceous	Montana Group	Pierre Shale, Upper part: Kara bentonitic member, 100 ± ft.; Monument Hill bentonitic member, 150-220 ft.	800 - 1,500	Dark-gray shale and claystone; locally beds of siltstone; abundant limestone concretions some fossiliferous in upper and lower parts; thickens southward from Montana. Kara and Monument Hill bentonitic members, gray bentonitic shale and impure bentonite with a few limestone concretions and small barite concretions.
Cretaceous	Upper Cretaceous	Montana Group	Pierre Shale: Mitten black shale member	145 - 1,000	Dark-gray to black shale with beds of yellowish-gray bentonite at base and numerous large yellowish-brown-weathering fossiliferous septarian limestone concretions in upper part; thickens southward from Montana.
Cretaceous	Upper Cretaceous	Montana Group	Pierre Shale, Gammon ferruginous member: Groat sandstone bed, 0-125 ft.	0 - 1,000	Light-gray claystone and shale with abundant reddish-brown iron-stained concretions and thin lenses of siderite. Groat sandstone bed, mapped north of T. 55N., consists of gray fine-grained glauconitic and ferruginous sandstone.
Cretaceous	Upper Cretaceous	Colorado Group	Niobrara Formation	150 - 225	Chalk marl and calcareous shale; numerous thin beds of bentonite, dark gray when fresh, weathers light yellow.
Cretaceous	Upper Cretaceous	Colorado Group	Carlile Shale: Sage Breaks member	200 - 300	Grayish-black noncalcareous shale with numerous beds of septarian limestone concretions that weather light gray.
Cretaceous	Upper Cretaceous	Colorado Group	Carlile Shale: Turner sandy member	150 - 260	Oark-gray shale, locally sandy and silty, with numerous beds of light-yellow and red silty limestone concretions; commonly a thin bed of light-gray medium-grained sandstone at the base.
Cretaceous	Upper Cretaceous	Colorado Group	Carlile Shale: Lower unnamed number	40 - 130	Dark-gray shale with a few limestone concretions; locally slightly silty and sandy; thickest in Montana.
Cretaceous	Upper Cretaceous	Colorado Group	Greenhorn Formation	70 - 370	In northeastern and southeastern parts; gray calcareous shale and marl with some light-gray, thin-bedded limestone; in central part; gray noncalcareous shale containing prominent light-gray weathering septarian limestone concretions; thins westward.
Cretaceous	Upper Cretaceous	Colorado Group	Belle Fourche Shale	350 - 850	Dark-gray to black shale with numerous dark purplish-red weathering siderite concretions in lower part, and several beds of light-gray and yellow-weathering limestone concretions in middle and upper parts; thickens westward.
Cretaceous	Lower Cretaceous	Colorado Group	Mowry Shale	180 - 230	Dark-gray siliceous shale, weathers light gray; numerous fish scales along partings; many thin bentonite beds; Clay Spur bentonite bed at top.
Cretaceous	Lower Cretaceous	Colorado Group	Newcastle Sandstone	0 - 95	Lenticular beds of light-gray sandstone and siltstone and dark-gray shale and claystone; a few beds of impure coal and bentonite; thickness varies within short distances, but averages about 40 feet.
Cretaceous	Lower Cretaceous	Colorado Group	Skull Creek Shale	180 - 270	Black shale with a few dark-red ferruginous concretions.
Cretaceous	Lower Cretaceous	Inyan Kara Group	Fall River Formation	95 - 200	Fine- to medium-grained light yellowish-brown to brown sandstone with interbedded gray and black shale and gray siltstone; averages about 135 feet in thickness near its outcrop.
		Inyan Kara Group	Unconformity		
Cretaceous	Lower Cretaceous	Inyan Kara Group	Lakota Formation	45 - 300	Light yellowish-gray to white fine- to coarse-grained sandstone and conglomeratic sandstone irregularly interbedded with red, green, yellow, gray, and black claystone; coal beds near base locally; thickness varies within short distances.
Jurassic	Upper Jurassic		Morrison Formation	0 - 150	Greenish-gray, green, and grayish-red claystone with a few thin discontinuous beds of light-gray sandstone and limestone; thickness at most places between 80 and 120 feet.
Jurassic	Upper Jurassic	Sundance Formation	Redwater shale member	30 - 195	Greenish-gray soft fissile sandy and silty shale; includes some thin beds of glauconitic sandstone and oolitic and coquinoid limestone; thickness at most places between 160 and 190 feet.
Jurassic	Upper Jurassic	Sundance Formation	Lak member	40 - 80	Yellow and pink crudely bedded fine-grained sandstone and siltstone.
Jurassic	Upper Jurassic	Sundance Formation	Hulett sandstone member	55 - 90	Yellowish-gray fine-grained thin-bedded to massive calcareous sandstone; locally pink northeast of Devils Tower.
Jurassic	Upper Jurassic	Sundance Formation	Stockade Beaver shale member	50 - 90	Soft gray calcareous shale with some thin beds of yellowish-gray sandstone.
Jurassic	Upper Jurassic	Sundance Formation	Canyon Springs sandstone member	0 - 40	Friable yellowish-gray or pink sandstone, some light greenish-gray siltstone.
		Sundance Formation	Unconformity		
Jurassic	Middle Jurassic		Gypsum Spring member	0 - 125	At base, massive white gypsum with interbedded red gypsiferous claystone; overlain near Hulett by interbedded gray cherty limestone and red claystone; thins southward from a maximum observed thickness of 125 feet near the junction of Deer Creek and the Belle Fourche River (SW ¼ sec. 13, T. 55 N., R. 64 W.).
			Unconformity		
Triassic and Permian			Spearfish Formation	450 - 825	Red sandy shale, siltstone, and sandstone; beds of massive white gypsum in lower half.
Permian		Goose Egg Formation	Minnekahta Limestone	40 ±	Light-gray thin-bedded limestone, pink on outcrop.
Permian		Goose Egg Formation	Opeche Formation	60 - 90	Reddish-brown and maroon fine-grained sandstone, siltstone, and shale.
			Unconformity		
Permian and Pennsylvanian			Minnelusa Formation	650 - 800	Light-gray and red sandstone, gray limestone and dolomite, red shale, local gypsum and anhydrite.
			Unconformity		
Mississippian			Madison Group	500 - 600	Light-gray limestone, locally dolomitic.
Mississippian	Lower Mississippian		Englewood Limestone	50 - 60	Pink or purplish-gray thin-bedded limestone; locally shaly.
			Unconformity		
Ordovician	Upper Ordovician		Red River Formation	50 - 60	Mottled grayish-yellow massively bedded dolomite, locally cherty near top.
Ordovician	Middle Ordovician		Winnipeg Formation	60 - 70	Upper part greenish-gray siltstone, lower part greenish-gray shale (Furnish, Barragy, and Miller, 1936; Carlson, 1958).
			Unconformity		
Cambrian and Ordovician	Upper Cambrian and Lower Ordovician		Deadwood Formation	300 - 500	Brown sandstone, gray glauconitic limestone and edgewise limestone conglomerate, and green shale.
			Unconformity		
Precambrian					Metamorphic and igneous rocks.

Source: Robinson, Mapel and Bergendahl, 1964.

Figure 3-1. GENERALIZED STRATIGRAPHIC COLUMN FOR THE EXPOSED SEDIMENTARY ROCKS ON THE NORTHERN AND WESTERN FLANKS OF THE BLACK HILLS UPLIFT

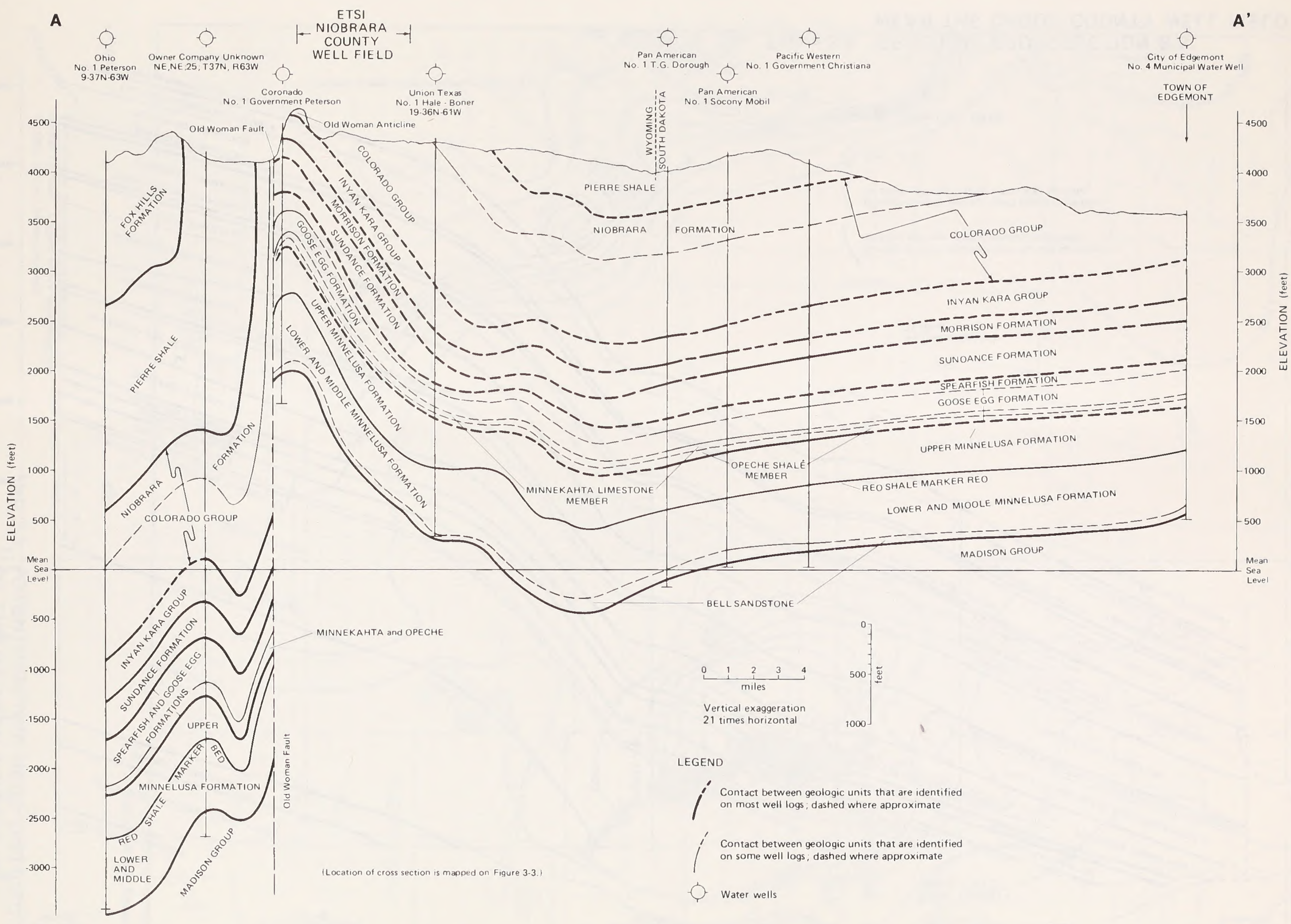


Figure 3-2. GEOLOGIC CROSS SECTION A-A'
NEAR THE NIOBRARA COUNTY WELL FIELD

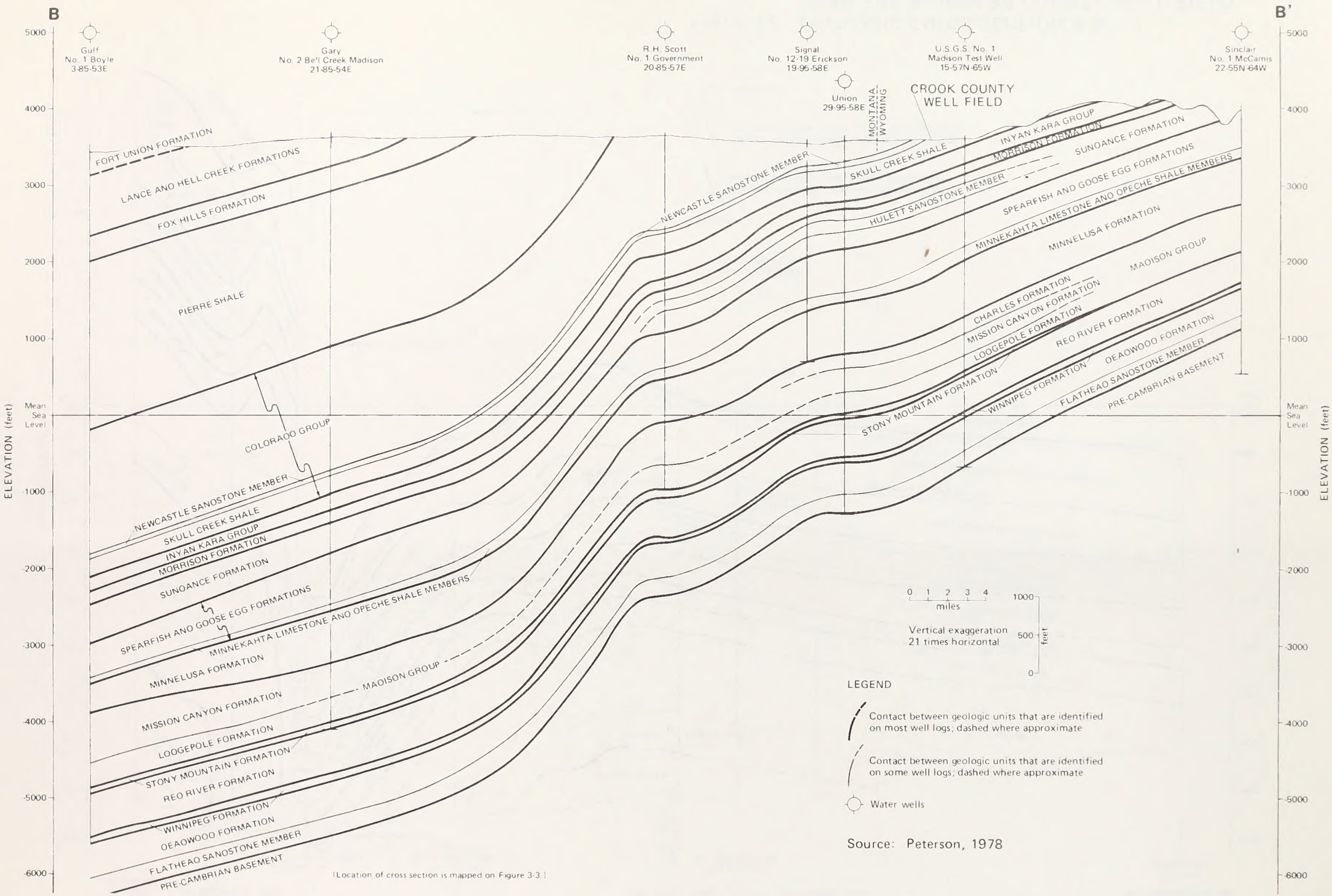
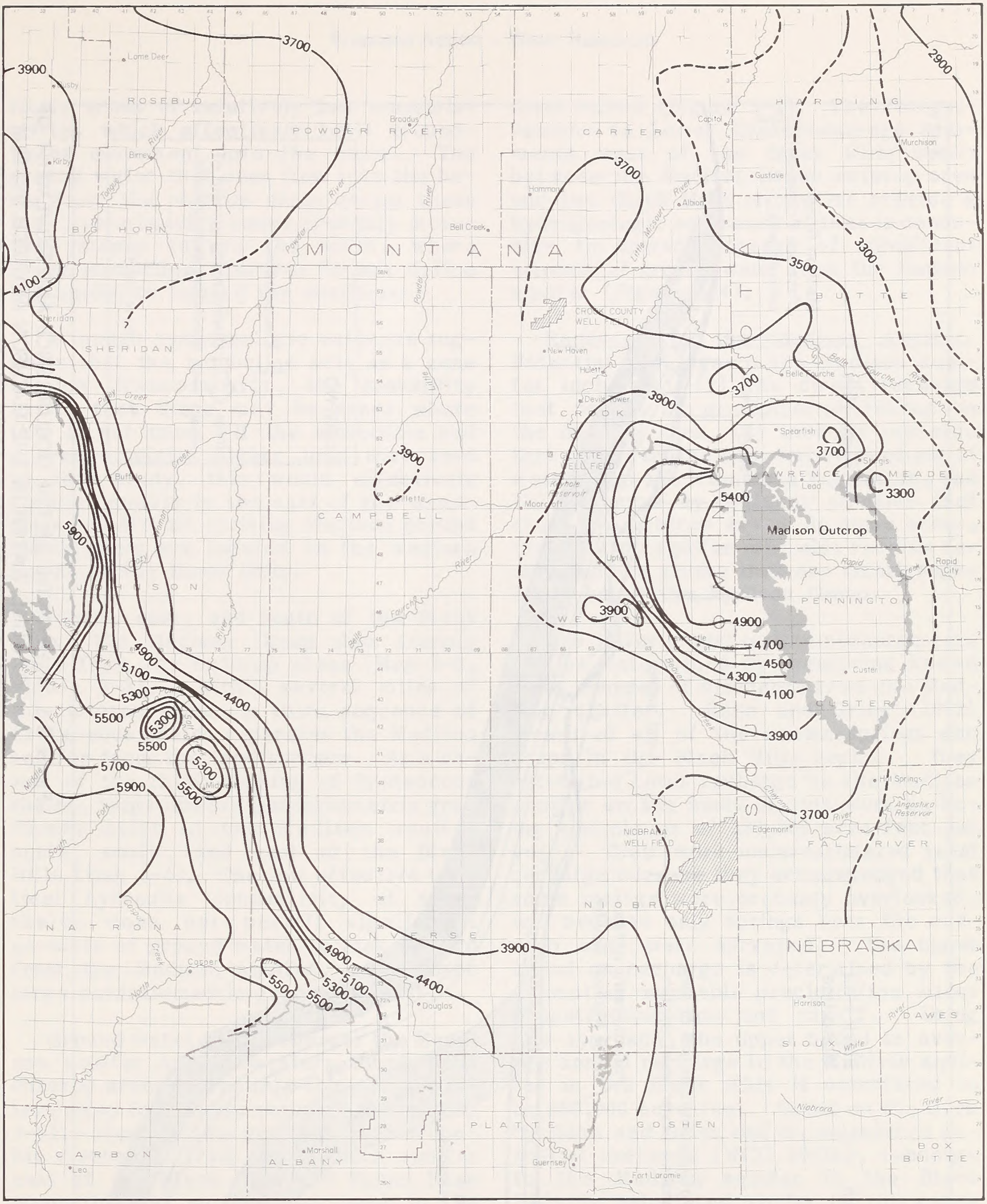


Figure 3-3. GEOLOGIC CROSS SECTION B-B' NEAR THE CROOK COUNTY WELL FIELD



Source: Miller and Strausz, 1980.

LEGEND

Line of equal potentiometric head distribution (in feet). Dashed where approximately located, queried where uncertain

0 5 10 15 20
miles

Map 3-4. POTENTIOMETRIC HEAD DISTRIBUTION OF THE MADISON AQUIFER (feet)

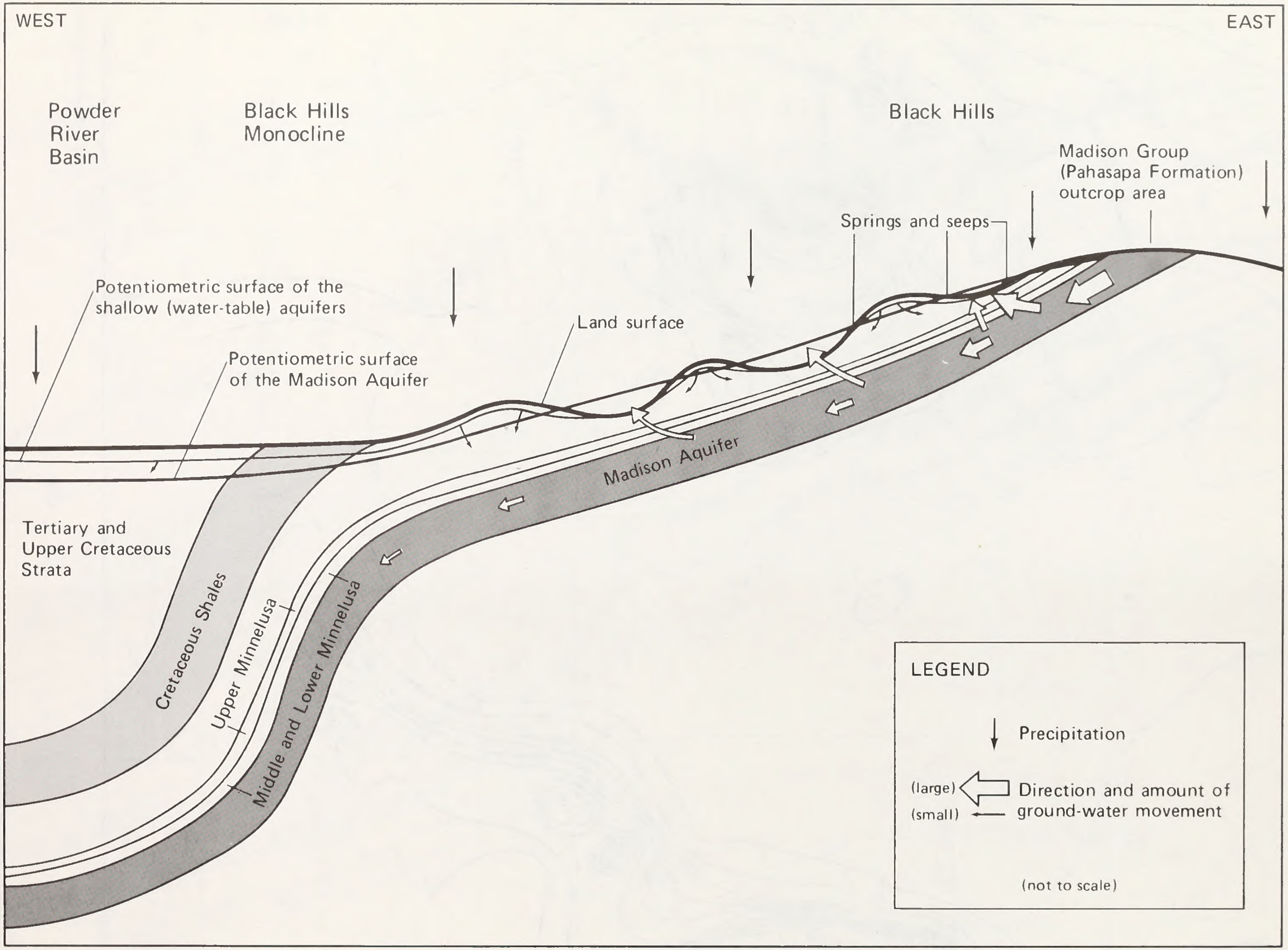


Figure 3-4. SCHEMATIC OF THE OCCURRENCE AND MOVEMENT OF GROUND WATER IN THE MADISON AQUIFER SYSTEM ON THE WESTERN FLANKS OF THE BLACK HILLS

likely zones of relatively low transmissivity, which effectively limit groundwater movement into the basin. The ground water that does flow into the basin from the outcrop areas across these low-transmissivity zones probably moves very slowly toward the north, where steep monoclinal flexures do not define the basin, or toward the southeast.

Although hydrogeologic evidence suggests that the monocline acts as a zone of low transmissivity, the possibility exists that there may be areas where this is not true. If the monocline had a transmissivity higher than that used in this study, this would effectively reduce impacts to the east of the monocline, where all existing Madison ground water users are located on the western flanks of the Black Hills.

North, east, and south of the Black Hills, the Madison Group dips steeply away from the outcrop areas (Map 3-3, Figure 3-3). Within several miles of the outcrop areas, a thick sequence of Cretaceous shales separates the Madison aquifer from the land surface. As a result of the thick capping of Cretaceous shales, large upward potentiometric gradients exist in the Madison aquifer north, south, and east of the Black Hills (Map 3-4). The low effective vertical hydraulic conductivity of these shales does not permit significant amounts of ground water to leak upward from the Madison aquifer, even where large potentiometric gradients exist.

Ground water that recharges the Madison aquifer at the western Black Hills outcrop areas moves in a semiradial pattern away from these recharge areas (Map 3-4). Most of this ground water probably discharges from the Madison aquifer east of the Black Hills and Fanny Peak monoclines as springs and seeps in the stream valleys, and to shallower aquifers where an upward potentiometric gradient exists (Figure 3-4). The Pennsylvanian- to Lower Cretaceous-age sediments west of the Black Hills uplift between the Madison Group outcrop area and the Black Hills monocline provide a hydrogeologic environment that is conducive to upward leakage of significant amounts of ground water from the Madison aquifer (Figure 3-4).

<u>Recharge to the Madison Aquifer</u>. Potential recharge to the Madison aquifer includes: (1) the direct recharge that occurs by precipitation falling on the outcrop area, (2) indirect recharge that occurs by the downward movement of water from the Minnelusa Formation, and (3) recharge by influent streams that cross the outcrop area. In some areas, the Madison aquifer may also receive recharge from strata that are stratigraphically below the Madison Group.

The lower bound on the recharge rate can be determined by measuring known point sources of discharge from the Madison aquifer. Rahn and Gries (1973) measured all of the known springs and seeps in the Black Hills region. They estimated total recharge to the Madison aquifer on the basis of this work as being a minimum of 139,000 acre-feet per year. Their work underestimated total recharge because they acknowledged that some springs were probably overlooked, and because only springs near the outcrop area were surveyed. The upper bound on recharge is determined by the amount of available precipitation minus evapotranspiration and runoff. Using this approach, the upper bound on average annual recharge to the Madison aquifer in the Black Hills is calculated to be 400,000 acre-feet. Based on the work by Rahn and Gries and on calculated potential recharge (WCC 1981b), recharge to the Madison aquifer in the Black Hills is calculated to be in the range of about 140,000 to 400,000 acre-feet per year.

The recharge to the Madison aquifer in the Hartville uplift area has been estimated by the Wyoming State Engineer's Office (1976) to be 2800 acre-feet per year. Actual recharge may be as much as several times larger than that estimated by the Wyoming State Engineer's Office, since recharge to the Madison aquifer can occur both at the Madison outcrop area in the Hartville uplift and by downward leakage from the Arikaree Formation, a rock unit which directly overlies the Madison Group in parts of the Hartville uplift.

Discharge from the Madison Aquifer System: Spring Flow and Stream Flow. Ground water discharges from the Madison aquifer in the Black Hills region as springs and seeps located in or near the streams that drain the region. In addition, ground water flows out of the Black Hills region in the Madison aquifer to the east and northeast. The locations and discharges of the major springs and seeps in the Black Hills were measured by Rahn and Gries (1973) (Map 3-5, Table 3-1).

The springs and seeps measured by Rahn and Gries sustain the base flow of all major streams that drain the Black Hills. These major streams in the Black Hills, which are fed by spring flow from the Madison Group, are:

- Spearfish Creek, Sand Creek, and Crow Creek, all tributaries of the Redwater River that drain the northeastern part of the Black Hills and have a total base flow of approximately 80 cubic feet per second (cfs)

- Elk Creek, Rapid Creek, Boxelder Creek, Spring Creek, and Battle Creek, all tributaries of the Cheyenne River that drain the eastern side of the Black Hills and have a total base flow of approximately 47 cfs

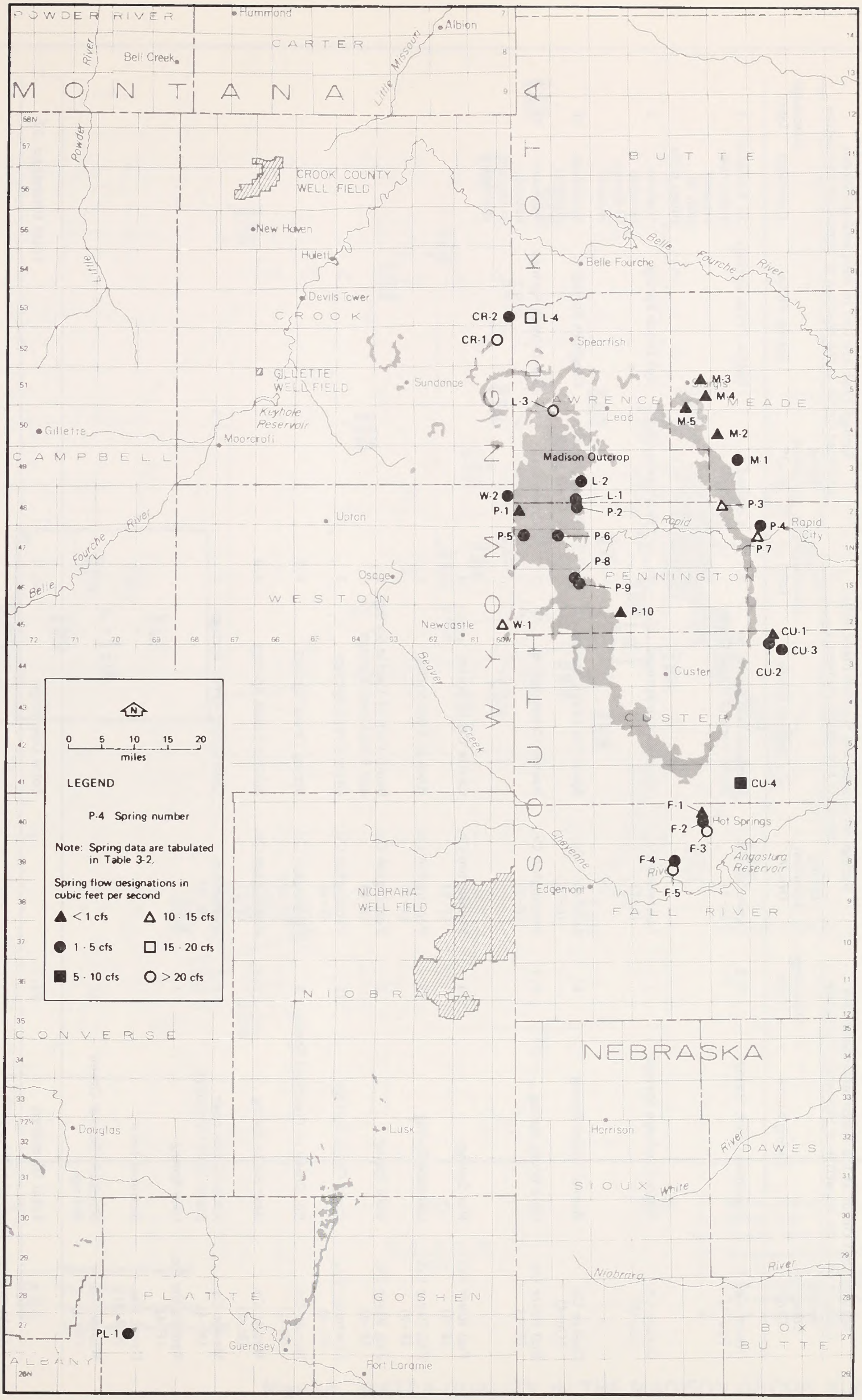
- Stockade-Beaver Creek, which drains part of the western side of the Black Hills and has a base flow of 13 cfs

- Cascade Springs Creek and the Fall River south of the Black Hills, which are fed by the large Cascade Spring and Hot Springs, respectively, and which have a total base flow of approximately 50 cfs.

Upward leakage from the Madison aquifer also accounts for part of the base flow of streams draining areas underlain by Lower Cretaceous and older strata in the study area that do not directly drain from the Black Hills. Streams which are likely to contain a Madison aquifer base-flow component include the Belle Fourche River, the Little Missouri River, Inyan Kara Creek, and the Cheyenne River. The base-flow contributions from the Madison aquifer to these streams are generally not recognized because: (1) the upward leakage from the Madison aquifer discharges as seeps through younger strata, (2) the total contribution to base flow from upward leakage from the Madison aquifer is not large, and (3) part of the base flow of these streams comes from ground-water discharge from local flow systems contained in strata overlying the Minnelusa Formation.

Water Quality.

Madison Group and Red River Formation. Ground water in the Madison aquifer in the Black Hills region has total dissolved solids (TDS) concentrations that are generally less than 1000 milligrams per liter (mg/l) (Map 3-6, Table 3-2). The principal cations in the ground water are calcium and magnesium, and the principal anions are bicarbonate and sulfate. The quality of Madison ground water is generally best near Madison outcrop areas, where TDS concentrations are less than 300 mg/l and sulfate concentrations are less than 10 mg/l.



Source: Cox, 1962;
Rahn and Gries, 1973;
Wyoming State Engineers Office, 1976.

Map 3-5. SPRINGS IN THE BLACK HILLS AND EASTERN POWDER RIVER BASIN

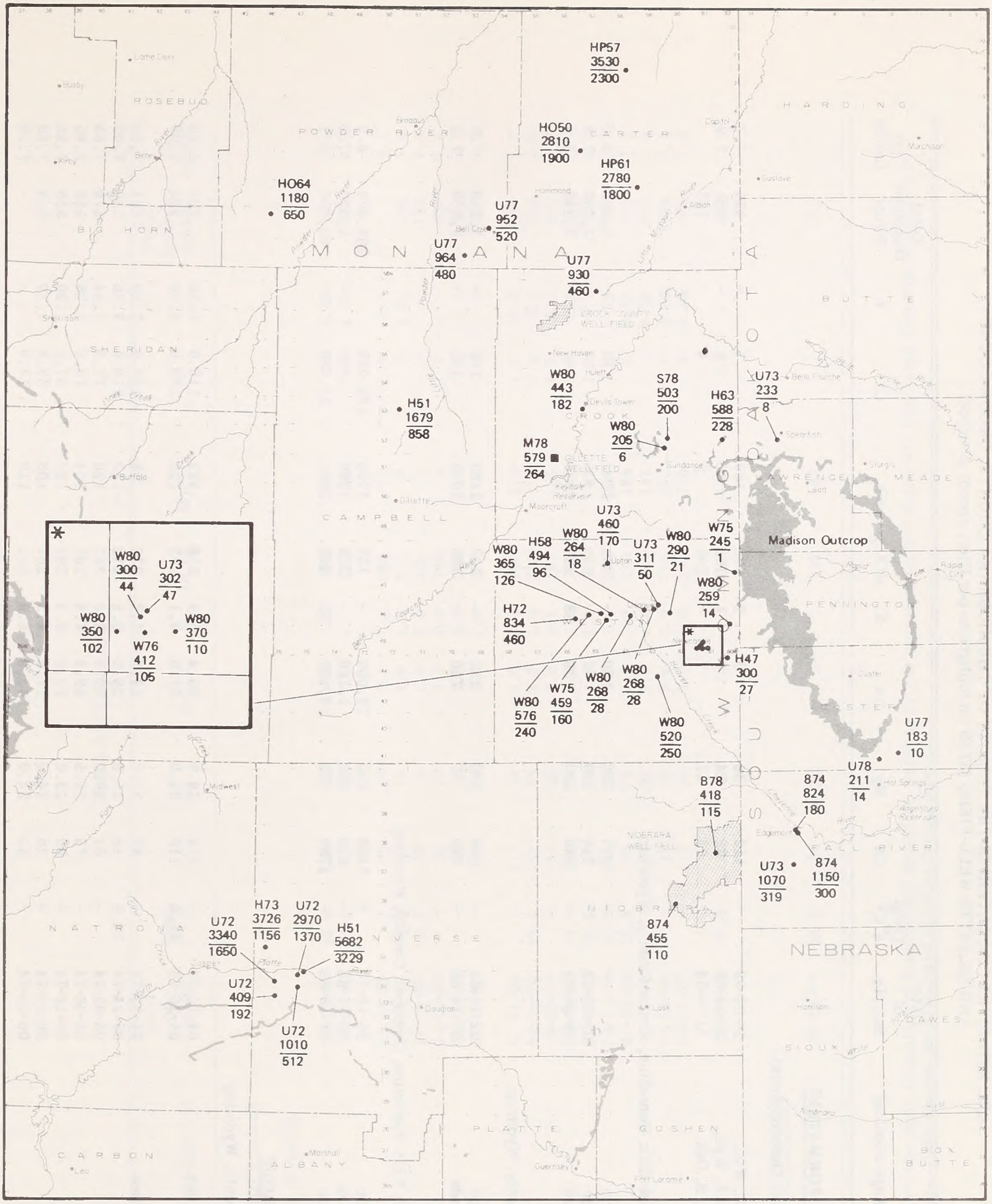
TABLE 3-1

SPRINGS OF THE BLACK HILLS REGION AS THEY RELATE TO REGIONAL GEOLOGY AND GEOGRAPHY

Springs That Occur at the Minnekahta-Spearfish Contact or in the Spearfish or Sundance Formation			Springs on or near the Central Black Hills Madison Limestone Plateau			Springs That Are Not in the Central Plateau, and That Occur in the Madison or Minnelusa Formation			
Spring Location (No.)*	Spring Name	Discharge (cfs)	Spring Location (No.)*	Spring Name	Discharge (cfs)	Spring Location (No.)*	Spring Name	Comment	Discharge (cfs)
Custer Co. (Cu-1)	Deadman Gulch Spring	0.8	Lawrence Co. (L-1)	Headquarters Spring on South Fork of Rapid Creek	3	Custer Co. (Cu-2)	Battle Creek Springs	At Madison-Minnelusa contact east of Black Hills	1
Custer Co. (Cu-3)	Grace Coolidge Springs	1	Lawrence Co. (L-2)	Tilson Creek Springs	2	Fall River Co. (F-2)	Hot Brook Springs	Madison outcrop in stream channel	2
Custer Co. (Cu-4)	Beaver Creek Spring	9	Lawrence Co. (L-3)	Spearfish Creek Springs	40	Pennington Co. (P-7)	Cleghorn Spring	Minnelusa outcrop	10
Fall River Co. (F-1)	Cold Brook Spring	0.7	Pennington Co. (P-5)	Beaver Creek Spring	2	Crook Co. (Cr-1)	Sand Creek Springs	Madison outcrop in stream channel	24
Fall River Co. (F-3)	Hot Springs	23	Pennington Co. (P-6)	Castle Creek Spring	4				
Fall River Co. (F-5)	Cascade Spring	23	Pennington Co. (P-2)	Rhoads' Fork Spring	4				
Fall River Co. (F-4)	Cold Spring	1	Pennington Co. (P-8)	South Fork of Castle Spring and Pole Creek Springs	1				
Lawrence Co. (L-4)	Crow Creek Springs	17	Pennington Co. (P-9)	Ditch Creek Springs	3				
Meade Co. (M-1)	Elk Creek at Piedmont Spring	2	Pennington Co. (P-10)	Spring Creek Springs	0.2				
Meade Co. (M-3)	Bear Butte Spring	0.6	Pennington Co. (P-1)	Soldier Creek Springs	0.4				
Meade Co. (M-4)	Alkali Creek near Black Hills Cemetery	0.6	Weston Co. (W-2)	Cold Spring Creek Springs	2				
Pennington Co. (P-4)	City Spring	1							
Crook Co. (CR-2)	Montana Lake								
Weston Co. (W-1)	Stockade-Beaver Creek Springs	13							
	Total Discharge:	92.7		Total Discharge:	61.6			Total Discharge:	37

Data source: Rahn and Gries 1973.

*See Map 3-5 for locations of springs.



LEGEND

H78 — Source code (see sources)
H78 — Year collected
1120 — Total dissolved solids, mg/l
400 — Sulfate ion concentration, mg/l

N

0 5 10 15 20
miles

Source: B - Bechtel, undated
H - Hodson, 1974
HO - Hopkins, 1976
M - Montgomery Engineers, 1979
U - U.S. Geological Survey data bank, collected by USGS, all U73 samples collected by Back
W - Eisen and others, 1980

Map 3-6. WATER QUALITY IN THE MADISON GROUP, BLACK HILLS, AND EASTERN POWDER RIVER BASIN

TABLE 3-2

REPRESENTATIVE WATER QUALITY ANALYSES OF THE MINNELUSA FORMATION, MADISON GROUP, AND RED RIVER FORMATION IN THE VICINITY OF THE NIOBRARA COUNTY, CROOK COUNTY, AND GILLETTE WELL-FIELD SITES (in milligrams per liter, except as noted)

Well No. (Township-Range-Section)	Date of Sample	Temp (°C)	Ca	Mg	Na	K	HCO_3	SO_4	Cl	F	Total Dissolved Solids	pH (units)
MINNELUSA FORMATION												
Near Minnelusa Outcrop Areas												
54N-64W-7BC, Wyo.	06-04-68	-	110	36	3	2	286	180	2	-	485	7.7
47N-60W-30AA, Wyo.	06-03-69	-	68	24	1	1	305	12	1	-	280	7.9
6N-2F-10DA, S. Dak.	11----54	-	63	21	7	-	296	8	4	-	247	-
Near the Black Hills Monocline, Crook County, Wyoming												
51N-66W-09db	-	-	620	220	130	-	293	2200	16	-	3,300	8.0
52N-67W-19cc	01-22-58	-	740	230	5	-	330	2400	14	-	3,580	7.0
52N-68W-20dd	08-04-64	-	580	190	30	68	232	2000	40	-	3,040	8.4
Niobrara County, Wyoming												
35N-63W-15bd	02-14-65	-	600	240	250	-	709	2100	160	-	3,710	7.3
36N-64W-26ada	09-14-65	-	240	37	750	-	185	2000	130	-	3,210	7.2
West of Black Hills Monocline, Campbell County, Wyoming												
52N-69W-11cc	06-10-70	-	2400	650	76,000	-	131	2200	120,000	-	202,000	6.0
52N-69W-28db	01-07-63	-	610	230	1,100	-	378	2200	1,600	-	5,920	7.3
52N-70W-15da	07-10-63	-	1700	750	20,000	35	488	3300	34,000	-	60,500	8.1
MADISON GROUP												
Niobrara County, Wyoming												
36N-62W-28 aba	04-15-74	-	114	30.9	36.4	5.9	256	122	110.0	1.56	704	7.80
	04-26-74	46.0	110	35.0	36.0	6.1	242	120	130.0	3.60	584	7.00
36N-62W-28 baa	05-22-74	-	88	51.0	29.2	4.2	232	98	125.0	2.20	661	7.50
	05-24-74	54.0	98	35.0	28.0	6.1	219	110	110.0	3.00	526	7.00
	06-02-74	-	84	29.0	30.3	5.8	207	120	72.5	1.44	579	7.65
	06-08-74	-	78	25.5	29.8	4.8	207	104	70.0	1.28	556	7.65
	06-12-74	-	80	23.0	29.6	6.3	201	109	57.5	1.20	536	7.65
	06-13-74	-	90	24.0	27.8	4.2	207	108	62.5	1.20	554	7.50
	06-20-74	-	85	24.0	42.0	6.0	232	110	74.0	-	-	7.30
38N-61W 35d	09-30-78	-	80	17.0	44.0	7.0	256	115	32.0	0.57	414	8.10

TABLE 3-2 Concluded

Well No. (Township-Range-Section)	Date of Sample	Temp (°C)	Ca	Mg	Na	K	HCO_3	SO_4	Cl	F	Total Dissolved Solids	pH (units)
MADISON GROUP (cont.)												
Crook County, Wyoming												
51-66-6 cab	12-12-79	22.0	148	56	11.0	2.0	272	335	28	2.65	707	7.5
51-66-6 bc	02-20-80	23.0	104	40	4.0	1.0	281	195	4	0.66	488	6.8
52-63-25 dc	03-16-73	-	65	16	2.1	1.2	268	7.4	1.7	0.6	-	8.3
	12-13-79	9.0	52	17	3.0	1.0	250	4	2	0.36	204	7.6
	02-15-80	10.0	50	16	1.0	1.0	229	0	3	-	182	7.6
	03-13-80	-	57	16	3.0	1.0	244	6	4	-	205	7.8
	04-12-80	-	55	16	2.0	1.0	244	8	2	-	205	7.1
	05-13-80	-	63	14	3.0	1.0	254	10	4	-	221	7.8
53-65-18 bbd	07-11-62	-	112	43	4.0	1.0	264	275	1.5	0.5	579	7.2
	04-28-70	15.0	112	35	3.3	1.5	261	210	3.4	1.2	504	7.9
	09-27-73	-	112	36	3.0	2.0	194	185	1.5	0.3	500	7.5
	08-30-75	17.0	110	38	3.7	1.5	273	210	2.6	0.5	512	7.6
	08-30-75	10.0	66	24	1.9	1.2	307	15	1.7	0.2	273	7.6
	12-12-79	15.0	115	42	4.0	1.0	264	240	5	0.52	539	7.8
	02-15-80	13.0	98	35	2.0	1.0	220	194	6	0.56	442	7.9
	03-13-80	-	101	34	4.0	1.0	244	182	4	0.54	443	7.5
	04-12-80	-	110	39	3.0	2.0	278	200	4	0.58	494	7.1
	05-13-80	-	115	36	2.0	1.0	273	200	5	0.58	493	7.9
57-65-15da	08-05-77	47.6	180	48	35	8	190	450	51	-	902	-
RED RIVER FORMATION												
57-65-15da	08-12-71	50.0	84	39	5	2	220	190	3	-	460	-

Note: A more complete tabulation of Madison and Minnelusa water quality is contained in the Well-Field Hydrology Technical Report (WCC 1981b). Data sources are also listed in the technical report.

Sulfate and TDS concentrations in the Madison aquifer increase with distance from the outcrop areas. At the Niobrara County well field, which is located approximately 24 miles north of Madison Group outcrops in the Hartville uplift, TDS and sulfate concentrations average approximately 450 and 110 mg/l, respectively. At the Gillette well field, which is located approximately 35 miles west of the Madison Group outcrop in the Black Hills, TDS concentrations range from about 480 to 700 mg/l and sulfate concentrations range from about 195 to 335 mg/l. At the proposed Crook County well field, which is located approximately 60 miles northwest of the Madison Group outcrops in the Black Hills, TDS concentrations range from about 500 to 900 mg/l and sulfate concentrations range from about 200 to 460 mg/l.

Relatively high concentrations of uranium, radium 226, and strontium 90 are found in some Madison aquifer ground water. Ground water from an ETSI test well (38N-61W-35) in Niobrara County had a radium 226 concentration of 8 picocuries per liter (pCi/l) when sampled in September 1978. This concentration exceeds the Environmental Protection Agency (EPA) mandatory drinking water criterion for radium 226 of 5 pCi/l. Radium 226 levels in Madison ground water at the towns of Philip and Midland, South Dakota, have been measured as 100 and 15 pCi/l, respectively (Wilson 1979). The high concentrations of uranium and uranium decay products that are found in Madison ground water may be related to the uranium mineralization that occurs in the Inyan Kara Group in the Black Hills region. The origin of the uranium is not known, but Gott et al. (1974) suggested that the uranium reached the Inyan Kara Group by upward migration from deeper strata. Regardless of the mechanism of origin, the data available imply only that locally, relatively high concentrations of radioactive elements are found in Madison ground water.

<u>Minnelusa Formation</u>. The chemical quality of ground water in the Minnelusa Formation differs markedly from that in the Madison Group (Table 3-2). The lithology of the Minnelusa Formation is highly variable; as a result, groundwater quality variations in the Minnelusa Formation section are significant. Generally, three distinct lithologic units can be defined: (1) a basal clastic unit, called the Bell Sand; (2) a middle unit, consisting of carbonates with interbedded sandstones, shales, and evaporites; and (3) an upper sandy unit that is often interbedded with evaporites. Each of these lithologic units functions as a separate hydrologic unit; the upper and lower units locally yield large quantities of water to wells and the middle unit typically does not; therefore the water quality in each of these units is discussed separately.

Water quality in the sandy upper Minnelusa unit, though it is quite variable, can be divided into three distinct types:

- Calcium bicarbonate and calcium bicarbonate sulfate-type ground water with TDS concentrations of less than 1000 mg/l. This water type occurs near outcrop areas of the Minnelusa Formation.

- Calcium sulfate-type ground water with TDS concentrations of greater than 2000 mg/l. This water type occurs in the upper Minnelusa unit in the Black Hills region away from the outcrop areas. Anhydrite and gypsum in the upper Minnelusa unit are the source of the calcium and sulfate. Calcium sulfate ground water with TDS concentrations ranging from 2000 to 4000 mg/l is found in the upper Minnelusa unit in most of the Black Hills region.

- Sodium chloride-type ground water with TDS concentrations ranging from

4000 to over 200,000 mg/l west of the Black Hills monocline and possibly west of the Fanny Peak monocline. Near the Black Hills monocline in Crook County, Wyoming, sodium chloride waters are found in stratigraphic traps with oil; calcium sulfate waters occur away from these stratigraphic traps. Calcium sulfate-type water cannot be found more than a few miles west of the Black Hills monocline, except near the Montana-Wyoming border where the monocline flattens out (Map 3-3). The high concentrations of sodium chloride in the ground water west of the Black Hills and Fanny Peak monoclines are probably the result of very slow ground-water movement.

The few water quality samples that have been taken from the middle Minnelusa unit east of the Black Hills monocline suggest that water quality in the middle Minnelusa is similar to that in the upper Minnelusa Formation.

The basal clastic unit usually contains calcium carbonate-type ground water with TDS concentrations of less than 1000 mg/l. The water quality in this unit is similar to that in the Madison aquifer and differs markedly from water quality in the upper and middle units of the Minnelusa Formation (Eisen and others 1980). Only one well is known to be completed solely in this unit, but several wells are completed in both this clastic unit and the Madison Group.

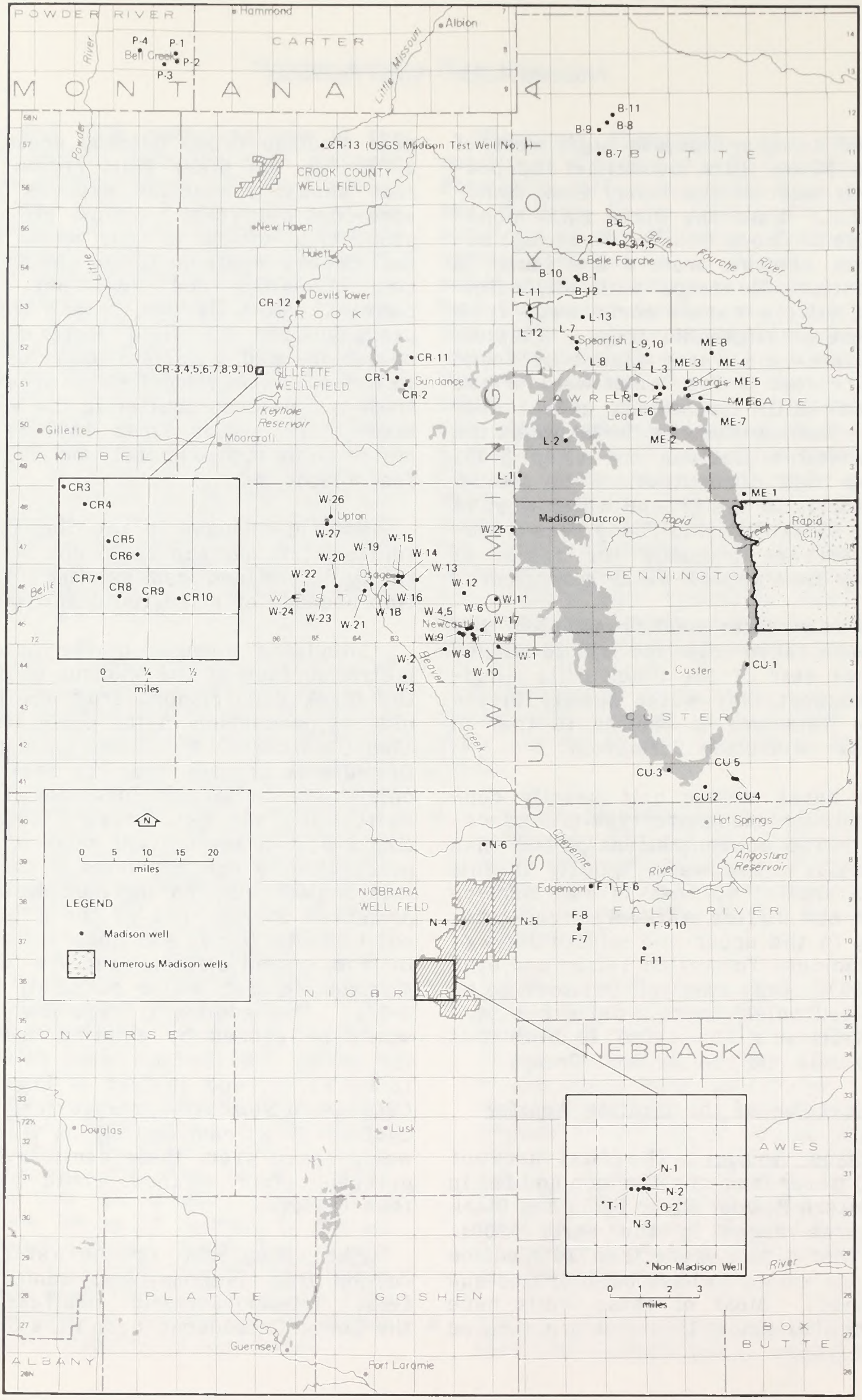
Historical Use of the Madison Aquifer System.

Madison Aquifer. The first uses of ground water from the Madison aquifer in the eastern Powder River Basin and Black Hills area began in the early 1900s. Since that time, more than 75 Madison wells are known to have been drilled and developed. Most of these wells have been drilled since 1950 and are located near Madison Group outcrop areas (Map 3-7). In the Black Hills region, current annual production exceeds 10,000 acre-feet per year. Almost all of this production occurs in four small areas: Bell Creek, Montana; Osage and Newcastle, Wyoming; and Edgemont, South Dakota. Most Madison ground water is produced for oil field water-flooding operations and municipal uses, or flows to waste. Total ground-water production from the Madison aquifer in the western Black Hills region since 1900 is estimated to be approximately 300,000 acre-feet (Table 3-3).

Historic changes in the Madison potentiometric surface could not be accurately determined from existing information because of a limited data base.

Calculated changes in the potentiometric surface of the Madison aquifer in the Black Hills region, from the beginning of production in the early 1900s to 1980 (Table 3-4) are shown on Map 3-8. Drawdowns greater than 25 feet occur only in the vicinity of Edgemont, Osage, Newcastle, and Bell Creek (Table 3-5, Map 3-9). If the current rates of water production by existing users of the Madison aquifer were to continue during the projected 50-year life of the ETSI project (1985 to 2035), additional drawdowns in the potentiometric surface of the Madison aquifer would be small (Table 3-5). The additional drawdowns that would be caused by existing users for the period 1985 to 2035 were calculated to be 8, 14, and 19 feet at Edgemont, Osage, and Newcastle, respectively. Reductions in stream and spring flow that would result from these declines in the potentiometric surface would be less than 0.5 cfs.

Other Aquifers. Ground-water production from Permian-Pennsylvanian aquifers, Triassic-Jurassic aquifers, and the Lower Cretaceous Inyan Kara Group is



Note: More detailed information on these wells is provided in Appendix E of the Well Field Hydrology Technical Report (WCC 1981).

Map 3-7. MADISON WELLS IN THE BLACK HILLS AND EASTERN POWDER RIVER BASIN

TABLE 3-3

HISTORICAL WATER USE OF MADISON WATER AT THE MAJOR PUMPING CENTERS IN THE EASTERN POWDER RIVER BASIN AND THE WESTERN AND SOUTHERN BLACK HILLS

	Production Period[a]				
Location	1900-1949	1950-1959	1960-1969	1970-1979	1979
Bell Creek, Montana (8S-54E and 95-53E)	0	0	0	25,000	1,400
Osage Area, Wyoming (46N-63E)	9,000	12,000	12,000	13,000	1,300
Osage Area, Wyoming (46N-64 and 65W)	0	1,200	15,000	11,000	800
Newcastle Area, Wyoming (45N-61W)	0	16,000	46,000	52,000	5,700
Edgemont and Provo, S. Dak. (8 and 9S-2E)	35,000	18,000	18,000	18,000	1,800
Yearly Totals	44,000	47,200	91,000	119,000	11,000

Total Production to 1979: 301,200 acre-feet

Data sources: Eisen 1980; Hodson 1974; M. Brown 1979.

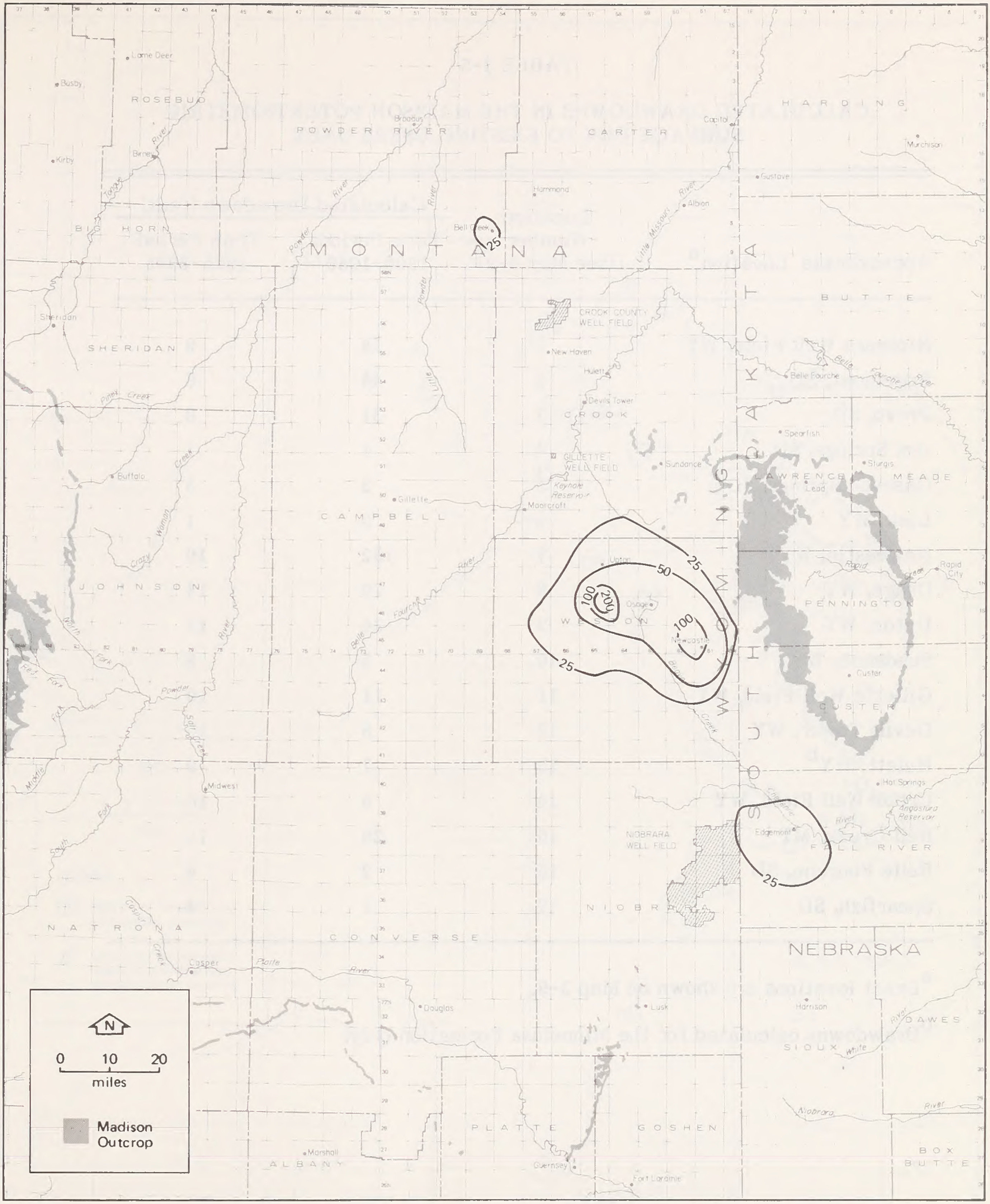
[a] Amount produced is in acre-feet

TABLE 3-4

PUMPING SCHEDULES USED FOR SIMULATING HISTORICAL PRODUCTION FROM THE MADISON AQUIFER SYSTEM AND FUTURE PRODUCTION FROM THE MADISON AQUIFER SYSTEM

Location	Simulated Historical Pumping Schedule	Simulated Future Pumping Schedules	
		Continued Production by Existing Producers	Projected Production
Bell Creek, Montana (8S-54E and 9S-53E)	4.3 cfs (1970-1977); 2.1 cfs (1978-1980)	2.1 cfs (1981-2035)	2.1 cfs (1981-2035)
Edgemont, South Dakota (8S-2E and 9S-2E)	1.1 cfs (1907-1945); 2.5 cfs (1946-1980)	2.5 cfs (1981-2035)	2.5 cfs (1981-2035)
Gillette Well Field, Wyoming (51N-66E-6)	—	—	2.1 cfs (1981-1985); 4.1 cfs (1986-1995); 5.8 cfs (1996-2005); 6.6 cfs (2006-2015); 7.1 cfs (2016-2025); 7.3 cfs (2026-2035)
Marten's Well, Wyoming (46N-60E-31ba)	0.1 cfs (1942-1980)	0.1 cfs (1981-2035)	0.1 cfs (1981-2035)
Newcastle, Wyoming (45N-61E)	2.2 cfs (1949-1962); 7.1 cfs (1962-1977); 7.8 cfs (1978-1980)	7.8 cfs (1981-2035)	7.8 cfs (1981-2035)
Osage, Wyoming (46N-63E)	1.2 cfs (1941-1951); 1.7 cfs (1950-1980)	1.7 cfs (1981-2035)	1.7 cfs (1981-1995); 3.7 cfs (1996-2035)
West Osage Area, Wyoming (46N-64W and 46N-65W)	2.1 cfs (1960-1969); 1.5 cfs (1970-1980)	1.5 cfs (1981-2035)	1.5 cfs (1981-2035)
Sundance, Wyoming (51N-63W)	0.1 cfs (1971-1980)	0.1 cfs (1981-2035)	0.1 cfs (1981-2035)
Upton, Wyoming (48N-65W)	0.2 cfs (1949-1975); 0.3 cfs (1976-1980)	0.3 cfs (1981-2035)	0.3 cfs (1981-2035)

Sources: Belden 1980, M. Brown 1979, Eisen 1980, Montgomery Engineers 1979.



Note: Pumping rates used in simulation are listed in Table 3-4.

Map 3-8. CALCULATED WATER-LEVEL DECLINES IN THE MADISON POTENTIOMETRIC SURFACE IN THE BLACK HILLS REGION IN 1980 CAUSED BY PUMPING BY EXISTING MADISON GROUP WATER USERS

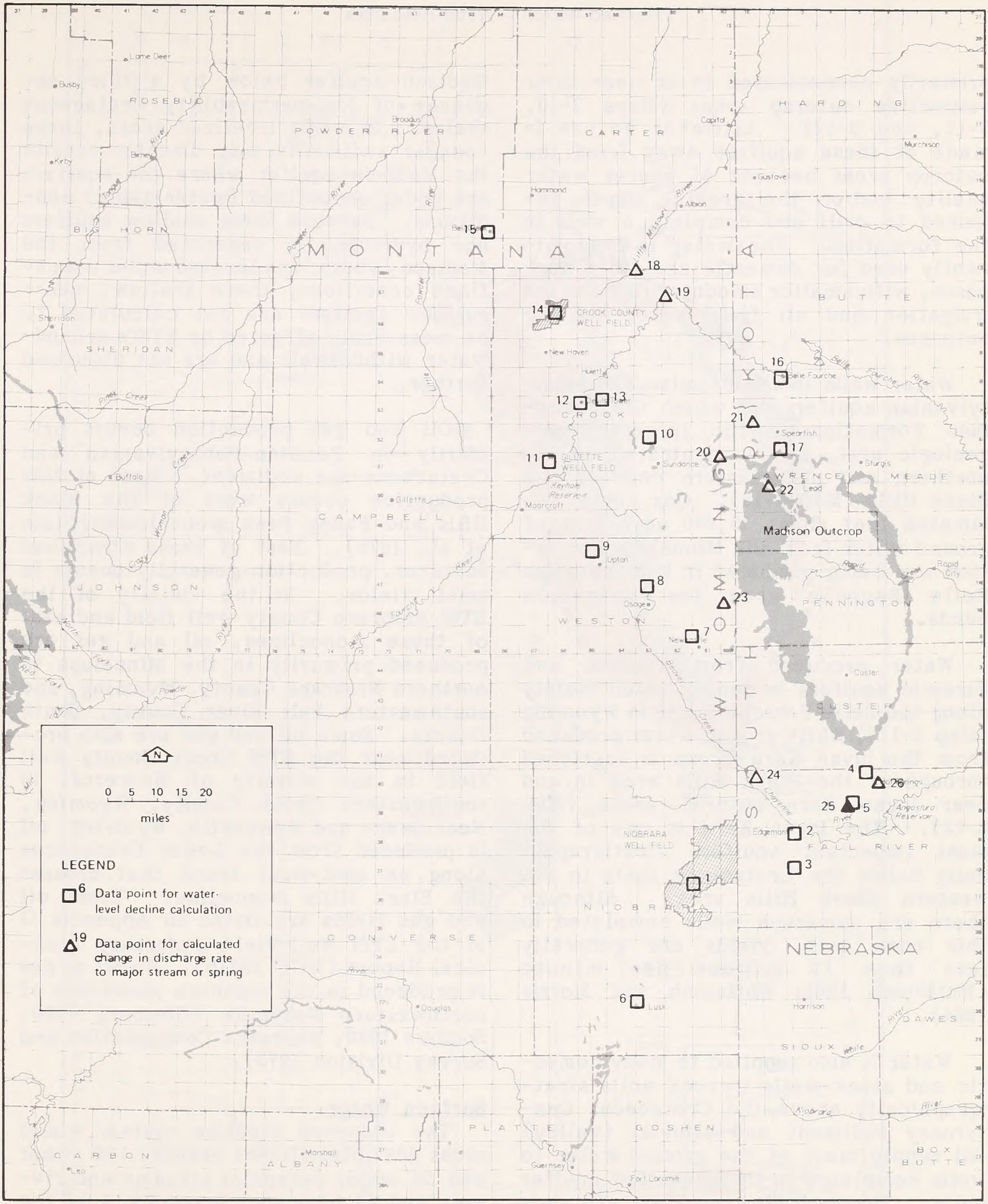
TABLE 3-5

CALCULATED DRAWDOWNS IN THE MADISON POTENTIOMETRIC SURFACE DUE TO EXISTING USERS ONLY

Approximate Location[a]	Location Number (see Map 3-9)	Calculated Drawdown (feet) Time Period: 1900-1980	Time Period: 1985-2035
Niobrara Well Field, WY	1	18	9
Edgemont, SD	2	44	8
Provo, SD	3	31	8
Hot Springs, SD	4	1	1
Cascade Springs, SD	5	3	3
Lusk, WY	6	0	1
Newcastle, WY	7	132	19
Osage, WY	8	70	14
Upton, WY	9	34	13
Sundance, WY	10	5	8
Gillette Well Field, WY	11	11	10
Devils Tower, WY	12	8	10
Hulett, WY[b]	13	7	9
Crook Well Field, WY	14	9	10
Bell Creek, MT	15	28	11
Belle Fourche, SD	16	2	4
Spearfish, SD	17	1	4

[a]Exact locations are shown on Map 3-9.

[b]Drawdowns calculated for the Minnelusa Formation only.



Map 3-9. LOCATIONS OF DATA POINTS FOR TABLES SHOWING WATER-LEVEL DECLINES AND SPRING AND STREAM FLOW REDUCTIONS

primarily concentrated in or near their respective outcrop areas (Maps 3-10, 3-11, and 3-12). Little or no use is made of these aquifers away from the outcrop areas because of poorer water quality and/or the greater depth required to drill and complete a well in the formation. The water is predominantly used for domestic and stock purposes, with smaller amounts produced for irrigation and oil field water-flooding purposes.

Water wells in the Permian and Pennsylvanian aquifers, of which the Minnelusa Formation is the largest single geologic unit, are concentrated at the northern and northeastern ends of the Black Hills (Map 3-10). Cox (1962) estimated that about 10,000 acre-feet of ground water from the Minnelusa Formation was being produced in the Spearfish Belle Fourche area for irrigation needs.

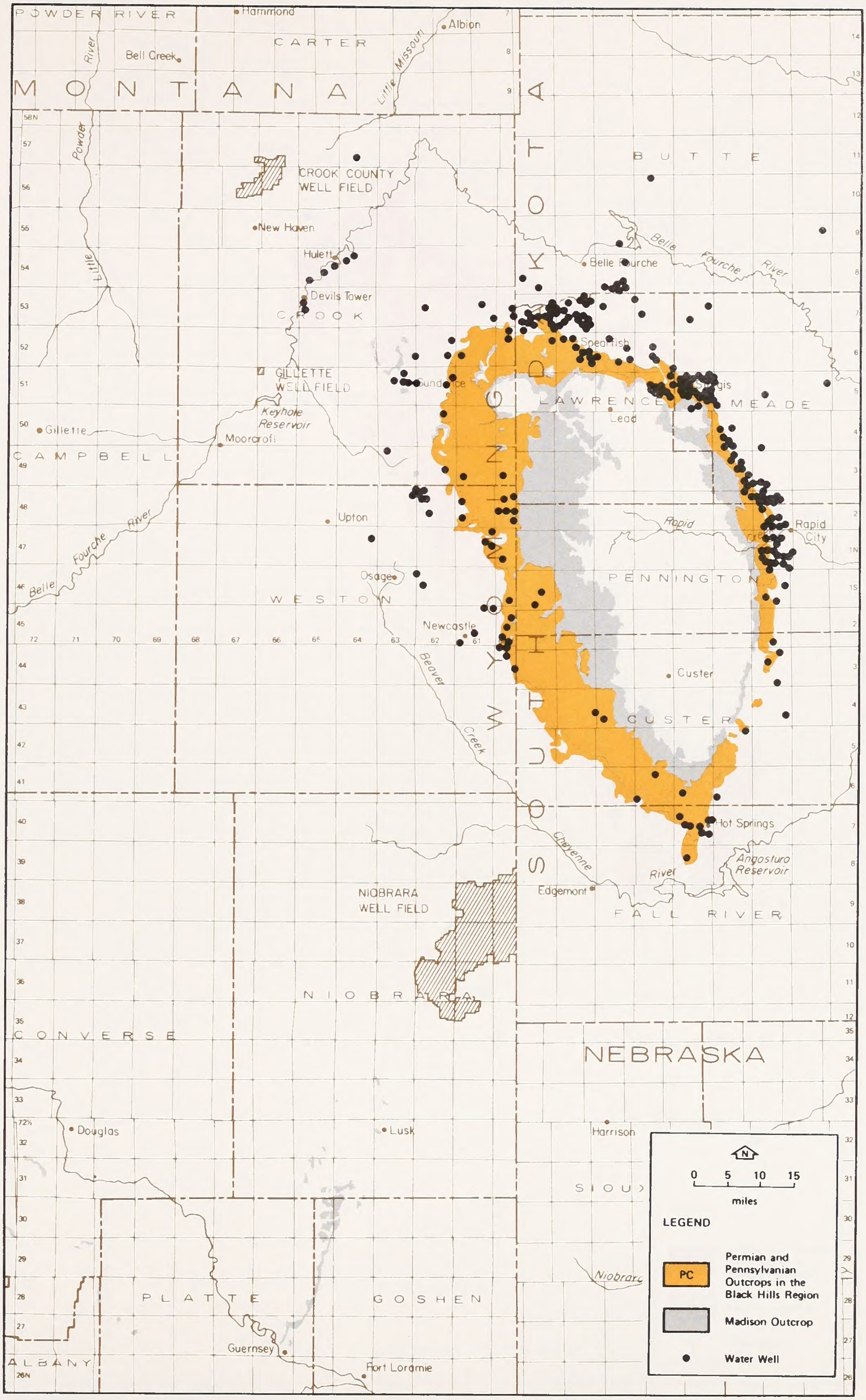
Water produced from Triassic and Jurassic aquifers is concentrated mainly along the Belle Fourche River in Wyoming (Map 3-11), while ground water produced from the Inyan Kara Group is scattered throughout the Black Hills area in and near Inyan Kara outcrop areas (Map 3-12). The Inyan Kara is one of the most important aquifers stratigraphically below the Cretaceous shale in the western Black Hills area. Although there are numerous wells completed in this rock unit, yields are generally less than 10 gallons per minute (Whitcomb 1965; Whitcomb and Morris 1964).

Water is also supplied to many domestic and stock wells in rock units stratigraphically above the Cretaceous Quaternary sediment and alluvial (valley) fill supply most of the ground water to wells completed in these shallow aquifer units. These shallow aquifers are generally hydraulically separated from the Madison aquifer below by a thick sequence of low-permeability Cretaceous shales. In small localized areas, these younger sediments may directly overlie the Madison aquifer where the aquifers are under unconfined (water-table) conditions. Because these shallow aquifers are hydraulically separated from the Madison, and/or are located under unconfined conditions, these shallow, near-surface aquifers are not calculated to be measurably affected by ETSI's groundwater withdrawals and are not discussed further.

Oil and gas production occurs primarily in Permian-Pennsylvanian and Cretaceous-age sediment. Most of this production occurs west of the Black Hills and Fanny Peak monoclines (Glass et al. 1975). East of these structural features, production generally occurs in small fields. In the vicinity of the ETSI Niobrara County well field and east of these monoclines, oil and gas are produced primarily in the Minnelusa in northern Niobrara County, Wyoming, and southwestern Fall River County, South Dakota. Some oil and gas are also produced near the ETSI Crook County well field in the vicinity of Moorcroft in southwestern Crook County, Wyoming. Near Osage and Newcastle, Wyoming, oil is produced from the Lower Cretaceous along an east-west trend that crosses the Black Hills monocline. These oil and gas fields are listed in Appendix G of the ETSI Well-Field Hydrology Technical Report (WCC 1981b). No oil or gas is produced in the northern panhandle of northwestern Nebraska (Ginsberg 1980, Souders 1980, Nebraska Conservation and Survey Division 1979).

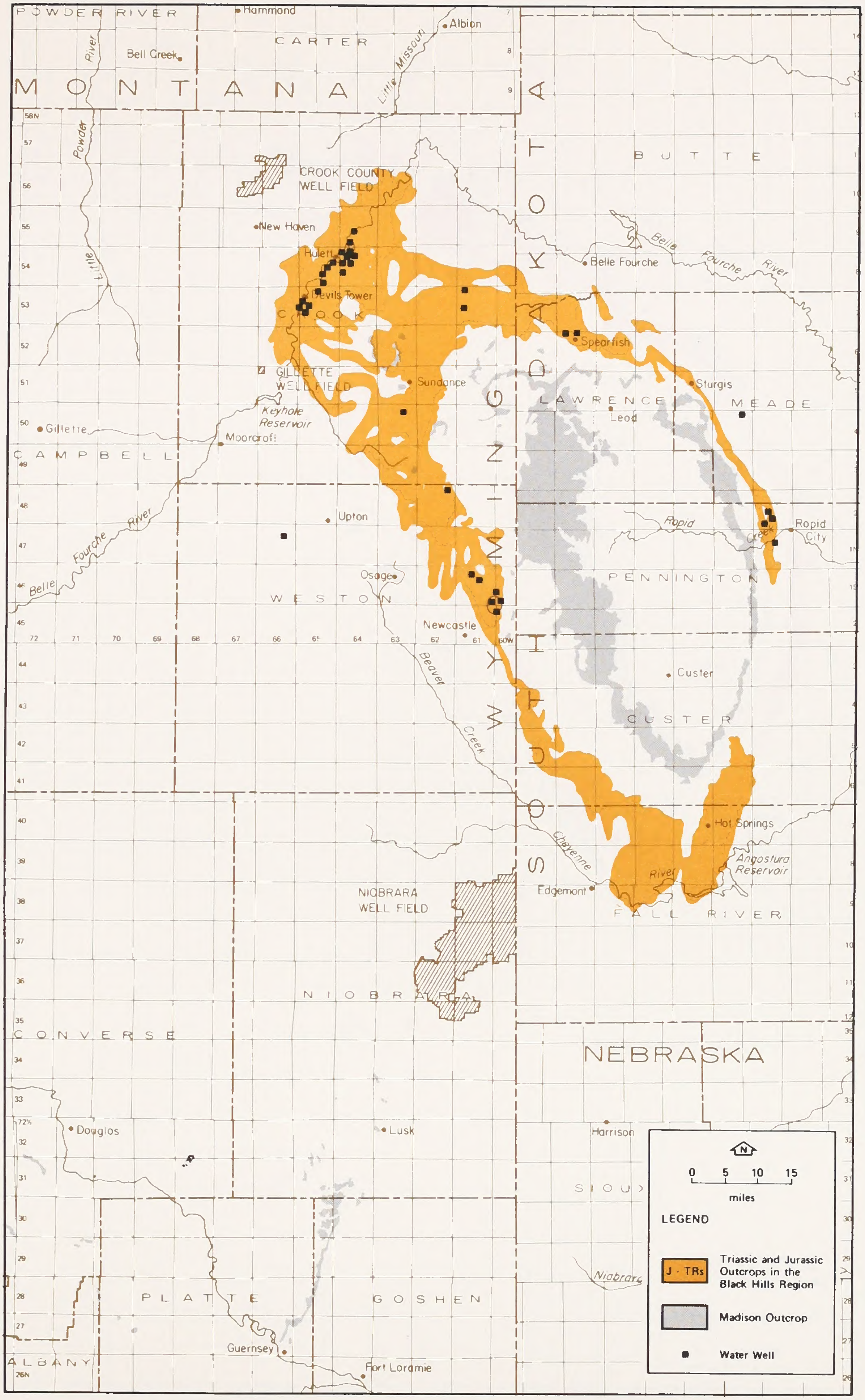
Surface Water

The proposed pipeline system would cross 408 intermittent creeks, 109 minor and 59 major perennial streams and rivers, and 84 bayous. Appendix A of the Surface Water Quality Technical Report



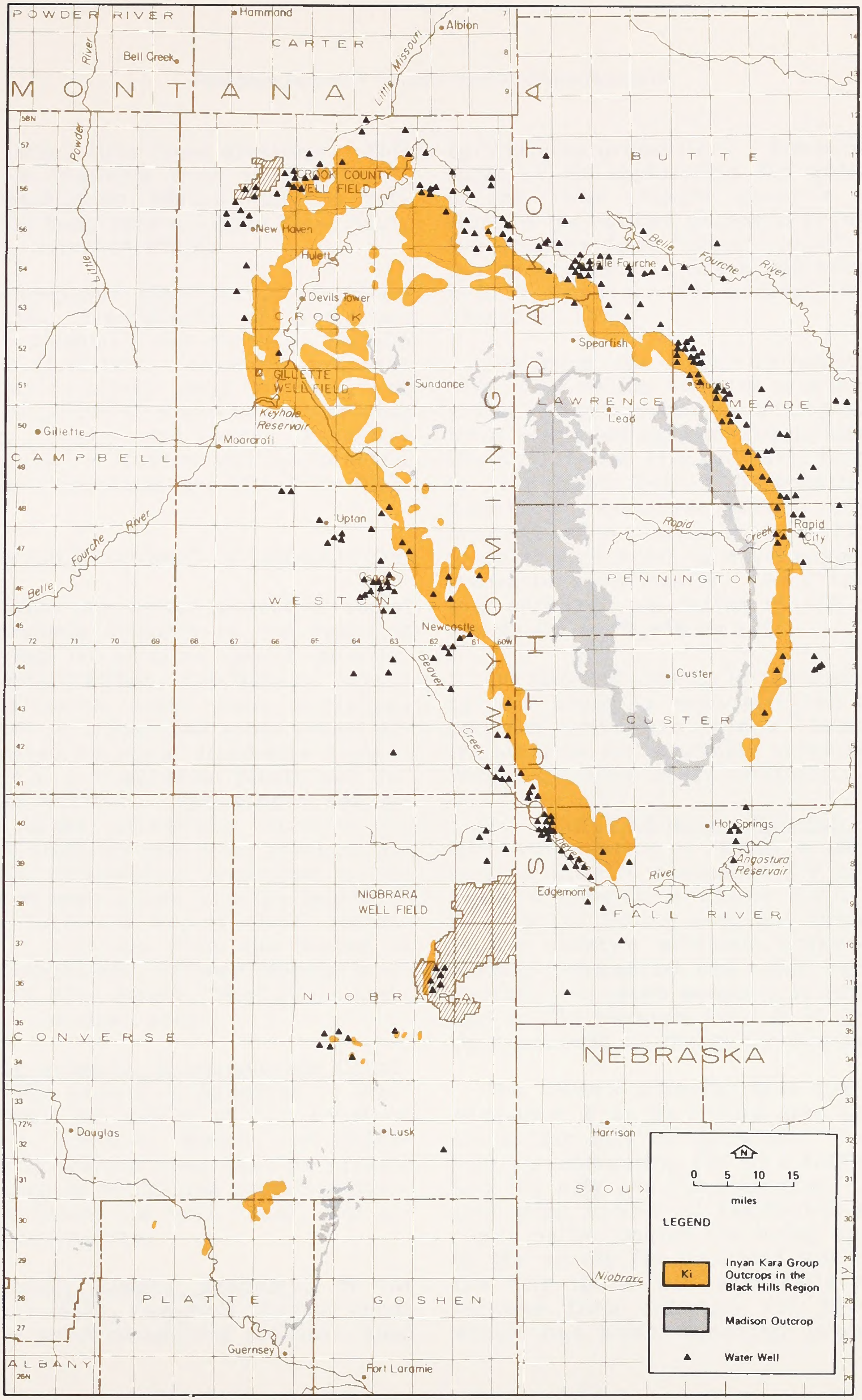
Source: Howells, 1980; U.S. Geological Survey, 1981.

Map 3-10. WATER WELLS IN PERMIAN AND PENNSYLVANIAN AGE STRATA



Source: U.S. Geological Survey, 1981.

Map 3-11. WATER WELLS IN TRIASSIC AND JURASSIC AGE STRATA



Source: U.S. Geological Survey, 1981.

Map 3-12. WATER WELLS IN INYAN KARA GROUP STRATA

(WCC 1981c) lists these crossings. This report is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228.

The proposed pipeline system would cross the floodplains of numerous creeks, streams, and rivers. Certain surface facilities, including preparation plants, slurry pump stations, and dewatering plants, would be located near creeks, streams, and rivers. Facilities that could be located within potential 100-year floodplains are listed in Table 3-6.

3.A.2 SOCIOECONOMIC CONSIDERATIONS

In order to assess potential social and economic impacts of the proposed action and its pipeline system alternative configurations, two sets of potentially affected areas were identified. The first set comprised areas potentially affected by major fixed-site components (i.e., preparation plants and dewatering plants). The second set included areas potentially affected by pipeline segments and pump stations only. The information presented in this section is summarized from the Socioeconomics Technical Report (WCC 1981d), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228.

Wyoming Baseline Socioeconomic Conditions. The project components in Wyoming would be located in four counties: Campbell, Converse, Weston, and Niobrara. This section describes the present and projected social and economic baseline conditions for each county and affected community.

Campbell County Economy. In the 1940s and 1950s, Campbell County's economy was based on ranching and some minor agricultural production. However, the surge in oil exploration and extraction in the 1960s brought about a sudden shift in the rate of economic growth and the county's first "energy boom"; countywide population, which had been 5800 in 1960, had more than doubled to 13,000 people by 1970.

Following the OPEC oil embargo in 1974, coal mining emerged as a mainstay in the county's economy. Mining employment increased significantly in Campbell County between 1970 and 1975, from 1108 to 1402 (Table 3-7). The construction, business and consumer services, and government and education employment levels associated with mining development have increased significantly. As a result of this activity, population in the county had grown to 26,600 by 1979.

The two communities in Campbell County that could be most affected by the proposed action are Gillette (because of its location and available services) and Wright (because of its location).

1. Gillette/Gillette Planning Area. With a population of 13,800 in 1979, the city of Gillette accounted for half the county's population (Table 3-8). Gillette is the county seat and the center of the county's economic activity, including commercial and retail services. Overall, the city's economy is very similar to the county's in that it is heavily dependent on energy development.

The Gillette Planning Area (GPA) encompasses a 5- by 6-mile area that includes the city of Gillette. The reasons for addressing the GPA rather than just the city are the following: (1) an increasing number of residential settlements being located (or being approved by the county for location) just outside the city limits will eventually require services from Gillette; (2) the city, which has been annexing properties

TABLE 3-6

SURFACE FACILITIES LOCATED WITHIN POTENTIAL 100-YEAR FLOODPLAINS

Facility	County (Parish)/State	Area (acres)[a] PA	MA	BA
Slurry Pump Stations[b]				
PMBC-1	Campbell/Wyoming	25	25	25
P-2	Campbell/Wyoming	25	25	25
P-3	Campbell/Wyoming	25	25	25
P-6	Decatur/Kansas	25	25	25
PM-15	Ouachita/Louisiana	25	25	0
PM-16	LaSalle/Louisiana	25	25	0
PM(B)-1	Rapides/Louisiana	25	25	0
PM-17	Rapides/Louisiana	25	25	0
PM(NW)-1	Rapides/Louisiana	25	25	0
Dewatering Plants				
Pryor	Mayes/Oklahoma	10	10	10
Muskogee	Muskogee/Oklahoma	10	0	0
White Bluff	Jefferson/Arkansas	10	10	10
New Roads	Pointe-Coupee/Louisiana	10	10	0
Wilton	Iberville/Louisiana	10	10	0
Oologah	Rogers/Oklahoma	0	10	10
Independence	Independence/Arkansas	10	10	10
Cypress Bend	Desha/Arkansas	0	0	205
Baton Rouge	W. Baton Rouge/Louisiana	0	10	0
Lake Charles	Calcasieu/Louisiana	10	10	0
Boyce	Rapides/Louisiana	10	10	0

Sources: (1) U.S. Department of Housing and Urban Development, 1978-1980. Flood Insurance Rate Maps. (2) Where maps are unavailable, facilities within first contour interval of watercourses (ETSI project location maps, 1980) are also included.

[a]PA = proposed action
MA = market alternative
BA = Cypress Bend pipeline-barge alternative

[b]Facility symbols are explained in Appendix A.

TABLE 3-7

EMPLOYMENT, BY SECTOR, FOR AFFECTED WYOMING COUNTIES

County	Sector						Total Employment (persons)
	Agriculture	Mining	Construction	Manufacturing	Business & Consumer Services	Government and Education	
Campbell							
1970	157	1108	473	27	2157	772	4694
1975	188	1402	1031	84	2733	966	6404
1978	b	3028	2015	141	b	b	b
Converse							
1970	198	155	177	19	848	491	1888
1975	239	654	286	42	1332	555	3108
1978	b	1468	465	66	b	b	b
Niobrara							
1970	96	78	56	33	442	203	908
1975	116	89	23	31	425	210	894
1978	b	137	137	42	b	b	b
Crook[a]							
1970	130	135	64	120	351	367	1167
1975	157	190	127	133	416	388	1411
1978	b	356	163	174	b	b	b
Weston							
1970	78	439	26	102	924	491	2060
1975	93	484	63	250	953	510	2353
1978	b	566	212	204	b	b	b

Sources: BLM 1979, pp. R2-116, R2-117, for 1970 and 1975. Wyoming Employment Security Commission undated.

[a]Crook County employment data are provided as baseline when estimating the Crook County well field alternative.

[b]Data are unavailable.

TABLE 3-8

POPULATION STATISTICS FOR WYOMING CITIES AND TOWNS WITHIN COMMUTING DISTANCE OF PROJECT COMPONENTS: PROPOSED ACTION

County	City or Town	Census 1970 Pop.[a]	Estimated 1975 Pop.[a]	Estimated 1979 Pop.[b]	Annual[c] Growth Rate
Campbell		12,957	13,090	26,600	19.4
	Gillette	7,763	8,215	13,800	13.9
	Gillette Planning Area	NA	NA	18,600	--
	Wright	NA	NA	825	--
Converse		5,938	8,048	13,400	13.6
	Douglas[d]	2,677	3,839	8,500[b]	22.0
	Glenrock[d]	1,515	2,071	2,900	8.8
Niobrara		2,924	2,895	3,132	2.0
	Lusk	1,495	1,628	1,750	1.8
Crook[e]		4,535	4,883	5,661	3.8
	Moorcroft	981	1,030	1,200[f]	5.2
	Sundance	1,056	1,282	2,500[f]	39.7
Weston		6,307	6,245	7,900	6.1
	Newcastle	3,432	3,421	3,900	3.3
	Upton	987	927	1,500	12.8

NA = not applicable.

[a]Source: U.S. Bureau of the Census 1977.

[b]Sources: Campbell County Planning Office (1980) and Gillette Planning Department (1980); countywide estimates for Converse, Weston, Crook, and Niobrara from Wyoming, Department of Administration and Fiscal Control (1980); information on individual cities and towns from respective planning or city managers' offices.

[c]Compound annual growth rate. Source: Bureau of Land Management 1979, Table R2-33.

[d]1978 estimates for Douglas and Glenrock may not be strictly comparable with earlier years due to sprawl outside community boundaries.

[e]Crook County population estimates are provided as baseline when estimating the Crook County well field alternative.

[f]Moorcroft estimated population is for 1978. Sundance estimated population is for 1977. (Source: Schroder 1980a; Wyoming Department of Economic Planning and Development 1977).

adjacent to its boundaries both to provide municipal services to these outlying communities and to include commercial and industrial properties into its tax base, will probably continue this practice over the next few years and thereby extend the city limits toward the GPA boundaries. The population of the GPA is estimated to be 18,600, which is roughly 70 percent of the county's population base (Table 3-8).

In June 1979, the Gillette/Campbell County Department of Planning and Development estimated the total number of housing units in the city (4300 units) and county (8200 total dwelling units) (Table 3-9).

2. Wright. A newly formed (1976) and rapidly growing community, Wright is located near the heart of coal mining operations in southern Campbell County. Founded by the Atlantic Richfield Company (ARCO) in anticipation of housing needs for ARCO mine employees and other energy-related workers in the area, it is the closest place to reside with any sense of community. It is approximately 40 miles from Gillette, 70 miles from Douglas in Converse County, and 40 miles from Newcastle in Weston County (Map 1-2).

Wright's economy is based principally on coal and other energy developments in the region. Although there are no current employment estimates, it can be expected that a large majority of the residents (839 in 1978) are either directly or indirectly associated with the energy industry. The community is planned to comprise 1800 to 2000 units, or between 6000 and 6500 people, and is anticipated to be completed by 1985 or 1987 (Housing Services Inc. 1979).

Data on the planned housing supply (and the housing mix) can be found in Table 3-10. Note that nearly 44 percent of the completed units will be single-family units, 30 percent multifamily units, and about 26 percent mobile homes.

Table 3-11 indicates that there is substantial temporary housing available in Wright, including both motel rooms and mobile home and recreational vehicle (RV) spaces. As a temporary solution to the excess housing demand, much of the land planned for single-family units and mobile homes was made available for travel trailers.

Projected Baseline for Campbell County. This section discusses an employment, population, and housing baseline for 1984 and 1990 based on the anticipated construction and production schedules for energy developments in the area except for the ETSI project. The purpose of selecting these specific years is to compare the impact of anticipated peak ETSI employment periods with the projected baseline (Section 4.A.2). The methodology for estimating the increase in population and the general effects on housing, public services, and the economy is discussed in Appendix H.

Anticipated growth over the next few years would alter the socioeconomic complexion of Gillette and the GPA. The anticipated increase in mining and other energy-related activities will result in a doubling of the demand for labor both to work directly on the projects and to staff the operations of the support and service sectors. It was estimated that by 1984 there would be approximately 2640 additional construction workers employed in the county; there would be 279 by 1985 and only 70 by 1990. It was estimated that permanent workers would increase from 2942 in 1980 to approximately 6000 by 1984, and 8800 by 1990 (WCC 1981d).

Estimates of future employment and population for the GPA are found in Table 3-12. Population in the GPA would

TABLE 3-9

ESTIMATES OF HOUSING UNITS IN CAMPBELL COUNTY
DECEMBER 1977 AND JUNE 1979

	1977	1979	Percent of Total
City of Gillette			
Single-Family	1628	2098	49
Multifamily	680	815	19
Mobile Homes	1530	1391	32
Total	3838	4304	100
Gillette Planning Area			
Single-Family	2138	2646	46
Multifamily	712	883	15
Mobile Homes	2438	2190	39
Total	5288	5719	100
Campbell County[a]			
Single-Family	2661	3452	42
Multifamily	716	895	12
Mobile Homes	3821	3681	46
Total	7198	8028	100

Source: Gillette-Campbell County Department of Planning and Development 1979.

[a] Includes Gillette Planning Area, Wright, and other rural sections of Campbell County.

TABLE 3-10

HOUSING AND POPULATION PROJECTIONS FOR WRIGHT, WYOMING

	Single-Family Detached	Single-Family Attached	Multi-family	Mobile Homes	Recreation Vehicles[a]	Total
Housing Projections						
1978	24	-	-	206	37	267
1985[b]	546	273	561	500	-	1880
Population per Dwelling Unit[c]	3.53	3.25	3.00	3.30	2.00	
Population Projections						
1978	85	-	-	680	74	839
1985	1927	887	1683	1650	-	6147

Source: Housing Services Inc. 1979.

[a]Because of the shortage of housing in the area, 37 recreation vehicle spaces are presently occupied on a semipermanent basis (with an Atlantic Richfield Company estimate of two residents per unit). The plan is to eliminate long-term use of these spaces when sufficient permanent housing is developed at Wright.

[b]The present development plan for Wright anticipates that the total project will be completed in 1985. The 1985 figures, therefore, are the estimated totals for the entire community.

[c]The population per housing-unit levels are based on a survey of 400 households completed by the Gillette-Campbell County Department of Planning and Development in July 1978. The indicated figures are the averages for Campbell County, outside the city of Gillette.

TABLE 3-11

TEMPORARY HOUSING AVAILABLE IN 1980 AT LIKELY PIPELINE CONSTRUCTION SPREAD HEADQUARTERS IN WYOMING

Wyoming Community	Existing Hotel/Motel Rooms	Hotel/Motel Construction (Rooms)	Existing Rental Units (Apartments & Houses)	Rental Vacancy Rate	Rental Units Planned or Under Construction	Existing Mobile Home Park Spaces	Existing R.V. Park Spaces	Mobile Home Spaces Planned or Under Construction
Gillette	560	60	815	5%	252	1391	NA	471
Wright	11	40	NA	low	75	311	75	200
Douglas	260	100	344	4-5%	0	130	40	72
Glenrock	54	0	312	3%	68	250	0	220
Moorcroft	63	0	425	5%	12	12	0	0
Lusk	150	0	330	low	20	50	0	0
Newcastle	210	0	170	low	0	400	20	100

Sources: Sientz 1980; Zaborac 1980; Sewell 1980; Bruner 1980; Holdt 1980; Stuart/Nichols Associates 1978a; and Schroder 1980a.

NA = data not available.

TABLE 3-12

PROJECTED BASELINE FOR GILLETTE PLANNING AREA

Social/Economic Indicators	Baseline Existing[a] 1979	Projected[b] 1984	Projected[b] 1990
Employment	8,000	14,000	14,800
Population	18,600	31,700	33,500
Housing/Households	5,719	10,000	10,500

[a]Data sources for existing population and housing were obtained from the Gillette-Campbell County Planning Department (1979). Existing employment data were calculated using assumptions of 1.45 workers per household and a 3 percent rate of unemployment. The rationale for deriving these assumptions may be found in Appendix H.

[b]The methodology for estimating the projected baseline is presented in Appendix H.

increase from 18,600 to 31,600 in 1984 and to 33,500 by 1990. Population in the city of Gillette would nearly double, growing from 13,800 to 24,500 in just 5 years; countywide population would increase to 43,200 in the same period.

An increase in population in the GPA will also require a doubling of the housing supply in an already constrained market. There will probably be a greater emphasis on mobile homes to serve the construction work crews and also as a means of providing large numbers of dwelling units in a limited time. With a doubling of the population in only 5 years, local and state officials will most likely find it difficult to provide for orderly and managed growth. Many of the new housing developments have located and will continue to look to locating in the area outside the city in the GPA because the county has exhibited less stringent land use and zoning controls than those adopted by the city of Gillette.

Wright Economy. The town of Wright is a planned community and, in principle, is therefore capable of regulating its growth in accordance with predetermined rates and in conjunction with availability of public services. It is assumed that town planners will be able to control the flow of in-migration to avoid any significant impacts. It is concluded, therefore, that no further discussion of Wright is required in this report.

Converse County Economy. Converse County is located due south of Campbell County. With some exceptions, the economy of Converse County is quite similar to that of Campbell County. The demand for energy products, such as coal and uranium, spurred mining activities in the county; employment increased from 1888 in 1970 to 5932 by 1979 (Wyoming Department of Administration and Fiscal Control 1980). During this time, mining employment grew from 155 to 1445 workers. The economy has been quite healthy over the past few years, with the unemployment rate generally being near 2.5 to 3 percent. In September of 1979, the unemployment rate had dipped below 2 percent.

The economic base of Converse County is diversified. There are several uranium mines and mills either planned or in operation in the county. Also, because the two principal towns of Douglas and Glenrock are located along a major interstate highway, the economic base receives support from travel and tourist related expenditures.

Douglas and Glenrock grew substantially during the 1970s. As can be seen from Table 3-8, the population of Douglas tripled between 1970 and 1978, growing from 2677 to 8500; and Glenrock's population almost doubled (growing from 1515 to 2900) by 1978.

From 1970 to 1979, the number of dwelling units in Converse County more than doubled. The Converse County area planning officer estimated that of the 4717 units available in early 1979, 63 percent were single-family homes, 27 percent mobile homes, and 10 percent multifamily homes. Nearly half the units are estimated to be located in Douglas, close to 20 percent in Glenrock, and the remainder outside the two communities.

In addition to the permanent housing, Douglas and Glenrock have 294 hotel and motel rooms. A new 100-room hotel is also planned for Douglas in the next year. These rooms could serve as temporary housing, especially for short-term construction workers during peak employment periods (Table 3-11).

Projected Baseline for Converse County. Converse County will grow substantially as a result of the development of energy resources in the county, including several uranium mines, an oil refinery, a power plant, and a major synfuels project. Details on employment levels for these projects (except the WyCoalGas coal gasification plant) may be found in the Socioeconomics Technical Report (WCC 1981d, Table 4-11). Population and employment estimates are presented in Table 3-13. Since data on the WyCoalGas project are not yet final, they were not included in these projections. However, preliminary estimates indicate that the synfuels project could increase the county's population by 7000 by 1986.

Weston County Economy. Weston County is located due east of Campbell County and serves as a residential community for people working in Campbell County. Many of those employed by the major energy development companies in south Campbell County have chosen to locate in nearby Newcastle in Weston County rather than in Gillette or Wright. It has been estimated that between 60 and 65 percent of the workers at Kerr-McGee's Jacobs Ranch mine commute daily from Newcastle, a distance of 50 miles, on company-provided buses (Newcastle City Engineer 1980).

Overall, the county has a substantial and diversified economic base. Besides the coal mining in Campbell County, much of the employment is based on oil drilling and pumping, forestry and the processing of forest products, and trucking (two major regional trucking firms are located in Newcastle) (Newcastle City Engineer 1980).

The county's population has steadily grown over the past few years. Between 1970 and 1979, countywide population increased from 6300 to 7900, with much of the increase coming in the last three years. A large part of this increase in population has settled in Newcastle and Upton. Newcastle is the larger of the two communities, with an estimated 1979 population of 3900 people, an increase of 500 people since 1970. In 1975 Upton had a population of 927; by 1979, the population had grown to 1500.

Housing in Newcastle is adequate for the existing population. There are about 1200 single-family dwelling units, 6 apartment buildings (with about 80 units), and 20 mobile home parks (accommodating about 400 mobile homes). Vacancy rates in the city are quite low. There is little housing information available for Upton.

Projected Baseline for Weston County. It is anticipated that Weston County will have only a modest growth over the next 10 years (Table 3-14). Its continued principal economic base will be its role as a residential community for those employed in Campbell County. It is not anticipated that the oil sector will grow by any appreciable amount.

As a result, most population projections for Weston County show a possible increase from 7900 in 1979 to 8700 by 1984 and 10,000 by 1990 (Wyoming Department of Administration and Fiscal Control 1980). Stuart/Nichols Associates (1978b) reports a slightly higher estimate for 1985 of 9700 people.

Future population estimates for Newcastle reflect a slightly higher growth, from 3900 in 1979 to 6000 by 1990 (Newcastle City Engineer 1980). This estimate, however, reflects an optimistic outlook. There are very few data for identifying the future housing impacts for Newcastle.

Niobrara County Economy. Located south of Weston County (Map 1-2), Niobrara County is principally rural, with

TABLE 3-13

PROJECTED BASELINE FOR CONVERSE COUNTY

Social/Economic Indicators	Baseline		
	Existing[a]	Projected[b,c]	
	1979	1984	1990
Employment	5,932	7,600	8,400
Population	13,400	14,700 - 18,700	15,600 - 21,800
Housing/Households	4,700	5,900	6,600

[a]Employment and population data are taken from Wyoming Department of Administration and Fiscal Control (1980). Data on housing are from the Converse Area Planning Office (1979).

[b]The projected population for 1984 and 1990, which is obtained from Wyoming Department of Administration and Fiscal Control (1980), serves as the basis for estimating future housing (using a ratio of 3.18 persons per household) and future employment (assuming 1.45 workers per household and a 3 percent rate of unemployment).

[c]Very little information on the WyCoalGas (Panhandle Eastern) coal gasification project was available prior to completion of the Socioeconomics Technical Report (WCC 1981d), so no population data for that project were included in the report.

TABLE 3-14

PROJECTED BASELINE FOR WESTON COUNTY

Social/Economic Indicators	Baseline		
	Existing[a]	Projected[b]	
	1979	1984	1990
Employment	3,346	3,300	4,400
Population			
Weston County	7,900	8,700	10,000
Newcastle	3,900	5,000	6,000
Housing/Households	2,700	2,900	3,400

[a]Employment and population data are taken from Wyoming Department of Administration and Fiscal Control (1980). Data on housing are from the Newcastle City Engineer (1980).

[b]The projected populations for 1984 and 1990, obtained from Wyoming Department of Administration and Fiscal Control (1980), serve as the basis for estimating future housing (using a ratio of 3.18 persons per household) and future employment (assuming 1.45 workers per household and a 3 percent rate of unemployment). See Appendix H for the rationale for deriving these assumptions.

agriculture playing a vital role in its economy. The northern two-thirds of the county are principally open range; the southern portion supports dry-land and irrigated farming. Between 30 and 35 percent of the jobs available in the county (420 jobs) in 1979 were in the agricultural sector (Lusk Town Planner 1980).

From 1970 through 1975, population decreased slightly. Since then, however, energy development in the neighboring counties has resulted in a population increase, from 2895 in 1975 to 3132 in 1979 (Table 3-8).

Over 55 percent of the population resides in Lusk, the county seat. Located in the southern portion of the county, Lusk has grown considerably in the past few years (1628 people in 1975, 1750 in 1979). It serves as a residential community for those working in Converse County. The increased population in the city also includes in-migration from ranch to town and more retired people moving into the area (Niobrara County Planning Commission and Tri-County Planning Office 1977).

Temporary housing in Lusk consists of about 550 total units. A quarter of the single-family units are rentals. In addition, there are 6 apartment buildings, 50 mobile homes, and 6 motels (150 units) (Table 3-11). Due to increased demand for low-income housing, the town has applied to the Department of Housing and Urban Development (HUD) to build 20 rental homes.

Projected Baseline for Niobrara County. It is anticipated that Niobrara County will continue to be a residential community for Converse County but will experience very little increase in population. County-wide population is projected to be 3200 by 1984 and 3300 by 1990, only a slight increase from 3132 in 1979. City officials expect that the population of Lusk will double by 1984 (Table 3-15) and have therefore planned for the expansion of wastewater treatment capacity and water supply. However, the city's projections may be too optimistic, particularly in light of the county's projection. Therefore the 1984 and 1990 population projections for Lusk are estimated at 1900 and 2000, respectively. The school district's projections are optimistic too; the combination of existing excess capacity and the use of temporary modular units should provide sufficient capacity for the lower projected population.

Project Components Outside Wyoming

Slurry Pipelines and Pump Stations. This section discusses the areas affected by pipeline and pump stations only, as shown in Table 3-16. Segments of pipeline and pump stations near dewatering plants are discussed in the Dewatering Plants section. The environment potentially affected by the pipeline and pump stations was identified as being: (1) all host counties (that is, counties containing project components) and (2) selected communities within 80 miles of a project component. The size of each host county, in terms of population and recent tax revenues, is shown in Table 3-16. Selected communities within 80 miles of project components are listed in Table 3-17. These communities were selected on the basis of the following two assumptions:

- Seekers of services will locate where services exist (i.e., construction workers will travel farther in order to secure services rather than live uncomfortably while located closer to the job site) (U.S. Department of Commerce 1965).
- Construction workers have been known to commute over 100 miles per day to a construction site (Missouri Basin

TABLE 3-15

PROJECTED BASELINE FOR NIOBRARA COUNTY

Social/Economic Indicators	Baseline: Existing[a] 1979	Projected[b] 1984	Projected[b] 1990
Employment	1,429	1,450	1,500
Population			
Niobrara County	3,132	3,200	3,300
Lusk	1,750	1,900	2,000
Housing/Households			
Niobrara County	1,160	1,185	1,222
Lusk	650	700	740

[a]Employment and population data are taken from Wyoming Department of Administration and Fiscal Control (1980). Data on housing are from the Lusk Town Planner (1980).

[b]The projected populations for 1984 and 1990, obtained from Wyoming Department of Administration and Fiscal Control (1980), serve as the basis for estimating future housing (using a ratio of 3.18 persons per household) and future employment (assuming 1.45 workers per household and a 3 percent rate of unemployment). See Appendix H for the rationale for deriving these assumptions.

TABLE 3-16

COUNTIES IN AREAS OUTSIDE WYOMING POTENTIALLY AFFECTED BY MAIN SLURRY PIPELINE AND PUMP STATIONS: PROPOSED ACTION

County/Parish	Pump Station[a]	1975 Population[b]	Fiscal Year 1976-77 Tax Revenues[c] ($000)
Nebraska			
Sioux		2,000	611
Box Butte		12,400	3,557
Morrill		6,100	2,295
Garden	P-4	2,900	1,571
Deuel		2,400	1,410
Keith		10,100	4,134
Perkins		3,500	2,022
Chase		4,800	2,743
Hayes		1,500	648
Hitchcock		4,000	2,201
Red Willow	P-5	12,800	4,602
Kansas			
Decatur	P-6	5,100	2,192
Norton		6,700	2,452
Graham		4,400	2,145
Trego		4,400	1,608
Ellis		27,400	6,902
Rush		4,800	2,566
Barton		31,600	9,368
Stafford	P-7	6,200	3,100
Reno		63,700	18,236
Kingman		8,900	3,834
Harper		7,900	3,382
Sumner		24,500	7,213

TABLE 3-16 Concluded

County/Parish	Pump Station[a]	1975 Population[b]	Fiscal Year 1976-77 Tax Revenues[c] ($000)
Oklahoma			
Sequoyah		28,600	1,290
Arkansas			
Crawford	P-11	33,400	2,277
Franklin		13,700	1,270
Johnson		17,100	1,220
Pope	PMB-12, PMB(I)-1	36,100	7,490
Conway		18,600	1,614
Van Buren	PMB(I)-2	11,800	692
Cleburne		15,800	1,462
Perry		7,400	556
Cleveland		6,900	476
Bradley	PM-14	12,700	1,089
Ashley		26,400	2,830
Louisiana			
Morehouse		33,700	3,496
Ouachita	PM-15	130,700	13,354
Caldwell		10,200	1,374
La Salle	PM-16	15,200	1,976

[a]Pump station designations are explained in Appendix A.

[b]U.S. Bureau of the Census 1978.

[c]U.S. Bureau of the Census 1979b.

TABLE 3-17

SELECTED COMMUNITIES IN AREAS OUTSIDE WYOMING POTENTIALLY AFFECTED BY MAIN SLURRY PIPELINE AND PUMP STATIONS: PROPOSED ACTION

Pipeline Spread[a]	Community/State	1975 Population[b]
I	Torrington, WY	4,667
I	Scottsbluff, NE	12,665
I	Alliance, NE	6,990
I	Sidney, NE	6,150
I	Ogallala, NE	5,442
I	North Platte, NE	21,882
I and II	McCook, NE	8,455
II	Hays, KS	16,544
II	Great Bend, KS	16,098
II	Larned, KS	4,827
II	Hutchinson, KS	40,925
II	Pratt, KS	6,661
II	Kingman, KS	3,650
II	Wichita, KS	264,901
II	Wellington, KS	7,653
II	Ponca City, OK	25,819
III	Ft. Smith, AR	64,734
III and V	Russellville, AR	13,790
V	Morrilton, AR	6,630
V	Little Rock, AR	141,143
V	Warren, AR	6,139
V	Crossett, AR	6,290
V	Bastrop, LA	14,266
V	Monroe, LA	61,016

Note: All communities are within 1.5 hours' commuting time (about 80 miles) from the various project components.

[a]See Table 1-6 for pipeline spread responsibilities.

[b]U.S. Bureau of the Census 1978.

Power Project 1980, Old West Regional Commission 1975). Therefore an estimated distance of 80 miles to the pipeline was used.

Use of these communities (all within 1.5 hours' drive of construction areas) for services would not mean that services would not be sought in other communities--even in some smaller communities closer to construction areas. Rather, it is expected that nearby communities would provide services to the extent that they can and that these larger, and in some cases more distant, communities would be used to meet the residual demand for services.

Dewatering Plants. Nine areas were defined as the areas potentially affected by construction and operation of the dewatering plants and associated pipelines and pump stations (Table 3-18). These areas include all counties in which dewatering plants would be located and selected adjacent counties from which the work force would come. Each of these areas is relatively urbanized and contains a large construction labor force that in many cases has been associated with prior construction of the power plant that the proposed dewatering plant would serve. Table 3-18 identifies these areas and the counties included. Brief area summaries follow.

Ponca City. The Ponca City dewatering plant site is 15 miles south of Ponca City, Oklahoma, in Noble County but adjacent to Pawnee County. In 1975 the four-county study area (Noble, Pawnee, Kay, and Payne counties) had a population of 126,311. Within 25 miles of the site are the towns of Ponca City, Pawnee, Perry, and Stillwater, with a combined population of 70,000. The pool of contract construction workers numbered approximately 3400 in 1976.

Pryor. The Pryor dewatering plant would be located in Mayes County, 40 miles from the city of Tulsa. While no project component would be located in Tulsa County, it is included because it would be a major source of construction labor. The city of Tulsa alone has a population in excess of 300,000, which includes construction employment of more than 8000.

Muskogee. The Muskogee dewatering plant would be located in the Muskogee Industrial Park in Muskogee County. Muskogee is a service and employment center for the surrounding area and has been designated a growth center by the state Department of Transportation and the federal Economic Development Administration. Tulsa, approximately 60 miles away, has a population of approximately 300,000 and would be a major source of construction labor.

Independence. The Independence dewatering plant site is located near the town of Newark, approximately 80 miles from Little Rock. Prior construction of a plant for Eastman Kodak Company used 800 construction workers, many of whom could potentially work on the ETSI project. Rental housing is scarce despite recent construction of new units.

White Bluff. The site of the proposed White Bluff dewatering plant is in Jefferson County about 18 miles from Pine Bluff and 55 miles from Little Rock. The White Bluff study area includes Saline and Pulaski counties, both part of the Little Rock - North Little Rock Standard Metropolitan Statistical Area (SMSA), and Jefferson County, which is part of the Pine Bluff SMSA. Little in-migration of construction workers was experienced during construction of the White Bluff power plant in 1978, 1979, and 1980.

Boyce. The site of the proposed Boyce dewatering plant is within the Alexandria (Louisiana) SMSA, which is made up of Grant and Rapides parishes.

TABLE 3-18

AREAS POTENTIALLY AFFECTED BY CONSTRUCTION AND OPERATION OF DEWATERING PLANTS: PROPOSED ACTION

Dewatering Plant Site	Counties/Parishes in Potentially Affected Area[a]	1975 County Population[b]	Area Construction Labor Pool[c]
Ponca City, OK	Grant	6,948	
	Kay	47,825	
	Noble	10,524	3,800
	Pawnee	13,128	
	(Payne)	54,834	
Pryor, OK	Osage	31,390	
	Washington	41,967	
	Rogers	33,671	8,340
	Mayes	27,213	
	(Tulsa)	416,892	
Muskogee, OK	Wagoner	27,225	
	Muskogee	61,894	
	(McIntosh)	13,603	11,985
	(Cherokee)	25,143	
	(Okmulgee)	36,423	
Independence, AR	Independence	24,232	565
	(Jackson)	21,193	
White Bluff, AR	Saline	40,177	
	Pulaski	308,294	20,917
	Jefferson	83,750	
Boyce, LA	Rapides	121,088	
	Grant	14,330	3,250
	Avoyelles	38,171	
Lake Charles, LA	Evangeline	32,365	
	Allen	20,356	5,400
	Jefferson Davis	30,250	
	Calcasieu	151,334	
New Roads, LA	St. Landry	80,553	
	Pointe Coupee	21,855	24,675
	W. Baton Rouge	17,522	
Wilton, LA	Iberville	30,601	
	Ascension	40,691	61,075
	St. James	19,507	

[a]Counties listed in parentheses would not have project components but are potentially affected by project activities.

[b]U.S. Bureau of the Census 1978.

[c]Source of employment figures varies by state. For individual state figures, see the Socioeconomics Technical Report (WCC 1981d).

The local study area includes these parishes as well as Avoyelles. (The affected area encompasses approximately a 40-mile radius.) Population of this three-parish area was 174,000 in 1975, with 3250 persons employed in construction.

Lake Charles. The site of the proposed Lake Charles dewatering plant is 5 miles northwest of Lake Charles, Louisiana, in Calcasieu Parish. The 1975 population of Lake Charles was 76,000, and the population in the four-parish area (Calcasieu, Evangeline, Allen, and Jefferson Davis) was 234,000. The annual average number of construction workers is in excess of 5000.

New Roads. The site of the proposed New Roads dewatering plant is approximately 5 miles from the community of New Roads and about 30 miles from Baton Rouge. Baton Rouge has a large construction labor pool that in 1978 numbered more than 24,000 persons. Baton Rouge was the source of most of the 1500 workers who built Big Cajun Power Plant units 1 and 2, which is located approximately 30 miles from the city.

Wilton. The site of the proposed Wilton dewatering plant is about 40 miles from Baton Rouge and 65 miles from New Orleans. Both of these cities would be sources of construction labor for the proposed ETSI facilities. Construction employment in the region was more than 61,000 in 1978.

3.A.3 VEGETATION

The proposed action would traverse or have permanent facilities located on agricultural lands, short-grass prairie, midgrass prairie, tall-grass prairie, shrub and brush rangeland, ponderosa pine forest, nonforested wetlands, forested wetlands, cross timbers, oak-hickory forest, southern pine-hardwood forest, and barren land. These areas are used mainly for agriculture (cropland), livestock grazing, wildlife habitat, and recreation. Acreages and mileages for each vegetation type that would be affected by the proposed action and each alternative are shown in Section 4.A.4, Table 4-16. Each of these vegetation habitat types is described in detail in Appendix B of the Terrestrial Biology Technical Report (WCC 1981e).

Threatened and Endangered Plant Species

No federally listed threatened or endangered plant species are known to occur in the affected vicinity of any project components associated with the proposed action (or any of the alternatives). At present, state-level endangered species legislation does not protect plant species in states that would have project components.

3.A.4 WILDLIFE

Several terrestrial communities composed of a more or less distinct assemblage of plants and animals occur in the vicinity of the proposed action. These are discussed in detail in the Terrestrial Biology Technical Report (WCC 1981e), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228. All terrestrial communities are influenced by vegetation. Many animals, such as small birds, rodents, weasels, snakes, and frogs, tend to have territories or ranges that are small relative to the area of the vegetative type. Therefore they do not usually leave the type community. Some animals, such as beavers and squirrels, and some insects are restricted to certain vegetation because of specific food requirements. On the other hand, some species or groups of species are not restricted but occur over large areas with diverse vegetative types. Some animals adapt to varied conditions and can live in numerous habitats, even though individuals tend to remain in small areas. Deer, elk, larger birds, and larger carnivores have relatively large territories or feeding ranges and may traverse several vegetation types in their activities. Large mobile or migratory species are influenced by weather and other factors and tend to move between one or more communities during the year. For instance, deer and elk move from the higher coniferous forests of their summer range to lower forests, prairies, or agricultural vegetative habitats to winter where snow cover is not so deep and food is more plentiful. Some avian species, such as ducks, geese, shorebirds, and songbirds, are migratory and remain for only short periods in communities during their travels. Table 3-19 lists the preferred vegetative habitats of wildlife species of concern which could be encountered at project locations.

Game Mammals

Big game species that occur in the vicinity of the proposed pipeline corridors are mule deer, pronghorn antelope, and white-tailed deer. Pronghorn would occur mostly in Wyoming and Nebraska, and mule deer range south into Kansas. White-tailed deer occur in all states that would have components of the coal slurry transportation project. The vegetative habitats where big game species could be encountered are listed in Table 3-19. Small game mammals, including rabbits and squirrels, occur in all states that would have project components and occupy most vegetative habitats that would be traversed.

Nongame Mammals

Nongame mammals that would be expected to occur in areas which would have project components include insectivores, bats, and rodents. Rodents, especially mice, voles, and gophers, are very common in cultivated areas and grasslands. Shrews tend to live in damp areas along rivers. Most bats hunt and probably rest in or near grasslands or open forest areas. Streams, lakes, and ponds also tend to attract feeding bats.

Game Birds

Upland game birds are abundant within the project region and provide a wide variety for hunters. Some important upland game species that would be encountered along the proposed pipeline corridor include sage grouse, ring-necked pheasant, bobwhite quail, sharp-tailed grouse, wild turkey, and mourning dove. These species are largely dependent on waste grains, weed seeds, and insects for food and on brushy stream bottoms, ditch banks, and fence rows for escape cover. As indicated in Table 3-19, upland game species would be expected to occur in most habitat types that would be traversed. Waterfowl would be encountered in wetland areas and at some river crossings.

Nongame Birds

A variety of nongame bird species would be expected to occur in the areas that would be affected by pipeline project components. Birds of prey (raptors) hunt in most of the vegetative habitats that would be traversed. Many of these birds are most often observed near bodies of water, cultivated fields, grasslands, and other areas where low vegetative cover facilitates hunting. In addition, their prey, consisting primarily of rodents, rabbits, and small birds, is more common in grasslands than in forests.

Threatened and Endangered Wildlife Species

According to the U.S. Fish and Wildlife Service (1980a), 14 wildlife species listed as threatened or endangered by the Department of the Interior could occur near components of the coal slurry pipeline project. These species are the

TABLE 3-19

TERRESTRIAL SPECIES OF SPECIAL CONCERN AND THEIR PREFERRED VEGETATIVE HABITATS

Species	State	Vegetative Habitat[a,b] A	SGP	MGP	TGP	SBR	PPF	NFW	FW	CT	OHF	SPHF	Project[c]
Endangered or Threatened: Federal List													
Black-footed ferret	SD, WY, CO, NE, KS	X	X	X		X							All
Florida panther	AR, LA								X		X	X	PA, MA, CB
Red wolf	LA							X	X				PA,MA
Gray bat	KS, OK, AR	Colonies restricted to caves or cave-like habitats.											PA, MA, CB
Indiana bat	OK, AR	Colonies in caves.											PA, MA, CB
Ozark big-eared bat	OK, AR	Colonies restricted to caves.											PA, MA, CB
Bald eagle	All states	Wide-ranging raptor that may occur in most habitat types.											All
Peregrine falcon	All states	Wide-ranging raptor that may occur in most habitat types.											All
Whooping crane	SD, NE, KS, OK							X					PA, MA, CB
Red-cockaded woodpecker	AR, LA											X	PA, MA, CB
American alligator	AR, LA							X	X				PA, MA, CB
Endangered or Threatened: State Lists													
Northern swift fox	SD, NE		X	X									PA, MA, CB, OA
Greater prairie chicken	CO, SD, NE, KS, OK			X	X								PA, MA, CB, CA
Interior least tern	SD, NE, KS							X					PA, MA, CB, OA
Big Game													
Pronghorn antelope	SD, WY, CO, NE		X	X		X							All
Mule deer	SD, WY, CO, NE, KS		X	X		X	X						All
White-tailed deer	All states	X						X	X	X	X	X	PA, MA, CB, CA, OA
Small Game													
Desert cottontail rabbit	SD, WY, NE, CO		X	X	X	X	X						All
Eastern cottontail rabbit	NE, KS, CO, OK, AR, LA	X						X	X	X	X	X	PA, MA, CB, CA, OA
Swamp rabbit	OK, AR, LA								X				PA, MA, CB
White-tailed jackrabbit	SD, WY, CO, NE		X	X		X							All

TABLE 3-19 Concluded

Species	State	Vegetative Habitat[a,b]											Project[c]
		A	SGP	MGP	TGP	SBR	PPF	NFW	FW	CT	OHF	SPHF	
Black-tailed jackrabbit	NE, KS, CO, OK, AR, LA		X	X		X							All
Gray squirrel	NE, KS, OK, AR, LA	X							X	X	X	X	PA, MA, CB
Fox squirrel	KS, OK, AR, LA	X							X	X	X	X	PA, MA, CB
Game Birds													
Sage grouse	WY			X		X							All
Ring-necked pheasant	NE, KS, SD	X		X				X					PA, MA, CB, OA
Bobwhite quail	All states	X			X			X	X	X			PA, MA
Sharptailed grouse	WY, SD, NE		X	X		X							PA, MA, CB, OA
Wild turkey	WY, NE, KS, OK, AR, LA						X	X	X	X	X	X	PA, MA, CB, OA
Mourning dove	All states	X						X	X	X	X	X	All
Other Species of Special Interest													
Golden eagle	SD, WY, CO, NE		X	X	X	X							All
Black-tailed prairie dog	SD, WY, CO, NE, KS, OK	X	X	X		X							All
White-tailed prairie dog	CO	X	X	X		X							CA
Sandhill crane	NE							X	X				PA, MA, CB
Great blue heron	KS, NE							X	X				PA

[a]See Appendix B of the Terrestrial Biology Technical Report (WCC 1981e) for detailed descriptions of habitats.

[b]A = agriculture; SGP = short-grass prairie; MGP = midgrass prairie; TGP = tall-grass prairie; SBR = shrub and brush rangeland; PPF = ponderosa pine forest; NFW = nonforested wetlands; FW = forested wetlands; CT = cross timbers; OHF = oak-hickory forest; SPHF = southern pine-hardwood forest.

[c]PA = proposed action; MA = market alternative; CB = Cypress Bend pipeline-barge alternative; CA = Colorado alternative; CC = Crook County alternative water supply system; OA = Oahe alternative water supply system.

black-footed ferret, Florida panther, red wolf, gray bat, Indiana bat, Ozark big-eared bat, bald eagle, peregrine falcon, whooping crane, Bachman's warbler, red-cockaded woodpecker, Eskimo curlew, ivory-billed woodpecker, and American alligator. In addition, the northern swift fox and interior least tern receive state-level protection. Preferred vegetative habitat types for each of these species are given in Table 3-19, and each species is discussed in greater detail in the Threatened and Endangered Species Technical Report (WCC 1981f), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228. Only a general discussion of each protected species that could be affected is presented here.

Federally Protected Species.

Black-Footed Ferret. The black-footed ferret was once found throughout the Great Plains, mountain basins, and semiarid grasslands of North America (Hillman and Clark 1979). Henderson et al. (1974) indicate the ferret was characteristic of the short- and midgrass prairies, and Clark (1978) indicates that 97 percent of ferret sightings in Wyoming were in shrub and brush and prairie vegetation types. Even though ferrets have been seen in haystacks, under buildings, and in ground squirrel colonies, most evidence indicates their principal habitat is prairie dog colonies (Clark 1978). Potential habitat for ferrets (prairie dog towns) occurs throughout the northern states that would have proposed action components, including Wyoming, Nebraska, Kansas, and Oklahoma. The Fish and Wildlife Service (FWS 1980b) considers the ferret extinct in Oklahoma.

In Wyoming a number of sightings of the ferret have been made (Clark 1978; Hehnke 1979). Seven ferret skulls were located in Wyoming during the summers of 1978 and 1979 (Martin and Schroeder 1978).

The Nebraska Game and Parks Commission (1977) reported only 14 reliable sightings of black-footed ferrets since about 1965. The 14 sightings were made at 12 different locations in 9 counties, primarily in the panhandle and the southwestern part of the state. Prairie dog colonies are present in 48 of the state's 93 counties and probably total 10,000 to 12,000 acres (500 to 600 separate dog towns).

In Kansas, one ferret was observed in Cheyenne County in 1975 (Kansas Fish and Game Commission 1977). The last time a ferret was collected in Kansas was in 1957 (Kansas Fish and Game Commission 1977). About a half-dozen sightings of ferrets were reported between 1969 and 1973 (Henderson and Little 1973); two of these were in counties that would be crossed by proposed action alignments (Trego and Barton counties).

Bald Eagle. Although the bald eagle formerly nested throughout much of the United States, it now breeds primarily in the northern states and Florida. During the winter the bald eagle may be found along many bodies of water, especially larger rivers and lakes, throughout states that would have components of the proposed action.

Bald eagle nests are usually constructed in the tops of tall trees and are renovated yearly. Snow (1973) reported that large numbers of bald eagles gather at communal roosts, usually near a food source or shelter. Since the bald eagle is primarily a fish eater, large winter concentrations are usually found near rivers and reservoirs. Where carrion is plentiful, bald eagles tend to be more scattered and often roost away from large water bodies. Such is the case in portions of Wyoming that would be affected by the proposed action. Habitat requirements of the bald eagle are discussed in greater detail in the Threatened and Endangered Species Technical Report (WCC 1981f).

Although bald eagles nest in all states that would be affected by the proposed action, at the present time no active or inactive nest sites are known to be present near proposed project components. No communal roosts are known to exist in the affected vicinity of the proposed action. The closest known winter roost area is approximately 3 miles east of the proposed North Rawhide slurry gathering line near the Belle Fourche River crossing in Campbell County, Wyoming. According to the National Wildlife Federation's 1980 midwinter bald eagle counts, bald eagles winter on most large rivers that would be traversed by the proposed action pipeline. Major rivers that would be traversed by the proposed action pipeline, where overwintering bald eagles may be found, are the Belle Fourche, North Platte, South Platte, and Republican rivers in Nebraska; the Arkansas River in Kansas; the Neosho and Arkansas rivers in Oklahoma; and the Arkansas River in Arkansas. Only one specific location identified is of known concern: the Arkansas River in Oklahoma near Ponca City, at approximately MP P-720 of the proposed action route. Large cottonwoods along this fairly shallow and clear river offer prime bald eagle winter habitat; according to Short (1980), many bald eagles overwinter in the area.

Peregrine Falcon. The peregrine falcon formerly bred and wintered throughout most of North America, with the primary exception being the southeastern portion of the United States. This falcon still breeds throughout much of the western United States but is fairly rare in the east.

Most peregrine falcon nests are located on cliffs, particularly ones that are extremely high, overlooking water, and offering an extensive view. An adequate food supply in the vicinity of the nest is also a necessity. Nesting sites are normally reused yearly (Snow 1972). Habitat requirements of the peregrine falcon are described in more detail in the Threatened and Endangered Species Technical Report (WCC 1981f).

The peregrine falcon was probably always rare in Wyoming because of limited suitable habitat (Wyoming Game and Fish Department 1977). The peregrine occurs most frequently as a migrant through Wyoming, although it may breed sparingly in the western portion of the state.

The only known record of peregrine nesting in Nebraska occurred in 1903 in Dawes County. According to the Nebraska Game and Parks Commission (1977), the peregrine occurs in Nebraska as a rare fall migrant and a rare winter resident. There are no known records of nesting peregrine falcons in Kansas during this century (American Peregrine Falcon Recovery Team 1977). According to Platt et al. (1974), the peregrine falcon occurs in Kansas as a fall and spring migrant and a winter resident. Typically, sightings occur around marshes, lakes, and rivers.

Chamberlain (1974) reported that the peregrine falcon breeds sparingly in western Oklahoma and occurs in eastern Oklahoma only as an occasional winter visitor. Seldom are more than a few birds reported in eastern Oklahoma in any one year. Eastern records include sightings near Washita National Wildlife Refuge, Hulah Reservoir, and Stillwater (Chamberlain 1974). Arkansas records suggest the peregrine is a rare fall and winter visitor in that state. Chamberlain reported recent records from Lonoke, Magazine Mountain, and Union

County. The last record of nesting activity in Arkansas occurred in 1888 (Arkansas Department of Planning 1974). Louisiana sightings occur most frequently in coastal areas, although Chamberlain suggested the peregrine is a rare winter resident in scattered locations in the state. Lowery (1974a) reported peregrine records from Louisiana for early September through mid-May. The only known recorded breeding in the state occurred in 1942 near Tallulah in Madison Parish (Gulf South Research Institute 1976).

The peregrine is not known to nest near any components of the proposed action, and it would occur over most of the route only as an occasional fall and winter visitor.

Whooping Crane. The whooping crane formerly bred from the southern MacKenzie District and northeastern Alberta in Canada south through the prairie provinces and the northern prairie states. An additional nonmigratory breeding population occurred in southwestern Louisiana. The migratory population wintered on the Gulf Coast from Florida to Mexico (Lippincott undated).

The preferred summer and winter habitats of the whooping crane are marshes, but open water is often used. During migration, sandbars and mudflats are used; data indicate that harvested grain fields are visited during fall migration (Lippincott undated).

The whooping crane could occur in each state that would be affected by the proposed action. In Wyoming, the state Game and Fish Department (1977) considered the whooping crane an occasional migrant through the eastern and western thirds of the state, although it is more frequent in the western portion. The whooping crane occurs in Nebraska only as a migrant during the fall and spring (Nebraska Game and Parks Commission 1977). While in Nebraska, the crane utilizes sandbars on the Platte and Niobrara rivers as well as wetlands and croplands for roosting, resting, and feeding. In May 1978, the Fish and Wildlife Service designated the area of the Platte River from Lexington to Denman, Nebraska (approximately 53 river miles), as critical habitat for the whooping crane (FWS 1978).

In Kansas the whooping crane occurs only as a transient visitor during March, April, and October (Platt et al. 1974). Cheyenne Bottoms State Waterfowl Refuge in Barton County, Kansas, is designated as critical habitat for migrating whooping cranes. The proposed action would traverse the southwestern corner of Barton County approximately 16 miles southeast of the refuge.

In Oklahoma the whooping crane appears as a transient visitor in the eastern two-thirds of the state. Salt Plains National Wildlife Refuge in Alfalfa County has been declared critical habitat for the whooping crane. Alfalfa County is located approximately 60 miles west of the proposed action route. The last whooping crane sighting in Louisiana was in 1950 near White Lake, Vermilion Parish, in the coastal wetlands area (Lowery 1974a).

Red-Cockaded Woodpecker. The red-cockaded woodpecker is found in scattered locations throughout the southeastern United States. Oklahoma, Arkansas, and Louisiana are the states in the present range of the red-cockaded woodpecker that would be affected by the proposed action.

The basic habitat requirement of the red-cockaded woodpecker is open stands of at least 60-year-old pines. Longleaf pine is most commonly used, but other species of southern pine are also acceptable (FWS 1980c). Hardwoods and dense pine stands with a dense understory are avoided. Roosting cavities typically occur in living pines and most frequently in trees that are infected with a fungus producing red-heart disease. Eggs are laid during April, May, and June. The female uses her mate's roosting cavity for a nest. From egg laying to fledging requires about 38 days, and another several weeks are needed before the young become completely independent.

The proposed action route in both Arkansas and Louisiana would traverse or pass near areas reported to have red-cockaded woodpeckers. Known colonies would occur between mileposts (MP) PMB-1060 and PMB-1070 (Barkley et al. 1980; James and Burnside 1979) and from MP PM-1160 to PM-1170 (Smith 1980) in Arkansas. The red-cockaded woodpecker could be encountered along the alignment in Arkansas from about MP PMB-1060 to PM-1175, and in Louisiana from MP PM-1240 to PM-1245 and from MP PM-1255 to PM-1275 (Dunham 1980).

Ivory-Billed Woodpecker. The ivory-billed woodpecker formerly occurred in the south Atlantic and Gulf states from North Carolina to eastern Texas and, to the north, in the Mississippi Valley to Missouri, southern Illinois, and southern Indiana (FWS 1980c). Most authors agree this woodpecker is now extinct, but during the late 1960s and early 1970s there were unconfirmed reports of sightings in the Big Thicket area of east Texas and in southern Louisiana (Lowery 1974a).

Ivory-bills mated for life and normally traveled in pairs. Nesting usually occurred in cavities excavated in dead or partially dead trees. Breeding occurred between January and May (FWS 1980c). The ivory-billed woodpecker is not expected to occur along any proposed pipeline corridors.

American Alligator. The American alligator occurs on the Atlantic coastal plain in North Carolina and extends southward and around the coastline to Texas and from there northward along the Mississippi drainage to Arkansas and southeastern Oklahoma.

Oklahoma, Arkansas, and Louisiana are the states in the range of the American alligator that would have components of the coal slurry pipeline project. The American alligator could be encountered in southeastern Arkansas and along most of the proposed action route in Louisiana, where the alignments would traverse river systems, canals, lakes, swamps, bayous, and coastal marshes.

Eskimo Curlew. The Eskimo curlew formerly nested in the Arctic tundra and wintered in the grasslands of South America (FWS 1980c). The fall migration of the Eskimo curlew began in July. During the fall migrations these birds flew from Nova Scotia over the Atlantic Ocean directly to eastern South America. Spring migration began in late February, with the birds arriving on the coasts of Texas and Louisiana in early March. From the Gulf Coast the Eskimo curlew gradually migrated northward through the prairies of the middle United States to eastern South Dakota (FWS 1980c).

At one time, the Eskimo curlew probably visited each state that would contain components of the coal slurry pipeline project; however, there have been no recent sightings of this migratory species within those states. The last sighting in Wyoming was in 1897 (Wyoming Game and Fish Department 1977); in Kansas, the last sighting was in 1891 (Platt et al. 1974). The last sighting in Nebraska was in 1926 (Nebraska Game and Parks Commission 1977), and the last sighting in Louisiana was in 1964

(Lowery 1974a). The Eskimo curlew is not expected to occur along the proposed pipeline corridors.

Bachman's Warbler. At one time, Bachman's warbler occupied wet forested areas in the southeastern United States during its breeding season (FWS 1980c). Nesting usually occurred from late March to early June. The present distribution of Bachman's warbler is unknown, but most authorities agree that if the warbler still exists it is most likely to be in the I'On Swamp area in Berkley and Charleston counties, South Carolina. There are no confirmed nesting records from this century for this species in any of the states that would have components of the coal slurry pipeline project. Bachman's warbler is not expected to occur along any of the proposed pipeline corridors.

Gray Bat. The gray bat occurs primarily in Alabama, Arkansas, Kentucky, Missouri, and Tennessee; a few colonies occur in Florida, Georgia, Kansas, Indiana, Illinois, Oklahoma, Virginia, and possibly North Carolina (FWS 1980c). Kansas, Oklahoma, and Arkansas are the states in the range of the gray bat that would have components of the coal slurry pipeline project.

Gray bat colonies are restricted entirely to caves or cave-like habitats. During summer the bats are highly selective for caves providing specific temperature and roost conditions, and in winter they use only deep, vertical caves having a temperature of 6° to 11°C. Consequently, only a small number of the caves in any area are used regularly. There are nine known roosting caves, which are believed to house roughly 95 percent of the hibernating population (FWS 1980c).

The only record of the gray bat in Kansas is from Cherokee County (Hays and Bingman 1964). The present distribution of the gray bat in Oklahoma includes the limestone cave regions of Adair, Cherokee, Delaware, and Ottawa counties in the northeastern corner of the state (FWS 1980b).

According to McDaniel and Gardner (1977), the gray bat is still abundant and widely distributed in the cave region of northern Arkansas. The gray bat occurs in the limestone and sandstone cave region of the northern portion of the Arkansas Ozarks comprising the Salem and Springfield plateaus. Maternity colonies have been reported in Benton, Madison, Stone, and Washington counties (Sealander 1979). Although records of gray bats exist for some counties that would have project components, cave habitats would be avoided by the project.

Indiana Bat. The Indiana bat occurs in the Midwest and eastern United States from the western edge of the Ozark region in Oklahoma to southern Wisconsin, east to Vermont, and as far south as northern Florida (FWS 1980c; Barbour and Davis 1968). Oklahoma and Arkansas are the states in the range of the Indiana bat that would be affected by the coal slurry pipeline project.

The Indiana bat uses mainly limestone caves for winter hibernation. A few individuals have been found under bridges and in old buildings, and several maternity colonies have been located under loose bark and in the hollows of trees. Summer foraging by females and juveniles is limited to riparian and floodplain areas. Creeks are apparently not used if riparian trees have been removed. Males forage over floodplain ridges and hillside forests and usually roost in caves.

Eastern Oklahoma is the extreme western edge of the known range of the Indiana bat. Glass (1975) reported Oklahoma records from Adair and Leflore counties. The U.S. Fish and Wildlife Service (1980b) reported additional collections from caves in Delaware and Pushmataha counties. Sealander (1956) reported Indiana bats from Baxter, Independence, Izard, Searcy, Stone, and Washington counties in Arkansas. Additional records exist from Newton, Benton, and Garland counties. Independence County is the only Arkansas county with records of the Indiana bat that would be affected by the slurry pipeline project.

The Indiana bat is not expected to occur near any of the coal slurry pipeline project components.

Ozark Big-Eared Bat. The Ozark big-eared bat has been reported from only a few caves in northwestern Arkansas, southwestern Missouri, and eastern Oklahoma (FWS 1980b and 1980c). Oklahoma and Arkansas are the states in the range of this bat that would have components of the coal slurry pipeline project.

Maternity and hibernating colonies of Ozark big-eared bats have been found only in caves. The only known maternity colony is in Kentucky (FWS 1980c). This bat is dependent on a few specific kinds of caves for hibernating and reproduction. It is highly susceptible to human disturbance and readily abandons roosts when disturbed.

According to the U.S. Fish and Wildlife Service (1980b), the Ozark big-eared bat has been reported from Cherokee and Adair counties in eastern Oklahoma. These Oklahoma records consist of occasional specimens found in caves. Harvey et al. (1978) reviewed the status of this bat in Arkansas but mentioned records for only Washington and Marion counties. The U.S. Fish and Wildlife Service (1980c) also reported the Ozark big-eared bat from Crawford, Madison, and Newton counties.

The Ozark big-eared bat is not expected to occur near proposed alignments or surface facilities of the pipeline project.

Florida Panther. Historically, the Florida panther ranged throughout the southeastern United States, including portions of Arkansas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, and South Carolina (FWS 1980c; Hall and Kelson 1959). The Florida panther possibly still occurs in a number of small, isolated populations. Arkansas and Louisiana are the states in the historic range of the Florida panther that would have components of the coal slurry pipeline project.

Sealander and Gipson (1973) reported small panther populations near the Saline and Ouachita river bottomlands in southeastern Arkansas, in the White River National Wildlife Refuge near the confluence of the White and Arkansas rivers, in the western Ozark Mountains north of the Arkansas River, and in the Ouachita Mountains in west-central Arkansas south of the Arkansas River. Recent sightings indicate the panther is holding its own in Arkansas and suggest that population levels may be rising (Sealander and Gipson 1973). Most recent sightings have occurred in southeastern Arkansas. In Louisiana, Florida panther sightings have occurred recently in Natchitoches Parish (Goertz and Abegg 1966) and in Madison, Webster, St. Tammany, Concordia, Catahoula, and East Baton Rouge parishes (Lowery 1974b). The Florida panther's occurrence in areas that would have components of the coal slurry pipeline project is mostly a matter of conjecture (FWS 1980a).

Red Wolf. Although the red wolf was once found in numerous habitats throughout the southeastern United States (FWS 1980c), its recent range is restricted to less than 900 square miles in extreme southeastern Texas and less than 800 square miles of extreme southwestern Louisiana (Carley 1979). Louisiana is the only state in the present range of the red wolf that would have components of the coal slurry pipeline project.

The recent range of the red wolf in Louisiana is roughly the southwestern corner of the state, encompassing the area south of Interstate 10 and west of Calcasieu Lake. Generally, this area includes the western half of Cameron Parish and the southwestern quarter of Calcasieu Parish (Carley 1979).

The red wolf is not expected to occur in the vicinity of any proposed project components.

State-Protected Species.

Northern Swift Fox. The historical range of the swift fox included the Great Plains from the southern Canadian provinces to the Texas panhandle (Hillman and Sharps 1978). Wyoming and Colorado have stable populations of this fox, but only remnant populations survive in South Dakota and Nebraska. The northern swift fox is considered threatened in South Dakota and endangered in Nebraska.

The northern swift fox is usually found on short- and midgrass prairies and is closely associated with black-tailed prairie dog colonies (Sharps 1980). These foxes excavate their own dens or modify prairie dog burrows or badger diggings (Hillman and Sharps 1978). Breeding probably occurs in early March, and the pups occupy natal dens until late May or early June. The northern swift fox occurs in areas traversed by the proposed action in northwestern Nebraska, particularly between MP PMB-120 and PMB-130 (L. Carlson 1980). At this location in Nebraska the route would pass near denning sites of the northern swift fox (L. Carlson 1980).

Interior Least Tern. The interior least tern breeds in Texas, Oklahoma, Kansas, South Dakota, Nebraska, Arkansas, Tennessee, Illinois, and Mississippi. It is a state-listed endangered species in South Dakota and a threatened species in Nebraska and Kansas.

River sandbars, sandflats, and other similar habitats are required for nesting. In Nebraska, nesting colonies of the interior least tern are known to occur along certain portions of the Platte River east of central Lincoln County (Nebraska Game and Parks Commission 1977). Platt et al. (1974) list the least tern as a summer resident of Kansas and report breeding records from the following Kansas counties: Hamilton, Meade, Rooks, Barton, and Stafford.

Coal Slurry Preparation Plants

The major vegetative habitat type at the proposed preparation plant sites (North Rawhide, Jacobs Ranch, and North Antelope) is midgrass prairie. Wildlife species of special interest that would occur or might occur on the proposed preparation plant sites include the black-footed ferret, bald eagle, peregrine falcon, and golden eagle.

If prairie dog towns occur at the coal slurry preparation plants, potential ferret habitat also occurs. Bald eagles would occur at the coal slurry preparation plants only as visitors; no nests or roosts are known to occur at these sites. Likewise, no golden eagle nests are known to exist at these sites. The peregrine falcon could occur infrequently over the preparation plants.

Water Supply System

Wildlife species of special interest that would occur or might occur in association with the proposed water supply system include the black-footed ferret, bald eagle, peregrine falcon, sage grouse, and golden eagle.

Any prairie dog towns traversed by the water supply system could provide potential ferret habitat. No bald or golden eagle nests or roost sites have been identified on the various water supply lines.

Sage grouse strutting grounds could occur on or very near the North Rawhide water supply line at MP NR-17, NR-23, NR-28, and NR-31. Peregrines could occur infrequently over any portion of the water supply system.

Slurry Pipelines and Pump Stations

Wildlife species of special concern that could occur along the slurry pipeline corridor between Jacobs Ranch (Wyoming) and its termination in Louisiana include the black-footed ferret, bald eagle, golden eagle, northern swift fox, peregrine falcon, sage grouse, American alligator, red-cockaded woodpecker, and interior least tern. In addition, concern was expressed for the golden eagle in Nebraska and the greater prairie chicken in Oklahoma.

Three golden eagle nests have been identified near the proposed action route in Nebraska, to the north of about MP PMB-233, PMB-237, and PMB-246 (L. Carlson 1980). The greater prairie chicken, a species of special concern in Oklahoma, could be encountered between MP P-690 and P-718 and between MP P-810 and P-825 in Noble, Mayes, and Wagoner counties, Oklahoma.

Where the proposed action route in Kansas would traverse Rattlesnake Creek (at about MP P-551) in Stafford County, known wetland habitat of value to a variety of wildlife (including various waterfowl) would be affected. Other wetland areas could be traversed near the North Fork Ninnescah River crossing (MP P-567) and near the South Fork Ninnescah River crossing (MP P-593) (Queal and Wood 1980). The proposed action route in Kansas would also traverse the Kingman Wildlife Area in the vicinity of MP P-589 (Queal and Wood 1980).

In Oklahoma the proposed action route would pass through the Fort Gibson Game Management Area between MP P-819 and P-827. This area is managed for upland game, white-tailed deer, and waterfowl by the Oklahoma Department of Wildlife Conservation.

Two state nature areas that contain a variety of sensitive species are located south of the Independence lateral portion of the proposed pipeline route in Arkansas: Cove Creek Natural Area (south of MP PMB(I)-30) and Big Creek Natural Area (south of MP PMB(I)-68) (Smith 1980). The Quivira Wildlife Refuge in Kansas is located about 10 miles northeast of MP P-650.

The proposed action route in Arkansas would pass near or through the Harris Brake Wildlife Management Area between MP PMB-1020 and PM-1225 (Barkley et al. 1980). The area is managed for upland game.

The proposed pipeline route in Louisiana would traverse the following areas: (1) Georgia-Pacific Wildlife Management Area, near MP PM-1190; (2) Cities Service Wildlife Management Area, near MP PM-1205; and (3) Alexander State Forest, between MP PM-1315 and PM-1323 (Dunham 1980).

Dewatering Plants

Dewatering plants would be located mostly on urban and builtup lands. Some agricultural lands and southern pine-hardwood forest may also be affected.

3.A.5 AQUATIC BIOLOGY

For the purposes of aquatic biological analyses, the "affected environment" includes aquatic biota (plants and animals) and their physical habitats that would be either directly or indirectly disturbed by construction, operation, maintenance, or abandonment procedures. In general, directly disturbed resources include biota and habitats removed or displaced by proposed activities in the water body (e.g., riverbeds and biota disturbed by pipeline construction through a 100-foot right-of-way stream crossing). Indirectly disturbed aquatic biological resources include biota and habitats located downstream from areas that would be directly disturbed and hence affected by the flow of various materials away from the site of disturbance. Indirectly affected areas include streams and their biota, which would be affected by terrestrial components of the proposed action that could contribute to the stream sediment and pollutant loads without physically disturbing the stream bed (WCC 1981g).

Detailed aquatic biological descriptions of the affected environment for all project components and alternatives are included in the Aquatic Biology Technical Report (WCC 1981g), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Denver, Colorado 80228. Only those aquatic biota and habitats anticipated to be significantly affected by the proposed action or alternatives are described in this chapter.

Coal Slurry Preparation Plants

The three preparation plants would lie within a Missouri River subbasin that includes the Powder River and Cheyenne River drainages. This eastern Wyoming area is characterized as relatively flat, semiarid high plains, with annual precipitation averaging 10 to 18 inches (Pennak 1966; Missouri Basin Inter-Agency Committee 1969). The streams that might be affected by the proposed preparation plants (Table 3-20) would be ephemeral or intermittent (Baxter and Simon 1970).

Fish. The fish fauna of perennial reaches of these drainages consists of various minnows, shiners, chubs, suckers, catfish, trouts, and sunfish (Wesche and Johnson 1980, Fleischer 1978). Some of these fishes would be expected to occur in the intermittent streams identified in Table 3-20 during periods of flowing water, and perhaps in isolated pools during "dry" streambed conditions. Species that would occur in these intermittent streams are typically tolerant of intermittent and turbid stream conditions. They generally spawn from May through August in shallow, sandy stream areas (Baxter and Simon 1970).

Aquatic Invertebrates. Crustaceans, snails, and clams are limited in this region, primarily because of the intermittent nature of the streams, shifting substrates of the streams (Pennak 1966), and the lack of suitable fish hosts for the larval stages of many freshwater clams. Aquatic insects and worms are also adversely affected by unstable substrate conditions (Hynes 1970; Mackay and Kalff 1969; Cummins et al. 1964; Higler 1975). The result is low levels of biological production. Those areas of rivers and streams where coarse, stable substrates are available demonstrate dense and diverse populations of immature mayflies, caddisflies, flies, beetles, and aquatic worms. Wesche and Johnson (1980) reported low to moderate organism diversity and abundance in Thunder Basin streams.

Threatened and Endangered Species. No officially listed threatened, endangered, or other sensitive aquatic species would be affected by the proposed preparation plants. Extensive data regarding species classified as sensitive

TABLE 3-20

WYOMING RIVERS AND STREAMS CLOSEST TO THE PROPOSED COAL SLURRY PREPARATION PLANTS

Preparation Plant	Nearest Stream	Approximate Mileage from Plant Site to Stream
North Rawhide	Little Powder River	On site
	Dry Fork Little Powder River	On site
	Unnamed tributary to Little Rawhide Creek	On site
Jacobs Ranch	Little Thunder Creek	1.5 miles
	Unnamed tributary to Little Thunder Creek	1 mile
North Antelope	Porcupine Creek	1 mile
	Two unnamed tributaries to Porcupine Creek	1 mile

are reported in the Threatened and Endangered Species Technical Report (WCC 1981f).

Water Supply System

The four primary drainages potentially affected by the proposed water supply system are the Powder, Belle Fourche, Cheyenne, and Niobrara river basins. The proposed well field includes the intermittent headwaters of the Cheyenne River and a portion of its perennial mainstem. Approximately 32 intermittent streams would be crossed by the proposed water supply pipeline in Wyoming.

Fish. The fish fauna of the Niobrara River basin is similar to the Cheyenne, Belle Fourche, and Powder River fish faunas described above. The Niobrara basin shares much of its fish fauna with these drainages but also sustains populations of rainbow and brown trout, bluegill, and largemouth bass.

Aquatic Invertebrates. Aquatic invertebrates in the vicinity of the water supply system would be expected to be similar to the invertebrates discussed for the preparation plant sites.

Threatened and Endangered Species. It is not anticipated that any officially listed threatened or endangered aquatic species would be affected by the proposed water supply system.

Slurry Pipelines and Pump Stations

Fish. In Wyoming, 2 perennial and approximately 75 intermittent streams would be crossed by the proposed coal slurry pipelines. Some important characteristics of the various Wyoming drainages that would be affected by the pipelines and pump stations are described above. The Niobrara River would be crossed by the pipeline at milepost (MP) PMB-90.5, where northern pearl dace and finescale dace may occur. These species are considered rare in Wyoming (Wyoming Game and Fish Department 1977). Peak spawning activity for most Wyoming fish extends from late April through early August.

Permanent waters are encountered along the pipeline route in Nebraska as basins enlarge and as rainfall increases to 16 to 24 inches annually (Missouri Basin Inter-Agency Committee 1969). Approximately 11 perennial rivers and 41 intermittent or ephemeral streams would be crossed by the pipeline in Nebraska. Major drainages crossed by the proposed pipeline route include the Niobrara, North and South Platte, and Republican River basins.

Tributaries of the North Platte and Niobrara rivers are spawning grounds for trout from Lake McConaughy and Box Butte Reservoir, respectively. Nebraska's trout fisheries play an important role in the state's total sport fishery (Nebraska Game and Parks Commission 1972a, 1972b; Van Velson 1978). Both brown and rainbow trout ascend the Niobrara River during the fall, and the proposed North Platte River crossing location (MP PMB-203) is rated Class I waters (highest-value fishery resource) by the U.S. Fish and Wildlife Service and Nebraska Game and Parks Commission (1978) partially because of its importance as a migration corridor for fall (November, December) and spring (March) spawning trout. Spawning activity for other Nebraska fish generally extends from April through July.

The North Platte, South Platte, and Republican rivers are generally broad, shallow, sluggish, sand-bottomed waterways with similar fish populations; there are about 45 species among them (Bliss and Schainost 1973a, 1973b, 1973c, 1973d; Kansas Forestry, Fish and Game Commission 1972a, 1972b, 1977a, 1977b; Nebraska Game and Parks Commission 1972a, 1972b; Missouri River Basin

Commission 1975, 1976; Morris et al. 1974). Sport fishes found in one or more of these rivers include rainbow and brown trout, green sunfish, bluegill, largemouth and smallmouth bass, rock bass, northern pike, walleye, yellow perch, white crappie, and flathead and channel catfish. Spring Creek and the Republican River have been listed as Class I and II waters, respectively (highest and high-value fishery resources respectively), by the U.S. Fish and Wildlife Service and the Nebraska Game and Parks Commission (1978) because of their catfish fisheries (Kansas Fish and Game Commission 1979; Bliss and Schainost 1973d).

Streams proposed to be crossed in the South Platte River basin have little value as sport fisheries (U.S. Fish and Wildlife Service and Nebraska Game and Parks Commission 1978). The South Platte River itself is considered Class IV waters (limited local sport fishery value) by the U.S. Fish and Wildlife Service et al. (1978).

Streams in roughly the northern half of Kansas are tributaries of the Missouri River, and streams in the southern half of the state are within the Arkansas River basin. Twenty-three perennial rivers and approximately 98 intermittent or ephemeral streams would be crossed by the proposed action corridor in Kansas. Intermittent streams in the state seldom contain more than 10 to 15 fish species, but perennial streams commonly have more than 40 species (Cross and Collins 1975). Most large Kansas rivers have predominantly sand substrates, with reduced habitat and species diversity. These rivers contain gizzard shad, buffalo, catfish, drum, chubs, and shiners.

Southeastern Kansas has some small, rocky streams providing the variety of habitat to support as many as 30 fish species. Numerous springs and increased annual rainfall (30 to 40 inches) contribute significantly to the availability and permanence of regional streams. Madtoms, sunfishes, and darters are characteristic of these areas (Cross and Collins 1975). In Kansas, fish spawning activity generally extends from March through July.

Similar conditions exist in north-central and northeastern Oklahoma, where rainfall averages 42 to 56 inches per year. The proposed pipeline route would cross numerous "prairie" streams and would border the Ozark region, which has many sinks, caves, and underground drain ages (Webb 1970). In Oklahoma, 34 permanent and approximately 50 intermittent and ephemeral streams would be crossed by the proposed action pipeline corridor.

The prairie streams of north-central Oklahoma are generally sluggish, with sand or silt bottoms, and may be clear or turbid. Abundant fish in the smaller streams include the plains killifish, various shiners and minnows, stoneroller, sunfishes, and catfishes. Buffalo, gizzard shad, various suckers, and some bass species may be found in large prairie streams (Cross and Collins 1975).

Ozark rivers and streams tend to be high-gradient, clear, coarse-substrate waterways with a fish fauna dominated by madtoms, catfish, darters, chubs, suckers, sculpin, and shiners. Fourteen streams that would be crossed in Oklahoma are considered Class I waters (highest-value regional or statewide fishery) (FWS and Oklahoma Department of Wildlife Conservation 1978). Some of these streams serve as important spawning areas or migration corridors for striped bass. In addition, smallmouth bass and sunfishes provide some sport-fishing opportunity. In Oklahoma, fish spawning activity generally extends from March through July.

The Arkansas, White, and Ouachita river systems flow southeasterly to their confluences with the Mississippi River in Arkansas (Moore 1966). Approximately 44 perennial rivers and 77 intermittent or ephemeral streams would be crossed by the slurry pipeline within these drainages.

Arkansas has the most diverse fish fauna of all the states potentially affected by the pipeline system, with 193 species, 4 of which are not found outside the state's boundary (Buchanan 1973). The Saline River (MP PM-1118), in particular, is considered to maintain one of the most diverse faunas in the southeastern United States (Smith 1980). Common warm water fishes that would be expected to be affected by the proposed action in Arkansas include carp, shad, gar, shiners, minnows, chubs, suckers, darters, catfishes, bass, sunfishes, and crappie. Fish spawning activity generally extends from March through July in Arkansas.

In Louisiana, approximately 134 perennial and 37 intermittent or ephemeral streams and rivers would be crossed by the proposed pipeline system. Five of the eight major drainages in the state would be affected, including the Red-Atchafalaya, Calcasieu, Lafourche, Mississippi, and Mermentau-Teche basins (Douglas 1974).

Approximately 148 freshwater fish species are known to occur in Louisiana. Common rough fishes include various species of chubs, minnows, shiners, and suckers. Common sport fishes that are statewide in distribution include white and black crappie, largemouth and spotted bass, numerous sunfish species, and catfishes. Spawning activity in Louisiana rivers and streams generally extends from March through July.

Aquatic Invertebrates. The aquatic macroinvertebrate fauna of Wyoming rivers and streams was previously described in this section. It is important to note that in general the invertebrate fauna of ephemeral and intermittent streams crossed by the slurry pipeline would be less diverse and less dense than the fauna of perennial streams within the same drainages (Williams and Hynes 1977).

Most of Nebraska's major drainages are characterized by fairly swift-flowing, sand-bottomed streams. Typically, the current in these streams will roll sand along the streambed in the main channel, creating an inhospitable environment for benthic organisms. Therefore species diversity and numbers are much lower in the main stream channels than along the banks and in the backwater areas, as evidenced by Nagel's study of the benthic organisms in the Platte River (Nagel et al. 1974). Typical examples of macroinvertebrates that would inhabit Nebraska's streams and backwater areas include large numbers of immature midges, some damselflies, dragonflies, mayflies, caddisflies, a few aquatic beetles and stone flies, and varying numbers of several orders of worms.

Small, coarse-substrate streams in northern Kansas maintain macroinvertebrate populations of greater density, diversity, and productivity than the large, sand-substrate rivers (Robison and Harp 1971; Hynes 1970; Adams et al. 1976; Harp and Ricket 1977; Wilhm et al. 1978).

The potentially affected streams of southern Kansas, northeastern Oklahoma, and northwestern Arkansas are generally clear, coarse-substrate, often spring-fed streams with moderate to rapid current. The greatest degree of habitat and species diversity and macroinvertebrate productivity is found in the streams and rivers of this region.

The rivers and streams of southern Arkansas and Louisiana are turbid and sluggish, with sand, silt, and clay substrate. These waterways have lower macroinvertebrate density, diversity, and productivity than the Ozark streams. The snail and clam fauna, however, is well established (Burch 1973; Pennak 1978), and crustacean populations (primarily crayfish) are extensive (Hobbs 1976).

Macroinvertebrate populations of the lower Mississippi River include various mayfly, caddisfly, midge, beetle, worm, crustacean, snail, and clam species (Ragland 1974).

Threatened and Endangered Species.

Federally Protected Species. The only federally protected aquatic species of concern is the "fat pocketbook," a freshwater mussel that is considered endangered by the U.S. Fish and Wildlife Service. The fat pocketbook is found in various portions of the Mississippi River drainage (Burch 1973). It has been collected from both flowing and still water habitats with varied benthic substrates, although it seems to prefer flowing water and sand-silt substrates (EPA 1978a; U.S. Army Corps of Engineers 1979). It has been collected from shallow waters of just a few inches to depths of more than 8 feet (Parmalee 1967). Both historical and recent data indicate that the fat pocketbook inhabits the White and St. Francis river basins in Arkansas. These same data, however, suggest that this mussel is a large-river species, and it has been reported as such by the U.S. Army Corps of Engineers (1979), Starrett (1971), and Parmalee (1967). To date, the fat pocketbook has not been reported from ephemeral or intermittent streams or from small and medium-sized perennial streams. Therefore, it is suggested that the only river crossing location where this mussel may be expected to occur would be the White River crossing of the Independence lateral (MP PMB(I)-93).

Two other invertebrates, the Neosho early mussel and the Wheelers pearly mussel, are not federally listed at present but may be proposed in the near future (Chambers 1980).

There are no federally listed species of fish known to occur on the proposed action or alternative pipeline routes.

State-Listed Species. The only state-listed fish that may be affected by the proposed action is the Arkansas darter, which is presently listed as threatened by the state of Kansas and may be proposed for federal protection under the Endangered Species Act. In Kansas, the Arkansas darter is restricted to small prairie streams and streams along the western Ozark border in the Arkansas River drainage (Cross and Collins 1975). Approximately 45 streams would be crossed by the proposed pipeline between MP P-532 and MP P-649 in Kansas, and many of them may sustain populations of Arkansas darters. Spawning activity extends from March through May (Cross and Collins 1975).

Dewatering Plants

In Oklahoma, dewatering plants would be located adjacent to the Arkansas and Neosho rivers. In Arkansas, they would be located adjacent to the White and Arkansas rivers; and in Louisiana, dewatering plants would be located near the Calcasieu, Red, and Mississippi rivers and Castor Lake.

A general discussion of fish, aquatic invertebrates, and threatened and endangered species anticipated to exist in these rivers is included in the preceding discussion of species affected at pipeline river crossings. The invertebrate fauna of Castor Lake would probably be dominated by freshwater worms and various flies.

3.A.6 CULTURAL RESOURCES AND PALEONTOLOGY

A detailed synthesis of the prehistory and history of the region through which the proposed action and alternative pipeline routes would pass is provided in the Cultural Resources Technical Report (WCC 1981h), available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado, 80228. This synthesis includes cultural sequences through time and discussions of previous investigations within a 10-mile wide study corridor. Information on known cultural resources within the 10-mile-wide corridor of the proposed and alternative pipeline routes has been compiled and is presented as estimated sites per square mile. This figure is based upon recorded site reviews and reflects the number of sites listed by all previous inventories in the area rather than the actual number of sites that may be encountered. Figures for alternatives are given only for areas that differ from the proposed action. The estimated square-mile site density figure indicates an approximate number of unrecorded sites that may be encountered during project construction.

Prehistoric resources are discussed for the various project components by state, cultural area, and site type. The proposed slurry transportation project would cross four major prehistoric culture areas: the Plains, the Ozarks, the Lower Mississippi Valley, and the Caddo. These areas are discussed in detail in the Cultural Resources Technical Report (WCC 1981h). Historic resources are discussed by geographic region, major historic theme, and site type.

Paleontological resources that may be traversed by the proposed pipeline in Nebraska are included as an appendix to the Cultural Resources Technical Report (WCC 1981h).

The diversity of human occupation among the culture areas and through time is reflected in a wide variety of site types and locations. A site is a physical location of past human activities. Sensitive areas are those areas likely to contain sites that may be affected by the project. Sensitive areas are identified for the proposed action and alternatives.

Intensive on-the-ground inventories have not been conducted for any proposed or alternative project-related facility. Properties listed in the National Register of Historic Places (NRHP) are presented as Appendix F. Recorded resources not in the NRHP have not been evaluated as to their eligibility for the NRHP.

Preparation Plants and Water Supply System

<u>Prehistory</u>. The preparation plant sites and water supply system lie within the Plains Culture Area. Two sites have been recorded on the 1-square-mile study area for the proposed North Antelope preparation plant site. Large camps, consisting of extensive scatters of lithic artifacts and debitage, are the predominant site type in this area. No sites in the area are currently listed in the NRHP; however, several are considered potentially eligible. Based on known site locations, all areas near or

adjacent to Porcupine Creek, East Fork Porcupine Creek, and their tributaries are considered sensitive. Several sites are located on the shores of ancient, now dry, lake beds. Because of the importance of these former lakes as areas of prehistoric resource exploitation, they are considered to be sensitive.

No sites have been recorded on the 1-square-mile study area for the proposed Jacobs Ranch preparation plant site. Forty-six sites have been recorded within the 160-square-mile distribution water pipeline study area. The predominant site type is the stone circle or tipi ring, representing seasonal or temporary camps. Several larger villages are also present. These represent more permanent settlement within the area. Most of these sites are located along terraces or ridges adjacent to North Prong Little Thunder Creek and Little Thunder Creek. One site is located along Olsen Draw. Although eligibility for the NRHP has not been determined, none of these sites is considered eligible. On the basis of known site locations, the alluvial valleys of the North Prong Little Thunder Creek and Little Thunder Creek are considered to be sensitive. Other potentially sensitive areas include uplands away from the major and minor drainages, which may have provided exploitable prehistoric resources such as lithic materials and game animals.

No sites have been recorded on the 1-square-mile study area for the proposed North Rawhide preparation plant. One hundred eighty six sites have been recorded in the 540-square-mile study area for the distribution water pipeline. The predominant site type is the lithic scatter, representing seasonal or temporary habitation. Stone circles (tipi rings) have also been recorded. One bison jump/kill site has been recorded and is considered eligible for inclusion in the NRHP. Sensitive areas would include any locale that tended to be part of a bison migration route, upland areas (bluff tops, ridges) for lithic resources, and timbered canyons and slopes of river bottoms for winter shelter. Sensitive areas in the immediate area would, then, include terraces and ridges along Rawhide Creek, the Powder River and its tributaries, and all associated alluvial valleys and their upland margins.

The proposed water supply system lies in the Plains Culture Area. Three small, seasonal camps, consisting of lithic debris, fire-cracked rock, and hearths, are located in the proposed Niobrara County well field. No recorded inventories have been conducted within the 290-square-mile distribution water pipeline study area. Sensitive areas are drainage crossings and resource gathering areas in the uplands.

In the vicinity of the water supply system and preparation plants, a 732-square-mile study area was investigated and 237 previously recorded sites were located. Approximate numbers of sites that may be encountered are 0.32 site per square mile, or 1 site every 3 square miles. The predominant site type would be lithic scatter.

History. Native American groups that occupied the region were the Kiowa, Teton Dakota, Northern Arapaho, and Crow. Site types in eastern Wyoming associated with these groups are campsites, butchering sites, and trading areas. Eastern Wyoming was settled by homesteaders between 1870 and 1920. Settlement density in the initial phase of the homesteading wave was approximately four claims per square mile. No recorded historic sites are known to exist on preparation plant sites. Twenty-five historic sites are within the 10-mile study area for the proposed water supply system.

Slurry Pipelines, Pump Stations, and Dewatering Plants

Sensitive areas near the dewatering plant sites, if any, are discussed under the appropriate state.

Prehistory. The prehistory of Wyoming is discussed under Preparation Plants and Water Supply System, above. Sensitive areas are alluvial valleys and drainages, especially the North Platte River in Platte and Goshen counties. Thirty-two sites are recorded within the 1060-square-mile Wyoming study area. Approximate numbers of sites that may be encountered are 0.03 site per square mile, or 1 site per 33 square miles.

In Nebraska the predominant site types are large camps (or villages) with lithic and ceramic scatters, rock cairns, earth lodge villages, and burial grounds. A rock shelter is present. All drainages and alluvial valleys, especially the Niobrara and the North and South Platte rivers, are sensitive. Upland areas may have been utilized as resource gathering areas. Sixty-three sites are recorded as a result of 50 previous cultural resource inventories within the 2715-square-mile Nebraska study area. Approximate numbers of sites that may be encountered are 0.02 site per square mile, or 1 site per 43 square miles. Three sites on the NRHP in the vicinity of the proposed pipeline in Nebraska are Agate Fossil Beds National Monument in Sioux County, Ash Hollow Cave National Historic Landmark within Ash Hollow Historic District in Garden County, and the Lovitt Site in Chase County.

Large camps are also found in Kansas. All drainages and alluvial valleys, especially the Arkansas River and its tributaries, are sensitive. Thirty-nine sites are recorded as a result of over 100 previous cultural resource inventories within the 2731-square-mile Kansas study area. Approximate numbers of sites that may be encountered are 0.01 site per square mile, or 1 site per 70 square miles.

The proposed pipeline route lies within the Plains Culture Area in the northern section of Oklahoma. Near the Arkansas border and in northeast Oklahoma the proposed route enters the Ozark Culture Area. Large camps similar to those in Wyoming and Nebraska are also encountered along the route in Oklahoma. All alluvial valleys and drainages are sensitive, especially Lee Creek, Arkansas River, and Barren Fork Creek. Four hundred ten sites are recorded as a result of over 100 previous cultural resource inventories within the 2534-square-mile Oklahoma study area. Approximate numbers of sites that may be encountered are 0.16 site per square mile, or 1 site per 6 square miles.

The proposed pipeline route lies within the Ozark and Lower Mississippi Valley culture areas in Arkansas. Numerous shelters have been located in bluffs along major streams. Large sites (and villages) seem to occur in alluvial valleys. Other site types that may be encountered are mounds, mortuary sites, petroglyphs, shell middens, and campsites with lithic and ceramic scatters. All alluvial valleys and drainages are sensitive, especially the Arkansas River and its tributaries, the Saline River, and the Ouachita River. Other sensitive areas are river features above the seasonal inundation level, such as natural levees, terraces, knolls, and upland areas. Five hundred ninety-two sites are recorded as a result of several hundred previous cultural resource inventories within the 3545-square-mile Arkansas study area. Approximate numbers of sites that may be encountered are 0.17 site per square mile, or 1 site per 6 square miles.

The proposed pipeline route lies within the Lower Mississippi Valley and Caddo culture areas in Louisiana. All drainages and alluvial valleys that the proposed pipeline would cross are sensitive. Other sensitive areas are natural levees, abandoned river channels, terraces and ridges above and adjacent to major drainages, and other areas that are not seasonally inundated. Site types that may be encountered are camp and village sites, earthen mounds, kill and butchering sites, and fishing areas. Four hundred one sites are recorded as a result of several hundred previous cultural resource inventories within the 3239-square-mile Louisiana study area. Approximate numbers of sites that may be encountered are 0.12 site per square mile, or 1 site per 8 square miles.

History. In the Plains Culture Area, the proposed pipeline would encounter site types associated with nomadic Native American groups that occupied the region, such as kill and butchering sites, hide preparation sites, tipi rings, ceremonial sites, and trading areas. Site types associated with semisedentary groups (part-time farmers) are village sites with associated farming remains, kill and butchering sites, village defense walls, and earthen lodges. In the Ozark Culture Area, the proposed pipeline route passes through the southern portion of the Osage hunting territory in northwest Arkansas. Site types that could be encountered are camps, kill and butchering sites, and lithic scatters. In the Lower Mississippi Valley and Caddo culture areas, site types that may be encountered are villages with associated farming remains, and hunting and fishing areas.

Most of the major historical themes of the western and central United States, from the initial European exploration to the present day, are reflected within the geographic regions that would be traversed by the proposed pipeline. Homesteading, ranching, oil and coal exploration, and westward travel by stage are expressed in known historic resources. In Wyoming, the Wyodak Coal Mine would be traversed by gathering lines near milepost (MP) NR-8 and NR-10.5. The remains of a historic sheep camp are located near MP PMB-4. Black Hills Stage Route is crossed near MP PMB 72. A stopover for the stage route (used between 1876 and 1881) is near MP PMB-72.

The Oregon, Mormon, and Emigrant trails are crossed by the proposed pipeline in Nebraska. Ash Hollow, known as a campground on the Oregon Trail, is approximately 1 mile northeast of MP PMB-246. Remains of the campground, wagon road, cemetery, and sites of Fort Grattan and a fur trading post are a part of the Ash Hollow Historic District. California Hill, an important place on the Oregon Trail, is near MP PMB-258. The proposed route crosses the Santa Fe Trail at MP P-530 in Kansas.

3.A.7 AGRICULTURE

The proposed (and alternative pipeline) routes would traverse and have surface facilities located on irrigated and nonirrigated cropland, native rangeland (used for livestock grazing), and woodland areas. Acreages and mileages for cropland and vegetation types affected by the proposed action (and each alternative) are shown in Table 4-16 in Section 4.A.4.

Soils in the northern portion of the project area are used primarily as native rangeland (livestock grazing) and, to a lesser extent, for nonirrigated cropland and irrigated cropland along major streams and on upland areas where ground water is available. Winter wheat, corn, other feed grains, sugar beets, beans, potatoes, and alfalfa are the main crops.

Soils in the central portion of the proposed project area are used primarily for nonirrigated cropland, native rangeland, and, to a lesser extent, irrigated cropland along major streams and on upland areas where ground water is available. Winter wheat, grain sorghum, corn, sugar beets, beans, potatoes, and alfalfa are the main crops.

Soils in the southern portion of the project area are used primarily as woodland (some grazing) and, to a lesser extent, cropland. Cash crops such as cotton, corn, other feed grains, and rice are some of the main crops.

Prime Agricultural Land

Since all surface facilities associated with the proposed project could potentially take agricultural land out of production for the life of the project (50 years), each major surface facility location was evaluated to determine whether it was prime agricultural land. Some areas that qualify as potential prime agricultural land are not actually prime, due to factors such as present land use, lack of an adequate irrigation system, or high frequency of flooding. Locations of ancillary facilities such as microwave towers and high-voltage transmission lines were not evaluated for agricultural land potential because of their insignificant size. The three proposed coal slurry preparation plants in Campbell County, the proposed well field and pump station in Niobrara County, and the pump stations associated with the two water distribution lines in Campbell County would not be located on prime agricultural land (Table 3-21).

Sixteen of the 23 slurry pump stations along the proposed main slurry pipeline would be located on potential prime agricultural land, but three of these sites are on urban and built-up land and thus are not prime (Table 3-21). In addition, several sites are not currently used as cropland. At least one pump station in each state traversed by the proposed main slurry pipeline would be located on potential prime agricultural land.

All nine of the dewatering plants associated with the proposed action system would be located on potential prime agricultural land, but three of these nine sites are on urban and built-up land and thus are not prime. One site is purposely flooded and thus is not prime (Table 3-22). In addition, two other sites are currently not used as cropland.

3.A.8 AIR QUALITY

The affected environment for air quality discussed below for the proposed action route and facilities also applies to the market alternative. Similarly, the affected environment for the proposed action Niobrara County well field is also applicable for the Crook County, combined well field, and Oahe alternative water supply systems.

Coal Slurry Preparation Plants and Water Supply System

The proposed coal slurry preparation plants and the water supply system would be located in a semiarid area of Wyoming. No significant topographic features separate these project components, and both would be located in rural areas. Thus air quality conditions would be expected to be similar at both sites.

The ability of the atmosphere to disperse pollutants is strongly dependent on wind speed, wind direction, and atmospheric stability. Stability is usually classified into several classes

TABLE 3-21

PUMP STATIONS ON PRIME AGRICULTURAL LAND: PROPOSED ACTION

Pump Station Designation[a]	Milepost[a]	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
NR	NR-0.0	Shingle-Wibaux-Rock Outcrop	Grazing/Wildlife Habitat	No	
NA	NA-0.0	Shingle-Wibaux-Rock Outcrop	Grazing/Wildlife Habitat	No	
N-1	N-0.0	Samsil-Gaynor-Limon	Grazing/Wildlife Habitat	No	
Jacobs Ranch N-2 N-3 PMBC-1	PMBC-0.0	Haverson-Bidman-Glenberg	Grazing/Wildlife Habitat	No	
P-2	PMB-46.1	Manvel-Shingle	Grazing/Wildlife Habitat	No	
P-3	PMB-91.9	Trelona-Vetal-Hargreave	Nonirrigated Cropland/Grazing/ Wildlife Habitat	Yes	Vetal portion only. Must have an adequate irrigation system to qualify as prime.
P-4	PMB-231.1	Colby	Grazing/Nonirrigated Cropland	No	
P-5	PMB-373.9	Holdrege-Keith	Nonirrigated Cropland/ Irrigated Cropland	Yes	Must have an adequate irrigation system to qualify as prime.
P-6	P-408.5	Holdrege-Uly	Nonirrigated Cropland/ Irrigated Cropland/ Grazing	Yes	Must have an adequate irrigation system to qualify as prime.
P-7	P-560.6	Smolan	Nonirrigated Cropland/ Irrigated Cropland	Yes	Must have an adequate irrigation system to qualify as prime.

TABLE 3-21 Continued

Pump Station Designation[a]	Milepost[a]	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
P-8	P-700.0	Bethany-Tabler-Kirkland	Nonirrigated Cropland/ Grazing	Yes	Tabler-Kirkland portion only.
PMB-9	P-807.5	Lula-Summit	Urban Land	Yes	This area is on urban and built-up land, thus not prime.
P-10	P-841.6	Yahola-Port-Reinach	Nonirrigated Cropland/ Irrigated Cropland/Grazing	Yes	Reinach portion only.
P-11	P-911.6	Mountainburg-Enders	Wildlife Habitat/Grazing	No	
Atkins Junction PMB(I)-1 PMB-12	PMB(I)-0.0 PMB-997.4	Pickwick-Leadvale	Grazing/Nonirrigated Cropland/Irrigated Cropland	Yes	
PMB(I)-2	PMB(I)-39.0	Linker-Mountainburg-Hartsells	Grazing/Cropland/ Wildlife Habitat	Yes	Linker portion only.
PMB-13	PMB-1077.6	Savannah-Boswell-Bowie-Shubuta	Urban Land	Yes	Savannah portion only. Does not qualify as prime if frequently flooded. This area is on urban and built-up land, thus not prime.
PM-14	PM-1137.6	Shubuta-Ruston-Alaga	Timber Production/ Grazing/Cropland	Yes	Shubuta-Ruston portion only. Does not qualify as prime if frequently flooded.
PM-15	PM-1203.6	Providence	Timber Production/ Grazing/Cropland	No	Slope range is too high.
PM-16	PM-1257.6	Frizzel-Providence-Guyton	Timber Production/ Grazing	Yes	Does not qualify as prime if frequently flooded.

TABLE 3-21 Concluded

Pump Station Designation[a]	Milepost[a]	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
Alexandria Junction					
PM(B)-1	PM(B)-0.0	Norwood	Woodland	Yes	Does not qualify as prime if frequently flooded. This area is not currently used as cropland.
PM-17	PM-1315.0				
PM(NW)-1	PM(NW)-0.0				
PM-18	PM-1360.0	Crowley-Mowata	Cropland/Grazing	Yes	Does not qualify as prime if frequently flooded.
PM(NW)-2	PM(NW)-75.6	Sharkey-Tunica	Urban Land	Yes	Does not qualify as prime if frequently flooded. This area is on urban and built-up land, thus not prime.
PM(NW)-3	PM(NW)-108.0	Sharkey-Commerce	Cropland/Grazing	Yes	Does not qualify as prime if frequently flooded.

Note: Land use for each pump station location was determined from Soil Conservation Service (SCS) surveys, maps, and publications and from 1:40,000 scale aerial photographs where available. The potential for prime agricultural land was determined from SCS lists and/or publications.

[a]Refer to strip maps in Appendix A for explanation of pump station designations and locations.

Sources: Kansas Agricultural Experiment Station 1973; Oklahoma Agricultural Experiment Station 1959; SCS 1967a, b; 1970a, b, c; 1974a; 1975a; 1977a, b, c, d, e; 1978a, b, c, d, e; 1979a, b, c; undated; U.S. Bureau of Chemistry and Soils 1924.

TABLE 3-22

DEWATERING PLANTS ON PRIME AGRICULTURAL LAND: PROPOSED ACTION

Dewatering Plant	Milepost[a]	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
Ponca City	P-700.0	Bethany-Tabler-Kirkland	Nonirrigated Cropland/ Grazing	Yes	Tabler-Kirkland portion only.
Pryor	P-807.5	Lula-Summit	Urban Land	Yes	This area is on urban and built-up land, thus not prime.
Muskogee	P-841.6	Yahola-Port-Reinach	Nonirrigated Cropland/ Irrigated Cropland/Grazing	Yes	Reinach portion only.
Independence	PMB(I)-93.0	Dundee-Dubbs	Cropland	Yes	Dubbs portion only. Does not qualify as prime if frequently flooded.
White Bluff	PMB-1077.6	Savannah-Boswell-Bowie-Shubuta	Urban Land	Yes	Savannah portion only. Does not qualify as prime if frequently flooded. This area is on urban and built-up land, thus not prime.
New Roads	PM(NW)-75.6	Sharkey-Tunica	Urban Land	Yes	Does not qualify as prime if frequently flooded. This area is on urban and built-up land, thus not prime.
Wilton	PM(NW)-141.5	Commerce-Sharkey	Cropland (flooded)/ Woodland	Yes	Does not qualify as prime if frequently flooded. This area appears to be purposely flooded, thus not prime.

TABLE 3-22 Concluded

Dewatering Plant	Milepost[a]	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
Boyce	PM(B)-24.0	Norwood	Woodland	Yes	Does not qualify as prime if frequently flooded. This area is not currently used as cropland.
Lake Charles	PM-1404.0	Wrightsville-Acadia Bibb-Mantachie	Timber Production/Grazing	Yes	Wrightsville-Acadia portion only. Does not qualify as prime if frequently flooded. This area is not currently used as cropland.

Note: Land use for each dewatering plant location was determined from Soil Conservation Service (SCS) surveys, maps, and publications and from 1:40,000 scale aerial photographs where available. The potential for prime agricultural land was determined from SCS lists and/or publications.

[a]Refer to strip maps in Appendix A for location of dewatering plants.

Sources: Oklahoma Agricultural Experiment Station 1959; SCS 1967b, 1970c, 1971, 1972a, 1975a, 1977c, f, 1978e, 1979c, undated.

(Pasquill 1961; Turner 1964), ranging from extremely unstable (Class A) to extremely stable (Class G). The National Climatic Center has published frequency distributions of wind speed, wind direction, and stability (STAR programs). The STAR (stability array) program for Casper shows that the area has good dispersion conditions, with neutral or unstable conditions (Classes A-D) occurring about 76 percent of the time on an annual average (U.S. Department of Commerce 1973). Another indication of good dispersion conditions is high afternoon mixing depth. Mixing depth is an indication of the depth of the layer in which pollutants are free to disperse. According to a study by Holzworth (1972), annual average mixing depth for the area is about 2200 meters, well above the national average. Because of similarities in topography and climate at the plant sites and at Casper, dispersion climatology at Casper is expected to represent that at the coal preparation plant sites.

The proposed coal preparation plants would be located in a rural area within the Wyoming Intrastate Air Quality Control Region (EPA 1972). This area has been designated as being "better than national standards" or "cannot be classified" for all criteria pollutants (EPA 1978b). Measurements of total suspended particulates have been made in the vicinity of the plant sites. These data indicate an annual geometric mean concentration of about 20 to 25 micrograms per cubic meter ($\mu g/m^3$) (ETSI 1979), which is below the Wyoming state standard of 60 $\mu g/m^3$.

Few measurements of gaseous pollutants have been taken in the project vicinity. Sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) measurements taken at Casper indicate annual average concentrations of about 6 $\mu g/m^3$ and 26 $\mu g/m^3$, respectively; maximum 24-hour SO_2 concentrations were about 28 $\mu g/m^3$, (Wyoming Department of Environmental Quality 1979). These values are far below both federal and state standards. No measurements of ozone or carbon monoxide are available for the vicinity of the proposed preparation plants; however, concentrations are expected to be well below standards.

<u>Slurry Pipelines and Pump Stations, Dewatering Plants, and Ancillary Facilities</u>

Air quality conditions along the proposed pipeline route, including dewatering plants and ancillary facilities, are discussed below.

According to the National Climatic Center STAR programs available for the project region, good dispersion conditions exist along the proposed pipeline route. Neutral to unstable conditions (Classes A-D) occur from about 76 percent of the time on an annual basis at Casper to about 58 percent of the time at Baton Rouge.

Holzworth's (1972) study of mixing depths in the United States indicates that mean annual afternoon mixing depths in the region of the proposed route range from about 1200 meters to 2000 meters, with most areas having mixing depths above the national average.

The proposed pipeline route would cross 15 different air quality control regions, as designated by the EPA (1972). Currently nearly all of these regions are designated as "better than national standards" or "cannot be classified" for total suspended particulates (TSP). Portions of Tulsa and Mayes counties in Oklahoma and parts of Pulaski and Sebastian counties in Arkansas are the only regions that at present do not meet the National Air Quality Standards for TSP.

The air quality along the proposed route was assessed from ambient air quality monitoring data available from various agencies in the states through which the pipeline route is proposed to pass. Because of the rural setting of the proposed route, little information is available. Measurements taken in the project region, and considered representative of the proposed route, indicate that TSP concentrations are occasionally in violation of state and federal standards. Annual TSP concentrations range from about 53.1 $\mu g/m^3$ at Gillette to 73.6 $\mu g/m^3$ at Tulsa. It should be noted that these measurements may have been influenced by some isolated industrial sources and may indicate greater concentrations than would be expected along the pipeline route. However, occasional violations of the 24-hour TSP standard may occur as a result of natural windblown dust.

3.A.9 RECREATION RESOURCES

For purposes of this assessment, recreation resources are defined as areas that are managed by federal, state, or local agencies to preserve and further their use for play, amusement, or relaxation. Attention here focuses on managed areas where the recreation experience could be directly or indirectly affected by the proposed action. Included in those areas judged most significant are managed recreation lands actually traversed by the proposed pipeline route and areas where construction activities would be highly visible from the recreation site or access road, thereby affecting the natural scenic qualities of the landscape (an important element in the recreation experience, in many instances). Because of the importance of water-related activities, rivers, lakes, and reservoirs within close proximity to pipeline activities were also considered significant recreation resources.

The recreation areas under the management of various federal, state, county, and city agencies have been inventoried. Particular attention has been given to the following recreation resource concerns: (1) state-proposed or existing natural and scenic rivers; (2) rivers that have been inventoried by the former Heritage Conservation and Recreation Service in the Nationwide Rivers Inventory, Phase I (HCRS 1981a, 1981b) (this inventory program is now under the jurisdiction of the National Park Service); (3) major trails that are either proposed, under study, or existing under a state or federal system; (4) proposed or designated National Natural Landmarks; and (5) other recreation resource concerns (e.g., hunting, state parks and recreation areas, county and city recreation facilities, etc.).

<u>Coal Slurry Preparation Plants and Water Supply System</u>

The area that would be affected by the preparation plants is principally in Campbell County, Wyoming. Outdoor natural recreation facilities in and near the county include state parks, reservoirs, and streams (Table 3-23). With the exception of hunting, opportunities for these outdoor natural activities within the county are limited. The county is particularly deficient in public access to streams and reservoirs that can be used for recreation. Only 7 percent of the total stream miles and 26 percent of the total surface water acres used for recreation are public. Consequently, many Campbell County residents travel to neighboring counties for natural outdoor recreational experiences (BLM 1978).

Popular recreation areas outside the county include Big Horn National Forest in Sheridan and Johnson counties, the Devils Tower National Monument, Black Hills National Forest, and Keyhole State Park in Crook County. These recreation areas account for more than a million visitor days per year (Table 3-24).

TABLE 3-23

OUTDOOR NATURAL RECREATION FACILITIES IN OR NEAR CAMPBELL COUNTY, WYOMING

	Campbell County	Neighboring Counties[a]
Recreation Areas (acres)		
U.S. Forest Service	158,042	1,124,275
National Park Service	0	1,347
Bureau of Land Management	236,067	792,524
State Parks	0	4
Private	1,131,737	1,966,380
Total	1,525,846	3,900,644
Surface Water (acres)		
Alpine Lakes and Reservoirs	0	2,969
Lowland Lakes and Reservoirs	338	12,317
Farm Ponds	68	469
Total	406	15,755
Streams (miles)		
Public	10	649
Private	134	919
Total	144	1,568
Camping		
Family Sites	80	1,133
Capacity	400	5,665
Picnicking		
Family Sites	0	174
Capacity	0	870
Group Sites	0	50
Capacity	0	250
Swimming Sites	NA	1
Boating Sites	NA	3
Historic Areas	1	18

Source: Oblinger-McCaleb 1980.

NA = data not available.

[a]Includes Crook, Johnson, Sheridan, and Weston counties.

Generally, between 60 and 75 percent of all visits to the recreation areas are made by Wyoming residents. In the future, fuel uncertainties and increased costs of travel may limit the distance people would be willing to travel for recreation. If residents of the Campbell County area made fewer trips to Yellowstone and Teton national parks in northwest Wyoming, for example, the effect might be an increase in visits to nearby recreation areas (Table 3-24).

Hunting for pronghorn antelope is a major recreational activity in Campbell County. In 1978 about 16 percent (over 9000 antelope) of the state's antelope harvest occurred in this county. During the same year, about 10,000 people hunted antelope in this county; this represented about 20,000 hunter days. Approximately 45 percent of the antelope hunters were county residents. Between 1976 and 1978, the number of hunting permits available decreased by 8 percent, from about 12,000 to 11,000 (Wyoming Game and Fish Commission 1979). During the same period, population in the county increased by 31 percent, resulting in increased hunting demand, greater competition for a limited number of permits, and reduced hunting opportunities for residents (BLM 1978).

Slurry Pipelines and Pump Stations, Dewatering Plants, and Ancillary Facilities

Pipeline-related activities would cross or be near 15 managed or proposed federal, state, and county recreation areas (Table 3-25).

Fifteen rivers having scenic or recreational value would be crossed by the proposed pipeline route (Table 3-26). Of these, 7 rivers were identified in the HCRS Nationwide Rivers Inventory, Phase I (HCRS 1981a, 1981b). The additional rivers, some of which are in the Nationwide Inventory Program, are those identified as having the potential for inclusion into a state rivers system, or those rivers designated and under protection by state (Louisiana) law.

In addition, 16 major trails that would be crossed by the proposed slurry pipeline (Table 3-27) have historic, scenic, or recreation value. Many of these trails are included in state proposed plans. Since no significant impacts which would impair the recreation experience are expected, a complete listing of state trails is not presented here. Those trails having potential or existing national protection status are identified for informational purposes only.

Three National Natural Landmarks (NNL), either under proposed status or designated, would be crossed by the proposed slurry pipeline. Three additional proposed NNL's would be within 5 miles of the slurry pipeline. These NNL's are listed in Table 3-28.

No dewatering plants would be located in formally designated recreation areas.

The only ancillary facilities that could affect the recreation experience are proposed microwave communication towers along the southern ridges of Carter Mountain next to the Ozark National Forest in Arkansas and next to the Alexander State Forest in Louisiana. Additional microwave communication towers are proposed adjacent to rivers inventoried under the Nationwide Rivers Inventory Program (Big Piney Creek and Saline River).

3.A.10 TRANSPORTATION NETWORKS

All paved roads and railroads in the project vicinity were inventoried to identify transportation segments that

TABLE 3-24

CURRENT AND PROJECTED VISITOR USE OF PUBLIC RECREATION AREAS NEAR CAMPBELL COUNTY, WYOMING

Recreation Area	County	Visitor Days[a]			
		Current	1980	1985[b]	1990[b]
Big Horn National Forest	Sheridan, Johnson	845,800[c]	909,000	1,030,000	1,150,000
Black Hills National Forest	Crook	136,000[c]	146,000	165,000	185,000
Devil's Tower National Monument	Crook	43,302[d]	51,000	75,000	99,000

Source: Foster 1980; Oblinger-McCaleb 1980; Wyoming Recreation Commission 1980.

[a]A common unit of measurement for recreation, representing 12 hours in activity (e.g., 3 people visiting a historic area for 4 hours equals 1 visitor day).

[b]Linear extrapolation based on recent five-year trends.

[c]1978 data.

[d]1979 data.

TABLE 3-25

MANAGED RECREATION AREAS CROSSED BY OR WITHIN
5 MILES OF THE PROPOSED PIPELINE ROUTE

State	Milepost[b]	Recreation Area
Nebraska	PMB-248	Ash Hollow Historic Park[a]
Kansas	P-394	Oberlin-Sappa State Park[a]
	P-512	Walnut Creek Proposed Recreation Area[a]
	P-591	Kingman County State Lake[a]
Oklahoma	P-770—P-779	Will Rogers State Park[a]
	P-825—P-830	Fort Gibson Lake, Sequoyah State Park[a]
	P-850—P-866	Tenkiller State Park and Reservoir[a]
	P-860—P-865	Spaniard Creek Public Use Area at Webber's Falls Reservoir[a]
Arkansas	P-870—PMB-997	Ozark National Forest[a]
	PMB(I)-36—PMB(I)-60	Greers Ferry Reservoir and Recreation Area[a]
	PMB-1015	Petit Jean State Park, Point Remove Park[a]
	PMB-1021—PMB-1040	Ouachita National Forest[a]
	PM-1288	Kisatchie National Forest, Catahoula Lake[a]
Louisiana	PM-1312—PM-1320	Alexander State Forest[a]
	PM-1400	Sam Houston State Park[a]

[a]Not crossed by but within 5 miles of the right-of-way.

[b]See Appendix A for locations of recreation areas.

TABLE 3-26

SCENIC AND RECREATIONAL WATERWAYS[a] CROSSED: PROPOSED ACTION

State	Milepost[b]	River/Creek
Kansas	P-532	Arkansas River[d]
	P-565	N. Fork Ninnescah River[d]
	P-610	Chikaskia River[d]
Arkansas	PMB-929	Mulberry River[c,d]
	PM-964	Spadra Creek[d]
	PMB-972	Big Piney Creek[c]
	PMB-982	Illinois Bayou[c,d]
	PM-1120 and PM-1162	Saline River[c,d]
	PMB-(I)-30	Cadron Creek[d]
	PMB-(I)-60	Little Red River[c]
	PMB-(I)-67	Big Creek[c]
	PM-1092	Bayou Bartholomew[d]
Louisiana	PM-1199	Bayou Bartholomew[e]
	PM-1288	Little River[e]
	PM-1330	Spring Creek[c,e]

[a]Scenic and recreational waterways as defined by U.S. Heritage Conservation and Recreation Service or a state agency.

[b]See Appendix A for locations of protected waterways.

[c]Heritage Conservation and Recreation Service, Department of the Interior, Phase I Nationwide Rivers Inventory (1981a, 1981b).

[d]State river identified for study.

[e]State-protected river.

TABLE 3-27

MAJOR TRAIL CROSSINGS: PROPOSED ACTION

State	Name of Trail
Nebraska	Pioneer Mormon[a]
	Oregon Trail[a]
	Sidney-Deadwood Trail[b]
	Overland Stage-Denver Road[b]
Kansas	Santa Fe[b,c,d]
	Mormon Battalion[c]
	Old Cattle Trails[b,c,d]
	Parallel Road[b]
	Leavenworth Pikes Peak Express[b]
	Smoky Hill Trail[b]
Oklahoma	Old Cattle Trails (Western National Historical Trail)[c,d]
	Indian Nations[e]
	Texas Road (East Shawnee)[b]
	McClellan-Kerr Navigation System[f]
	Camp Grubber-Greenleaf Lake Trail[f]
	Tenkiller/Illinois/Barren Fork Rec. Trail[f]

[a]Existing Historic Trail, National Trails System Act (NTSA).

[b]Existing state trail.

[c]Studies complete, not recommended for designation (NTSA).

[d]House of Representatives Proposed Bill (HR80-87) trails legislation introduced for NTSA inclusion.

[e]Trail under study (NTSA).

[f]Proposed state trail.

TABLE 3-28

NATIONAL NATURAL LANDMARKS CROSSED BY OR WITHIN 5 MILES OF PROPOSED PIPELINE ROUTE

Milepost[e]	State/County	Name
PMB-40 to PMB-60	Wyoming/Niobrara	Lance Creek Fossil Area[a,b]
PM-70	Wyoming/Niobrara	Hat Creek Break[a,c]
PMB-190 to PMB-210	Nebraska/Garden and Morrill	Oshkosh Prairie[a,c]
PMB-990	Arkansas/Pope	Cagle Rock[c,d]
PMB(I)-80	Arkansas/Independence	Salado Creek[c,d]
PMB-1015	Arkansas/Conway	Cedar Creek Canyon[c,d]

[a] Crossed by proposed route.

[b] Designated National Natural Landmark.

[c] Potential National Natural Landmark.

[d] Within 5 miles of proposed route.

[d] Refer to Appendix A for locations of National Natural Landmarks.

would be affected by construction, operation, maintenance, and abandonment of the proposed action. The status of the roads (whether interstate or state highway, and whether they are scenic or provide limited access to towns or recreation areas) was determined. In addition, railroad rights-of-way that would be crossed by the proposed pipeline were inventoried. The only segments of the transportation system that would be significantly affected by project-related activities are in the vicinity of the preparation plants and are described below.

Coal Slurry Preparation Plants

The principal means of access to all three preparation plants would be Wyoming State Highway 59. The North Rawhide preparation plant would be reached by Highway 59 north from Gillette, and both the Jacobs Ranch and North Antelope preparation plants would be reached by Highway 59 south of Gillette (see Maps A-1 through A-3 in Appendix A). The two southern plants are approximately 15 miles from the main highway, with immediate access provided by local county roads.

Highway 59, also known as Douglas Highway, is an element of the Federal Aid Primary system and is the main route connecting Douglas and Gillette. This road is currently under heavy use because of railroad construction in the area (the Burlington Northern and the Chicago and North Western railroads) as well as traffic related to the several coal mines between the two cities.

Highway 59 is a two-lane road, except for a five-mile portion immediately south of Gillette that has four lanes. Nearly 80 percent of the road has been rebuilt or is presently under contract. The remaining 20 percent of the road is planned for reconstruction within the next three to five years. This portion represents three segments of road: around the community of Bill, near the Reno Junction, and just south of Gillette. Currently the road is used for movement of heavy equipment used in oil and mining activities, which has contributed to degradation of the surface.

Highway 450 extends westward from Newcastle through Weston County toward the Jacobs Ranch and North Antelope preparation plant sites. Highway 450 is a two-lane road that would provide access to these two sites from Newcastle.

3.A.11 VISUAL RESOURCES

Visual resources are the physical characteristics of a landscape that determine its scenic quality and relevant value to the viewing public. These characteristics are frequently described according to the form, line, color, and texture of the natural features in the environment (landform, vegetation, water, soils) that make up a specific landscape scene.

Since the term "scenic" implies exposure to human sensory experience, the visual resources for this project will include only those landscapes within the "seen area" of human use (highways, rivers, trails, recreation areas, and human developments). This section will focus on identifying and describing particularly sensitive visual resources, such as mountainous regions, steep slopes, waterways, valleys, heavily forested areas, and landscapes with fragile vegetation. Special attention is also given to areas already identified as having high scenic quality, such as wilderness areas, parks, scenic roadways, natural and scenic creeks and rivers, natural and historic landmarks and trails identified by the former Heritage Conservation and Recreation Service or state agencies (Tables 3-25 through 3-28), and the public lands under the jurisdiction of BLM and rated a protected status under the agency's visual resource management (VRM) program. Ratings are derived by assessing (1) the inherent quality of the landscape, (2) the sensitivity of visual resources to modification, and (3) the distance from areas of human use. Ratings imply the level of management required for maintaining visual quality.

Most of the land that would be used for the proposed project is private rather than public; standard BLM inventory information (VRM classifications) was available only for the BLM-managed land in Wyoming. However, the basic procedure used by BLM for identifying visual resources is applied throughout. Resource material for this portion of the assessment included U.S. Geological Survey topographic maps, state roadway maps, national and state natural river listings, the ETSI pipeline right-of-way log, and input from other technical disciplines (particularly biology, recreation, transportation, and cultural resources).

The existing visual resources within the affected environment along the proposed route were examined for the following facilities: coal preparation plants, water supply system, slurry pipelines, and pump stations (by milepost), and dewatering facilities and ancillary facilities (e.g., microwave towers). Existing visual resources are described in detail below only for those landscapes where pipeline facilities would cause significant or long-term visual impacts. Areas where pipeline facilities were determined to have visual impacts but landscapes were not considered of particular scenic value (either because they had already been degraded by human activity or they did not exhibit any pronounced visual characteristics) included: the preparation plants; portions of the pipeline right-of-way, including the New Roads, Baton Rouge, and Wilton laterals; pump stations; the Ponca City, Pryor, Muskogee, White Bluff, Baton Rouge, and Lake Charles dewatering plants; and the Cypress Bend barge loading site. (The Baton Rouge lateral and dewatering plant and the barge loading site are part of the market and/or Cypress Bend pipeline-barge alternatives rather than the proposed action.)

Water Supply System

The water well field site is located in rolling rangeland with few visual features of special note. U.S. Highway 85 (5 miles away) and several scattered ranch dwellings are the nearest areas of human use in the vicinity of the proposed well field.

Slurry Pipelines and Pump Stations

The following discussion of the affected environment is by pipeline milepost designation for the proposed action.

MP PMB-91 and Pump Station P-3 (MP PMB-91.5). This section of the proposed pipeline and this pump station intersect three human use areas--U.S. 20 from Lusk, Wyoming, to Crawford, Nebraska; the Niobrara River (a prime rainbow trout spawning ground and sport fishing stream); and the Chicago and Northwestern railroad.

The Niobrara River at this point is sluggish and clear. The surrounding landscape is made up of short-grass range with some agriculture and is slightly rolling terrain. The area is primarily natural, with a few ranches scattered nearby. The town of Lusk is about 15 miles to the northwest. The overall visual image is one of openness, with little variation in texture, form, and color, except for that introduced by the understory and low brush along the river.

MP PMB-265. This pipeline segment intersects U.S. 30, the South Platte River, and I-80 5 miles from the town of Ogallala and 3 miles from Brule, Nebraska. The river is a recreation resource for fishing, boating, and other activities.

The riparian zone, or riverbank, has cottonwoods and a dense understory, providing interesting texture, color, and form along the scenic riverscape.

MP PMB-360. This segment intersects U.S. 6/34 midway between the towns of Culbertson and McCook, Nebraska, and crosses the Republican River (a Class II water--of high value as a fishery resource). The riparian zone is densely vegetated with cottonwood, willow, elm, locust timber, and understory. The river is clear, with a sand bottom and a sufficient velocity to create ripples and other sense of action, providing high-quality color and texture. The landscape characteristics along this segment have high scenic quality, with diversity in color, texture, and line.

Pump Station P-8, MP PMB-373.9. This site is adjacent to U.S. 83 south of McCook. The surrounding terrain is rolling farmland. Visual features are high ridges to the west and east, creating a definitive visual border and enclosed view of the landscape.

MP P-434 to P-436. This segment crosses U.S. 24 (scenic highway), Union Pacific railroad, and the South Fork of Solomon River 6 miles west of Hill City, Kansas. The riparian vegetation includes large cottonwoods with dense understory. The river is sluggish and somewhat turbid. The surrounding terrain is hilly with a variety of vegetation; it is considered of high scenic quality because of the interesting color, textures, and form of the landscape.

MP P-445, P-486, P-496, P-508, P-515, P-530. These segments would intersect several major roadways: U.S. 283, I-70, U.S. 183, State Highways 4 and 96, and U.S. 56 (scenic). Nearby towns are LaCross, Great Bend, and Ellis, Kansas. The Walnut Creek area is a proposed state recreation area. These segments of the proposed pipeline would also cross several rivers and creeks with dense vegetation (willow bush, cottonwood, and understory). Since surrounding landscapes are primarily dryland farms and open, rolling range, the colorful and richly textured riverbeds offer scenic diversity and constitute focal points on the landscape and are therefore high-quality visual resources.

Pump Station P-10, MP P-560. This site is adjacent to U.S. 83 near Stafford, Kansas. The surrounding terrain is rolling farmland. High ridges to the west and east create a visual border and enclosed view of the landscape.

MP P-591. The proposed pipeline would cross U.S. 54 six miles west of Kingman, Kansas, very close to the Kingman County State Lake camping and recreation area. This site is about 40 miles from the metropolitan area of Wichita. The Kingman State Lake and the Ninnescah River landscapes are well vegetated and of high scenic quality (as evidenced by the presence of a state recreation area). The diversity in color offered by the presence of water and the rich textures of a variety of vegetation provide interesting landscape features for human enjoyment.

MP P-610. The proposed pipeline would cross the Chikaskia River near State Highway 14. The Chikaskia has been inventoried for study by the state and the

HCRS for protection as a natural and scenic river. It has good flow and a sand bottom and is densely vegetated, providing a rich variety of color, texture, and line.

MP P-761. This portion, located on the Osage Indian Reservation, would intersect State Highway 11 four miles north of Skiatook, Oklahoma. Rolling hills, forested with nonmerchantable oak and brush, and rock outcroppings characterize this landscape. The composition is one of interesting texture and pattern. Oil wells are scattered throughout, moderately reducing the visual quality of the otherwise natural setting.

MP P-770 to P-779. This proposed segment would pass 1 mile below Oologah Lake, 3.5 miles from State Highway 88, and along the southern border of Will Rogers State Park. The nearby Verdigris River is approximately 300 feet of open water with a well-vegetated riparian zone. The surrounding landscape is woodlots and farmland to the west and scenic Oologah Lake to the north. This is a high-quality landscape offering a picturesque composition of interesting colors, textures, and forms.

MP P-808. This segment would intersect State 33 just south of the Grand River crossing 3 miles south of Chouteau and 9 miles from Pryor, Oklahoma. The Grand River is a commercial and sport-boating water. The Grand (Neosho) River is a river drainage of Lake Hudson. The river crossing is 500 to 600 feet of open water with steep-ledge rock banks. The riparian zone is heavily timbered on both sides of the river.

MP P-838. The pipeline would cross the Neosho River approximately 1 mile from Highway 2 and 4 miles north of Muskogee, Oklahoma. This is a densely vegetated scenic area with abundant waterways and recreation sites.

MP P-850 to P-866. This segment would pass 8 miles south of Muskogee and 4 miles east of U.S. 64 along the Arkansas River. It would be visible primarily from the Muskogee Turnpike, which the pipeline would parallel along this segment. Tenkiller State Park and reservoir are on the other side of the river, adding significantly to the value of the landscape features. The high-quality scenic river landscape characterizes this segment of the proposed pipeline route. There is dense vegetation in the riparian zone. Spaniard Creek and the Webbers Falls Lock and Dam provide additional scenic attributes.

MP PMB-929. The pipeline would pass less than 1 mile from Pleasant Hill, U.S. 64, and I-40 (scenic). The riparian zone of the Mulberry River is well vegetated; the terrain is flat to rolling. The river has been identified for study as both a state and nationally designated river. Ozark National Forest is directly to the north.

MP PMB-960 to PMB-999. This segment would parallel I-40 and cross several state roadways and paved county roads. There is scattered residential development in the surrounding landscape, which is south of Ozark National Forest and Recreation Area. The segment would pass just north of Clarksville, Dardanelle Lake, and Russellville, Arkansas. The right-of-way would cross the Spadra Creek, which has been identified for study as a state scenic river.

Piney Creek and the Illinois Bayou have both been inventoried as candidates for the status of scenic rivers by the Heritage Conservation and Recreation Service. In addition, the Illinois Bayou has been identified for further study by the state. Coniferous forests are noticeable in the landscape; the scenic Ozark National Forest is in the background to the north, and Dardanelle Lake is to the south. The combination of the forested mountains in the background and the scenic rivers in the foreground makes this landscape rich in color, texture, and form.

Independence Lateral: PMB-(I)-36 to PMB(I)-60. This segment of the pipeline runs through the foothills south of the Boston Mountain range and Ozark National Forest to the southern tip of Greers Ferry reservoir. The right-of-way crosses Cadron Creek and the Little Red River, waterways with high scenic qualities and that are being studied for special designation. The Greers Ferry reservoir is a popular recreation area in Arkansas. The landscape is characterized by rich color and texture from lush vegetation surrounding each of the above-mentioned waterways.

MP PMB-1013. This segment of pipeline would cross the Arkansas River between Point Remove Park and Petit Jean State Park, southwest of Morrilton and 1 to 2 miles north of State 154. This is a high-quality scenic landscape situated between two parks and along the Arkansas River. Its heavily vegetated and rolling terrain offers a scenic backdrop to the river landscape.

MP PMB-1021 to PMB-1030. This segment would parallel State 9 and cross State 10 leading to Ouachita National Forest and campgrounds (a recreation area used by residents and visitors in the Little Rock metropolitan area).

The proposed pipeline would cross the Fourche LaFave River (MP PM-1022), where vegetation is abundant. The terrain in this area is heavily forested, with rolling to mountainous topography in the background. The visual quality is high, with primarily undisturbed natural features.

MP PM-1199. The pipeline would cross Bayou Bartholomew approximately 2 miles north of U.S. 165 and the town of Perryville, Louisiana, and 12 miles north of the city of Monroe, Louisiana. Bayou Bartholomew has been identified as a state scenic river and is characterized by a large variety of lush vegetation and by diversity in color and texture.

MP PM-1288. This segment would cross the Louisiana scenic Little River at State 127, east of Kisatchie National Forest and northeast of Pineville, and the access road to Catahoula Lake and recreation area. This is a high-quality visual resource landscape, with the scenic Little River and Lake Catahoula as primary natural attributes. Vegetation is abundant, offering a variety of color, texture, and form to the visual setting.

MP PM-1312 to PM-1320. This portion of the pipeline would be near the border of the Kisatchie National Forest and the Alexander State Forest. The pipeline would also cross U.S. 165 south of Alexandria. In addition to its proximity to the national forest, this portion of the pipeline would cross Spring Creek, Bayou Boeuf, and Cocodrie Diversion Channel. This is a high-quality natural setting with diverse vegetation and natural waterways.

Dewatering Plants

All dewatering plants would be located in proximity to existing coal-fired power plants. The descriptions below are of the areas surrounding each site.

Oologah. This proposed plant site is immediately to the south of Oologah Lake and Will Rogers State Park along U.S. 169. It is within 9 miles of the city of Claremore, Oklahoma, and is in a prime recreation area. The scenic quality of the bordering recreation area (Oologah Lake, the Verdigris River, and the state park) is high. Abundant vegetation provides high-quality color and texture in this rolling landscape.

Independence. The proposed plant site is 8 miles outside Newport, Arkansas, along State 69 and the White River. The river landscape has interesting textures, colors, and form provided by dense understory and timber growth. Since the surrounding landscape is flat agricultural terrain, the richly varied river landscape is of increased significance.

Wilton. This proposed plant site is located off State 44 near the town of Romeville; the nearest cities are Donaldsonville and Reserve, Louisiana. The area includes riverside development surrounded by marsh floodplains and vegetation.

Boyce. The proposed plant site is 4 miles outside the town of Boyce along State 8 north of Alexandria, Louisiana. This is a high-quality natural setting surrounded by national forests, lakes, and scenic resources.

Ancillary Facilities

The following listing identifies areas of visual sensitivity where microwave towers would be located along the pipeline routes. Milepost indicators are the closest pipeline reference point.

MP PMB-93. This microwave tower would be adjacent to the Niobrara River, Nebraska, and visible from State 20. This natural setting is characterized by the meandering line of the river and the rich texture and color of the riverbed vegetation.

MP P-677. The proposed microwave site is next to State 11 outside of Blackwell, Kansas.

MP P-700. The proposed microwave site is near the Ponca City terminal in Oklahoma.

MP P-726. This tower would be visible from State 20 and is near the Arkansas River.

MP P-263. The site is next to the Osage reservation.

MP PMB-780. The site is at the southern tip of Oologah Lake and Will Rogers State Park near State 88. It would be visible by recreation visitors using the lake.

MP PMB-946. The site is located adjacent to Ozark National Forest.

MP PMB(I)-30. The proposed site is along the Republican River near State 25.

MP PM-1118. The proposed site is located along the Saline River (a natural river inventoried for protection by HCRS) and State 35 south of the town of Rison.

MP PM-1275. The site is located near the town of Jana and U.S. 84.

MP PM-1301. The site is located northeast of the city of Alexandria near State 28.

MP PM(NW)-1. The site is located near Summerville and Chambers, north of Alexander State Forest.

3.B MARKET ALTERNATIVE

For the following project components, the affected area for the market alternative is the same as the affected area for the proposed action:

- Coal slurry preparation plants
- Water supply system

- Slurry gathering pipelines
- Main slurry pipeline from milepost (MP) PMB-0 to MP PMB-378 and from MP PMB-922 to the seven dewatering plants in common
- Dewatering plants at Pryor, White Bluff, Independence, Boyce, Lake Charles, New Roads, and Wilton

Only the affected areas for the following market alternative components, which are different from the proposed action, are discussed in this section:

- Main slurry pipeline from MP PMB-378 (=MB-0) to MP PMB-922 (=MB-492) and the short pipeline to the Baton Rouge terminal
- Dewatering plants at Oologah and Baton Rouge

3.B.1 WATER RESOURCES

Surface Water

Under this alternative, 17 more intermittent creeks, 25 more minor streams, and 8 fewer major rivers would be crossed compared with the proposed action (WCC 1981c, Table 2-1). Surface facilities within potential 100-year floodplains are listed in Table 3-6.

3.B.2 SOCIOECONOMIC CONSIDERATIONS

Slurry Pipelines and Pump Stations

The counties not discussed under the proposed action that would potentially be affected by pipeline and pump station construction and operation under the market alternative are listed in Table 3-29.

Dewatering Plants

Since the Oologah and Pryor dewatering plants would be constructed within 30 miles of each other a single affected area was defined. Table 3-30 lists those potentially affected areas not discussed before (Section 3.A.2) and gives population and construction employment data for each. Summaries of the Oologah/Pryor and Baton Rouge areas follow.

Oologah/Pryor. The Oologah and Pryor dewatering sites are in Rogers and Mayes counties, respectively. Both counties are in the Tulsa Standard Metropolitan Statistical Area (SMSA), and the sites are approximately 35 miles from Tulsa proper. The area labor pool includes about 12,000 construction workers.

Baton Rouge. The site of the proposed Baton Rouge dewatering plant is located in Baton Rouge, in East Baton Rouge Parish. In 1978, the city of Baton Rouge had a population of 332,000 and the Baton Rouge SMSA had approximately 25,000 workers employed in construction.

3.B.3 VEGETATION

The market alternative would traverse or have permanent facilities located on the same vegetation types as listed for the proposed action in Section 3.A.3. Acreages and mileages for each vegetation type that would be affected are identified in Table 4-19 in Section 4.A.4.

Each of these vegetation habitat types is described in detail in Appendix B of the Terrestrial Biology Technical Report (WCC 1981e). These areas are used mainly for agriculture, livestock grazing, wildlife habitat, and recreation.

3.B.4 WILDLIFE

The primary wildlife habitat types which would be affected by the market alternative and wildlife species of special concern occurring within these types are listed in Table 3-19. Since

TABLE 3-29

COUNTIES IN AREAS POTENTIALLY AFFECTED BY ONLY MAIN SLURRY PIPELINE AND PUMP STATIONS: MARKET ALTERNATIVE

County/Parish	Pump Station	1975 Population	Fiscal Year 1976-77 Tax Revenues ($1000s)
Kansas			
Phillips		7,900	3,108
Rooks		7,300	2,854
Osborne		6,200	1,730
Russell		9,000	4,456
Ellsworth	MB-6	6,200	2,962
Rice		12,000	4,515
McPherson		25,900	8,720
Harvey		29,500	9,556
Sedgwick		351,000	90,077
Butler	MB-7	41,800	11,866
Cowley		34,700	8,986
Chatauqua		4,700	1,366

Sources: U.S. Bureau of the Census 1978, 1979b.

TABLE 3-30

AREAS POTENTIALLY AFFECTED BY CONSTRUCTION AND OPERATION OF DEWATERING PLANTS: MARKET ALTERNATIVE

Dewatering Plant Site	Counties/Parishes in Potentially Affected Area	July 1975 County Population	Area Construction Labor Pool
Oologah/Pryor	Osage	31,390	
	Washington	41,967	
	Rogers	33,671	
	Mayes	27,213	11,985
	(Tulsa)	416,892	
	(Wagoner)	27,225	
	Cherokee	25,143	
	Adair	16,615	
Baton Rouge	W. Baton Rouge	17,522	
	E. Baton Rouge	310,922	24,675

Sources: U.S. Bureau of the Census 1978. Source of state employment agency figures varies by state. For individual state figures, see the Socioeconomics Technical Report (WCC 1981d).

Note: Counties in parentheses would not have project components but would potentially be affected by the project.

the market alternative would traverse the same vegetative habitats as the proposed action, wildlife species encountered would be essentially the same as those described for the proposed action in Section 3.A.4.

The range of the greater prairie chicken in Oklahoma would be traversed by the market alternative between milepost (MP) MB-324 and MB-337 (Short 1980) and MB-365 and MB-375 (FWS 1981).

Threatened and Endangered Wildlife Species

Federal protected wildlife species which could occur in areas that would be affected by the market alternative include the black-footed ferret, bald eagle, peregrine falcon, red-cockaded woodpecker, and American alligator. In addition, two state protected species, the northern swift fox (Nebraska) and interior least tern (Kansas), could also be encountered. Each of these species is described in greater detail in the discussion of the affected environment for the proposed action (Section 3.A.4). Additional information is available in the Threatened and Endangered Species Technical Report (WCC 1981f).

3.B.5 AQUATIC BIOLOGY

Coal Slurry Pipelines and Pump Stations

In Kansas, approximately 26 more perennial streams and 41 intermittent streams would be crossed by the market alternative slurry pipeline than by the proposed action slurry pipeline. Most of the rivers and streams that would be crossed sustain populations of rough fishes (including chubs, minnows, suckers, shiners, and darters) and sport fishes (including catfishes, bass, crappies, and sunfishes).

In Oklahoma, approximately 23 permanent streams and 26 intermittent or ephemeral streams would be crossed by the slurry pipeline. The U.S. Fish and Wildlife Service and the Oklahoma Department of Wildlife Conservation (1978) list 8 streams that would be crossed by the market alternative pipeline as Class I (highest-value fishery resource), including Buck Creek, Verdigris River, Neosho River, Fourteenmile Creek, Illinois River, Barren Fork Creek, Sallisaw Creek, and Lee Creek.

The Illinois River and Barren Fork Creek provide quality fishing for smallmouth bass as well as a variety of other species. Also, the Neosho pearly mussel (Lamsilis refinesqueana) is found in both streams. This species has a very limited range and is of special interest even though it has no legal protection at the present time.

Dewatering Plants

Dewatering plants would be located adjacent to the Verdigris River in Oklahoma and the Mississippi River in Louisiana.

3.B.6 CULTURAL RESOURCES AND PALEONTOLOGY

Except for prehistoric site densities in Kansas and Oklahoma, the discussion for the proposed action (Section 3.A.6) applies to this alternative. Within Kansas, 170 sites are recorded as a result of over 100 previous cultural resource inventories within the 3245-square-mile study area. Approximate numbers of sites that may be encountered are 0.05 site per square mile or 1 site per 19 square miles. Within Oklahoma, 99 sites are recorded as a result of over 100 previous cultural resource inventories within the 900-square-mile study area. Approximate numbers of sites that may be encountered are 0.1 site per square mile or 1 site per 9 square miles. Sites in the vicinity of this alternative in the National Register of Historic Places are given in Table F-2, Appendix F.

3.B.7 AGRICULTURE

The market alternative would include eight slurry pump stations located differently from those associated with the main slurry pipeline for the proposed action. Five of these eight slurry pump stations would be located on potential prime agricultural land in Wyoming, Kansas, and Oklahoma. One of the five sites is on urban and builtup land and thus is not prime (Table 3-31). Refer to Table 4-16, Section 4.A.4, for acreages and mileages of cropland affected.

The market alternative would include two dewatering plants that are not associated with the proposed action. These two dewatering plants, in Oklahoma and Louisiana, would be located on potential prime agricultural land; however, both sites are on urban and builtup land and thus are not prime (Table 3-32).

3.B.8 RECREATION RESOURCES

The following discussion is for the portion of the market alternative slurry pipeline route (and associated dewatering and ancillary facilities) that does not follow the same right-of-way route or facility siting as the proposed action.

Seven managed recreation areas are within 5 miles of the market alternative pipeline route. One of these, Prairie Dog State Park in Kansas, would be approximately 3 miles from the alternative slurry pipeline route at MP MB-36. Additionally, Rooks County State Park in Kansas at MP MB-81 is also within 3 miles of the route (Table 3-33).

Six waterways having scenic and recreational value would be crossed by the alternative pipeline route in Kansas and Oklahoma (Table 3-34). Of these, five rivers have been identified by the Heritage Conservation and Recreation Service in the Nationwide Rivers Inventory, Phase I (HCRS 1981a, 1981b). These five rivers have the potential through future study to be added to the National Wild and Scenic Rivers System. The Barren Fork River, Illinois River, and Big Lee Creek are under protection by the Oklahoma Scenic Rivers Act. The Oklahoma Scenic Rivers Commission has jurisdiction for Barren Fork Creek and the Illinois River. The Caney River is considered to be the most important state recreation river in Kansas (Kansas Governor's Office of Policy and Research 1980).

The market alternative pipeline route would cross eleven major recreation trails (Table 3-35). Two of these, the Santa Fe Trail and the Western National Historic Trail, have as of September 8, 1980, been recommended for inclusion in the National Trails System.

No market alternative dewatering plants would be located in formally designated recreation areas. It should be noted, however, that the Oologah dewatering site would be immediately adjacent to the Will Rogers State Park in Oklahoma. For a discussion of the possible effects to the quality of the recreation experience in this vicinity, see Section 3.B.9 (Visual Resources).

The only ancillary facilities that could affect the quality of the recreation experience are microwave communication towers, which are discussed under the proposed action (Section 3.A.9). The presence of microwave communication towers could alter the visitor's perception of the natural setting. Of particular concern to this alternative route is the tower located next to the Ozark National Forest at MP MB-10. (See Visual Resources, Section 3.B.9, for a list

TABLE 3-31

PUMP STATIONS ON PRIME AGRICULTURAL LAND: MARKET ALTERNATIVE

Pump Station Designation[a]	Milepost[a]	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
MB-2	PMB-60.0	Samsil-Gaynor-Limon	Grazing/Wildlife Habitat	No	
MB-3	PMB-98.0	Trelona-Vetal-Hargreave	Nonirrigated Cropland/Grazing/ Wildlife Habitat	Yes	Vetal portion only. Must have an adequate irrigation system to qualify as prime.
MB-4	PMB-247.0	Colby	Grazing/Nonirrigated Cropland	No	
MB-5	MB-30.0	Holdrege-Uly	Nonirrigated Cropland/Irrigated Cropland/Grazing	Yes	Must have an adequate irrigation system to qualify as prime.
MB-6	MB-172.0	Crete-Hastings-Kipson	Nonirrigated Cropland/Grazing	Yes	Crete-Hastings portion only. Must have an adequate irrigation system to qualify as prime.
MB-7	MB-252.0	Goessel	Nonirrigated Cropland/Grazing	Yes	Must have an adequate irrigation system to qualify as prime.
MB-8	MB-378.0	Parsons-Dennis-Bates/ Sogn-Summit	Urban Land	Yes	Parsons-Dennis-Bates/ Summit portion only. This area is on urban and built-up land, thus not prime.
MB-10	MB-482.5	Mountainburg-Enders	Wildlife Habitat/ Recreation/Grazing	No	

Land use for each pump station site was determined from Soil Conservation Service (SCS) surveys, maps, publications, and 1:40,000 scale aerial photographs (where available). The potential for prime agricultural land was determined from lists and/or publications (SCS), which list on a state-wide or county basis those soil series or associations which meet the criteria to be considered potential prime agricultural land. Some areas that qualify as potential prime agricultural land are not actually prime, due to factors such as present land use, lack of an adequate irrigation system, or high frequency of flooding.

[a]Refer to strip maps in Appendix A for explanation of pump stations and locations.

Sources: Kansas Agricultural Experiment Station 1973; Oklahoma Agricultural Experiment Station 1959; SCS 1967b, 1975b, 1977a, 1978b, c, e, 1979a, b, U.S. Bureau of Chemistry and Soils 1924.

TABLE 3-32

DEWATERING PLANTS ON PRIME AGRICULTURAL LAND: MARKET ALTERNATIVE

Dewatering Plant Designation	Milepost	Soil Association or Series[a]	Land Use	Prime Agricultural Land Potential[a]	Notes
Oologah	MB-378.0	Parsons-Dennis-Bates/ Sogn-Summit	Urban Land	Yes	Parson-Dennis-Bates/ Summit portion only. This area is on urban and built-up land, thus not prime.
Baton Rouge	M-24.6	Olivier-Calhoun-Loring	Urban Land	Yes	Does not qualify as prime if frequently flooded. This area is on urban and built-up land, thus not prime.

Note: Land use for the dewatering plant sites was determined from Soil Conservation Service (SCS) surveys, maps, publications, and 1:40,000 scale aerial photographs (where available). The potential prime agricultural land was determined from lists and/or publications (SCS), which list on a state-wide or county basis those soil series or associations which meet the criteria to be considered potential prime agricultural land. Some areas that qualify as potential prime agricultural land are not actually prime, due to factors such as present land use, lack of an adequate irrigation system, or high frequency of flooding.

[a]Sources: Oklahoma Agricultural Experiment Station 1959. SCS 1972b, 1978e, 1979c.

TABLE 3-33

MANAGED RECREATION AREAS WITHIN
5 MILES OF THE MARKET ALTERNATIVE ROUTE

State	Milepost	Recreation Area
Kansas	MB-36	Prairie Dog State Park
	MB-81	Rooks County State Park & Webster Reservoir
	MB-120	Wilson State Park & Reservoir
Oklahoma	MB-330 to MB-335	Keystone State Park
	MB-347 to MB-366	Osage Hill State Park
	MB-378	Will Rogers State Park (Oologah Lake)
Arkansas	MB-452 to MB-492	Ozark National Forest

TABLE 3-34

SCENIC AND RECREATIONAL WATERWAYS[a] TO BE CROSSED:
MARKET ALTERNATIVE ROUTE

State	Milepost	River/Creek
Kansas	MB-125	Saline River[b]
	MB-291	Grouse Creek[b]
	MB-308	Caney River[b,c]
Oklahoma	MB-437	Illinois River[b,d]
	MB-440	Barren Fork River[d]
	MB-472	Lee Creek[b,d]

Note: See Table 3-26 for waterways crossed by the parts of the market alternative that are the same as that for the proposed action route.

[a]Scenic and recreational waterways as defined by Heritage Conservation and Recreation Service or a state agency.

[b]Heritage Conservation and Recreation Service, Department of the Interior, Phase 1 Nationwide Rivers Inventory (1981a, 1981b).

[c]State river identified for study (Arkansas, Kansas).

[d]State-protected river (Louisiana, Oklahoma).

TABLE 3-35

MAJOR TRAIL CROSSINGS: MARKET ALTERNATIVE

State	Name of Trail
Kansas	Santa Fe[a,b]
	Mormon Battalion[a]
	Old Cattle Trails[a,b]
	Parallel Road[c]
	Leavenworth Pikes Peak Express[c]
	Smoky Hill Trail[c]
Oklahoma	Old Cattle Trails[a,b]
	Indian Nations[d]
	Texas Road (East Shawnee)[c]
	Camp Grabber-Greenleaf Lake Trail[e]
	Oologah Reservoir Trail[e]

[a] Studies complete, not recommended for National Trail System Act designation.

[b] House of Representatives proposed bill (HR80-87) trails legislation introduced for NTSA inclusion.

[c] Existing state trail.

[d] Trail under study (NTSA).

[e] Proposed state trail.

of locations of towers near recreation waterways and park areas.)

3.B.9 VISUAL RESOURCES

MP MB-36 to MB-42. The market alternative right-of-way would intersect U.S. 36 approximately 2 miles west of Norton, Kansas. The route would continue south, crossing Prairie Dog Creek just above the Norton Reservoir and adjacent to Prairie Dog State Park. Riparian vegetation along the creek is thick, with low brush trees. The surrounding landscape is rolling terrain, with equal portions of dryland farming and range.

MP MB-60 to MB-83. The market alternative route would intersect U.S. 24 and U.S. 183 approximately 4 miles west of Stockton, Kansas. It would cross the South Fork of the Solomon River 7 miles downstream from Webster Reservoir and Webster State Park, and immediately adjacent to Rooks County State visual resources, as evidenced by two state parks. The landscape is rolling hills, and the riparian zone of the Solomon River is densely vegetated. The river is clear, with a sand bottom. Color, texture, and line create interesting visual features.

MP MB-115 to MB-137. This segment would be approximately 10 miles northwest of Russell, Kansas, adjacent to Wilson State Park and Reservoir. The pipeline would intersect roadways leading to these recreation areas. This area has rolling to hilly terrain and is well vegetated. There is a scenic area surrounding Wilson Reservoir and the Saline River, which has been inventoried by the former HCRS for potential consideration as a national wild and scenic river.

MP MB-324 to MB-330. This segment would pass south of Cedar Vale and cross the Osage Indian Reservation; it would pass close to a wilderness trail used for hiking and riding. This area is considered one of the more picturesque areas in Kansas. Dense riparian growth along Rock Creek (mostly scattered timber) adds high-quality texture and color to the setting.

MP MB-347 to MB-366. This portion of the pipeline would pass within 2 miles of Bartlesville, Oklahoma, and cross U.S. 60, State 123, and U.S. 75. Osage State Park is 4 to 5 miles west of the proposed pipeline. Scrub oak and cultivated fields provide visual color and texture on the rolling terrain. The Caney River banks are heavily vegetated and steep.

MP MB-417 to MB-427. This pipeline segment would parallel State 82 through a mountainous area used for hiking and camping. This is a high-quality scenic area, abundant with streams from the Neosho River and Lake Hudson drainage. The terrain is hilly to mountainous, with rock outcroppings and a variety of colorful vegetation.

MP MB-440 to MB-446. This pipeline segment would pass near the town of Welling along a county road, about 4 to 5 miles south of Tahlequah. It would pass northeast of Tenkiller Ferry Reservoir and recreation area by 6 to 8 miles. The terrain in this area is mountainous, densely vegetated, and has many streams. The Barren Fork and Illinois rivers are both protected state scenic rivers.

MP MB-482.5 (Pump Station MA-10). The pipeline would cross State 59 midway between Cedarville and Figure Five, as well as an access road into the Ozark National Forest. The background to the north is the Ozark National Forest and mountain range, providing high-quality form, line, color, and texture to this natural setting.

3.C CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

The affected area for this alternative is the same as for the market alternative at the coal slurry preparation plants, water supply system, slurry gathering pipelines, and main slurry pipeline from MP PMB-0 to PMB-1092. The dewatering plants for this pipeline-barge alternative are also served by the market alternative.

Only the affected areas for the following components of the pipeline-barge alternative, which are different from affected areas previously presented, are discussed in this section:

- Main slurry pipeline from MP PMB-1092 to MP B-81 (Cypress Bend lateral)
- Cypress Bend dewatering plant and barge loading facility

The affected areas along this pipeline-barge alternative for the wildlife and air quality resource topics are similar in type and description to the areas in Arkansas already discussed for the proposed action (Sections 3.A.4 and 3.A.8, respectively) and are therefore not discussed in this section.

3.C.1 WATER RESOURCES

This alternative system would cross 75 fewer intermittent creeks, 50 fewer minor and 34 fewer major perennial streams and rivers, and 61 fewer bayous, compared with the proposed action (WCC 1981c, Table 2-1). Surface facilities located within potential 100-year floodplains are listed in Table 3-6.

3.C.2 SOCIOECONOMIC CONSIDERATIONS

Slurry Pipelines and Pump Stations

The counties that make up the socioeconomic environment that would be potentially affected solely by pipeline and pump stations under the pipeline-barge alternative are the same as those listed for the market alternative (Tables 3-16 and 3-29), except that none of the parishes in Louisiana would be affected.

Dewatering Plant

The site of the proposed Cypress Bend dewatering plant and barge loading facility is in Desha County, Arkansas. This is a large agricultural area, with about 58 percent of the county's total acreage devoted to agriculture (Arkansas Department of Local Services 1977). The potentially affected area includes Desha, Drew, Chicot, Ashley, and Lincoln counties.

Population and Employment. The communities nearest to the site are Arkansas City (population 784), 8 miles away, and McGehee, Arkansas (population 4275), 14 miles away. The nearest cities are Greenville, Mississippi (population 42,449), 57 miles away, and Pine Bluff, Arkansas (population 54,631), 77 miles away.

Populations of the five counties in the local study area are shown in Table 3-36. In the 1960s and 1970s Desha County did not experience the growth of other Arkansas counties, and in fact lost population as a result of a decline in agriculture and forest products production.

Desha County, like much of southeastern Arkansas, has been primarily rural and agricultural. Neither the five-county area nor Desha County has a large labor force or a large pool of contract construction workers (Table 3-37). In 1977 the five-county study area had 964 persons and Desha County had 117 persons employed in contract construction. The ten-county southeastern Arkansas labor area, however, had 2724 persons employed in contract construction.

TABLE 3-36

POPULATIONS OF COUNTIES AND CITIES IN THE CYPRESS BEND LOCAL STUDY AREA

County	City	Census 1970 Population	1970 Percent Urban	1975 Population[a]	Population Change 1970-75	Distance to Site (miles)
Lincoln		13,310	0			NA
Desha		18,761	50.1	18,005	-2.7	NA
	Arkansas City			784[b]		8
	McGehee	4,683		4,275	-8.7	14
	Dumas	4,600		5,399	17.4	32
Chicot		18,164	63.1	17,953	-1.1	NA
	Dermott	4,250		4,368	2.8	25
	Lake Village	3,310		3,328	.5	36
	Eudora	3,687		3,538	-4.0	52
Drew		15,157	33.5	17,190	2.5	NA
	Monticello	5,809		6,698	15.3	42
Ashley		24,976	48.8	25,206	.5	NA
	Crossett	6,191		6,290	1.6	78
	Hamburg	3,102		3,146	1.4	63
5-County Total		90,368		78,354	1.6	

[a]Source: U.S. Bureau of the Census 1978.

[b]1979 population; source: Arkansas State Highway and Transportation Department 1979.

TABLE 3-37

EMPLOYMENT BY MAJOR INDUSTRY (1977)
SOUTHEASTERN ARKANSAS LABOR AREA[a]

	10-County Labor Area	Arkansas County	Ashley County	Bradley County	Chicot County	Cleveland County	Desha County	Drew County	Grant County	Jefferson County	Lincoln County	5-County Local Study Area[b]
Total Employment	48,457	6,450	6,401	3,168	1,918	333	3,403	4,228	1,683	19,817	1,056	17,006
Manufacturing	20,646	2,708	3,969	1,886	570	194	1,307	2,383	1,002	6,240	387	8,616
Mining	NA[c]	d	NA	NA	NA	NA	NA	NA	d	e	NA	NA
Contract Construction	2,724	425	462	197	102	14	117	154	61	1,053	139	974
Transportation and Other Public Utilities	2,543	387	112	51	86	17	206	96	37	1,475	76	576
Wholesale Trade	2,927	702	225	94	172	d	254	119	47	1,235	79	849
Retail Trade	9,817	1,303	796	485	532	53	862	803	324	4,464	195	3,188
Finance, Insurance, and Real Estate Services	2,173	256	167	120	108	d	142	142	47	1,155	36	595
Agricultural Services, Forestry, Fisheries	519	57	39	e	e	d	75	261	d	87	d	375

Source: U.S. Bureau of the Census 1979c.

[a]Number of employees for week including March 12, 1977.

[b]Five-county local study area consists of Ashley, Chicot, Desha, Drew, and Lincoln counties.

[c]NA = Information not available

[d]Employment-size class 0-19.

[e]Employment-size class 20-99.

There were some changes during the late 1970s, and efforts to develop the local economy are continuing. In particular, the Potlatch Corporation completed a $15 million paper mill in the area in 1977. The mill is 7 to 8 miles due north of Arkansas City and 8 miles east of McGehee.

Housing. At present, housing of any kind in the area is scarce. Some of the 300 people Potlatch Corporation presently employs at the paper mill near the Cypress Bend site commute from as far away as Monticello (about 42 miles) (Wilson 1980). The estimated available housing in four communities in the area is shown in Table 3-38. While vacancy rates in the four communities are low, there are differing opinions as to how tight the market is and how responsive it might be to additional demand in the area.

Several local mobile home parks constructed new spaces from 1975 to 1977 during the Potlatch paper mill construction. There are some mobile home spaces available now.

There has been some new construction of single-family homes in the area. In Dumas, 32 miles from the Cypress Bend site, some 25 to 30 new homes are under construction. Voters in Dumas recently passed a $10 million bond issue, of which $5.5 million has been made available for home loans at 8.5 percent interest (Peterson 1980).

Arkansas City has no hotel or motel accommodations, and the other three communities, McGehee, Dermott, and Dumas, have 200 to 225 hotel or motel rooms altogether (Table 3-38).

Public Services. Public services were inventoried for the four communities (Arkansas City, McGehee, Dermott, and Dumas) where most of the nonlocals would move to during construction, and where impacts would be concentrated. Interviews were held with eight officials in these cities. Other communities such as Monticello might host some inmigrants but not to the extent of these four (Arkansas Department of Local Services 1977; Mood 1980; Jackson 1980; Freeman 1980).

Water and sewer systems in these four communities are generally adequate. The Dermott water system could use an additional 300,000-gallon water tank. Dumas's sewer system is overloaded, with 2000 users for a system designed to serve 1500. A $2 million overhaul of the system is planned for the next two years.

The school districts in all four communities have plans for expanding or upgrading facilities. The Arkansas City School District, which includes the Cypress Bend site, receives $600,000 per year in property tax revenues from the new Potlatch paper mill and plans to construct a new high school (Frisby 1980). Dermott plans to build a new junior high school. McGehee has built a new elementary school and four new high school classrooms and plans to build a new junior high school. Dumas built a new high school four years ago.

3.C.3 VEGETATION

The Cypress Bend pipeline-barge alternative, where different from the proposed action, would traverse or have permanent facilities located on agricultural lands, forested wetlands, cross timbers, oak-hickory forest, southern pine-hardwood forest, and barren land (Table 4-16 in Section 4.A.4). These areas are used mainly for agriculture, livestock grazing, wildlife habitat, and recreation. Refer to Table 4-16 in Section 4.A.4 for acreages and mileages of vegetation types affected.

TABLE 3-38

TEMPORARY HOUSING AVAILABLE IN 1980 AT CYPRESS BEND AREA

Community	Existing Hotel/Motel (Rooms	Hotel/Motel Construction (Rooms)	Existing Rental Units (Apartments and Houses)	Rental Vacancy Rate	Rental Units Planned or Under Construction	Existing Mobile Home Park Spaces	Existing R.V. Park Spaces	Mobile Home Spaces Planned or Under Construction
Arkansas City	0	NA	230	1-2%	NA	35	NA	NA
McGehee	100-125	NA	150-200	0	50	130-150	NA	NA
Dermott	40-50	NA	20	0	NA	200-250	NA	NA
Dumas	48	NA	45	Low	NA	40	NA	NA

Sources: Bixler 1980; Fields 1980; McMahon 1980; Franks 1980; and Peterson 1980.

3.C.4 AQUATIC BIOLOGY

The Cypress Bend coal slurry pipeline from the White Bluff site to the dewatering and barge loading facility would cross approximately 14 permanent and 12 intermittent streams.

All of the potentially affected streams lie within the Mississippi alluvial plain, characterized as bottomlands with sluggish, meandering rivers. Common fishes of the region include minnows, shiners, chubs, shad, gar, suckers, sunfish, and bass (EPA 1978a). The aquatic macroinvertebrate fauna of those drainages would be numerically dominated by flies and aquatic worms, with fewer mayflies, caddisflies, beetles, and mussels (EPA 1978a). Macroinvertebrate populations of the lower Mississippi River include various mayfly, caddisfly, midge, beetle, worm, crustacean, and clam species (Ragland 1974).

3.C.5 CULTURAL RESOURCES AND PALEONTOLOGY

The discussion for the proposed action (Section 3.A.6) applies to this alternative. One hundred twenty eight sites are recorded within the 588-square mile study area that differs from the proposed action. Approximate numbers of sites that may be encountered are 0.2 site per square mile or 1 site per 5 square miles. Sites in the vicinity of the Cypress Bend lateral that are in the National Register of Historic Places are listed in Table F-3, Appendix F.

3.C.6 AGRICULTURE

The Cypress Bend pipeline-barge alternative would not include any slurry pump stations that are not associated with the market alternative.

The pipeline-barge alternative would include one dewatering plant that is not associated with the proposed action or the market alternative. The Cypress Bend dewatering plant and barge loading facility in Desha County, Arkansas, would be located on potential prime agricultural land (Table 3-39). The portions of the barge loading facility near the Mississippi River are frequently flooded and thus may not qualify as prime agricultural land.

3.C.7 AIR QUALITY

Data on total suspended particulates along the proposed slurry pipeline route (Section 3.A.8) would be applicable to the Cypress Bend region. Measurements of gaseous pollutants are scarce for the project vicinity; however, data collected by the states of Arkansas (1979), Oklahoma (1979), and Louisiana (1979) indicate that concentrations are generally low. Annual average measurements of sulfur dioxide (SO_2) ranged from about 2 micrograms per cubic meter ($\mu g/m^3$) to about 11 $\mu g/m^3$. The highest 24-hour SO_2 concentration reported in the area during 1978 was about 44 $\mu g/m^3$. Annual average concentrations of nitrogen dioxide ranged from about 27 $\mu g/m^3$ to about 48 $\mu g/m^3$. Measurements of other gaseous pollutants are not available in the project area.

3.C.8 RECREATION RESOURCES

At mileposts B-37 and B-45 of the Cypress Bend lateral, the pipeline would cross Bayou Bartholomew. Bayou Bartholomew is of importance to the state of Arkansas as a possible candidate for inclusion in a potential Arkansas State Rivers System program.

3.D COLORADO ALTERNATIVE

The Colorado alternative is an alternative northern main slurry pipeline segment that could connect with the proposed action, market alternative, or

TABLE 3-39

DEWATERING PLANTS ON PRIME AGRICULTURAL LAND: CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

Dewatering Plant	Milepost[a]	Soil Association or Series	Land Use	Prime Agricultural Land Potential	Notes
Cypress Bend	B-80.6	Sharkey-Desha-Commerce-Coushatta	Cropland/Woodland/ Wildlife Habitat	Yes	Sharkey-Desha portion only. Portions of this area are frequently flooded.

Sources: SCS 1972c, 1977g.

Note: Land use for this site was determined from Soil Conservation Service (SCS) surveys, maps, publications, and 1:40,000-scale aerial photographs (where available). The potential for prime agricultural land was determined from lists and/or publications (SCS), which list on a state-wide or county basis those soil series or associations which meet the criteria to be considered potential prime agricultural land. Some areas that qualify as potential prime agricultural land are not actually prime, due to factors such as present land use, lack of an adequate irrigation system, or high frequency of flooding.

[a]Refer to strip maps in Appendix A for location of dewatering plants.

Cypress Bend pipeline-barge alternative. It would replace the proposed action pipeline segment between mileposts PMB-0 and P-485 or the segment between mileposts PMB-0 and MB-181 of the market and Cypress Bend pipeline barge alternatives. Only the affected environment for this different northern route is described below.

3.D.1 WATER RESOURCES

This system would cross 57 more intermittent creeks, 11 more minor and 2 fewer major perennial streams and rivers compared with the proposed action (WCC 1981c, Table 2-1).

3.D.2 SOCIOECONOMIC CONSIDERATIONS

Slurry Pipelines and Pump Stations

The counties and towns that would be potentially affected by pipeline and pump stations under the Colorado alternative are listed in Table 3-40. Additional information about temporary housing is available in the Socioeconomics Technical Report (Table A-25, WCC 1981d).

3.D.3 VEGETATION

The Colorado alternative would traverse or have permanent facilities on agricultural lands, short-grass prairie, midgrass prairie, tall-grass prairie, shrub and brush rangeland, ponderosa pine forest, forested wetlands, and barren lands. These areas are used mainly for agriculture, livestock grazing, wildlife habitat, and recreation. See Table 4-16 in Section 4.A.4 for acreages and mileages of the vegetation types affected.

Two plant species that could occur in the vicinity of the Colorado alternative pipeline corridor were recently listed (December 1980) as "taxa currently under review" for inclusion in the federal list of threatened and endangered species. The first of these two species, the persistent sepal yellowcress, grows along sandy shores of rivers and reservoirs near the high-water mark (Dorn 1980a). According to Dorn (1980b) and Lichvar (1981), the persistent sepal yellowcress could occur along the North Platte River near the proposed Colorado alternative crossing at MP C-110.

Dorn (1980b) reported that the Colorado butterfly-weed occurs in Weld County, Colorado, and in Laramie County, Wyoming, near Cheyenne. The Colorado butterfly-weed is typically found in moist meadows, usually at a transition between wet stream bottom and dry uplands (Dorn 1980b). The Colorado butterfly-weed could occur in such habitat between approximately MP C-145 and C-250.

3.D.4 WILDLIFE

The primary wildlife habitat types that would be affected by the Colorado alternative and wildlife species of special concern occurring within these types are listed in Table 3-19. Game and nongame species that would occur in areas that would be affected by the Colorado alternative are essentially the same as those listed for the proposed action in Section 3.A.4.

Threatened and Endangered Wildlife Species

Federally protected wildlife species that could occur in the area that would be affected by the Colorado alternative include the black-footed ferret, bald eagle, peregrine falcon, and whooping crane. In addition, the greater prairie chicken, listed as endangered by Colorado legislation, could be present along the alignment through Colorado. The distribution of federally protected wildlife in Wyoming, Kansas, Oklahoma, Arkansas, and Louisiana is described in

TABLE 3-40

COUNTIES IN AREAS POTENTIALLY AFFECTED BY MAIN SLURRY PIPELINE AND PUMP STATIONS: COLORADO ALTERNATIVE

County	Pump Station	1975 Population	Fiscal Year 1976-77 Tax Revenues ($1000s)
Wyoming			
Goshen		12,000	2,628
Laramie		63,000	14,620
Colorado			
Weld	C-4	107,400	35,950
Logan		19,500	7,074
Washington		5,500	2,686
Yuma	C-5	8,900	3,467
Kansas			
Cheyenne		4,100	1,112
Sherman		8,200	3,118
Thomas		8,100	4,472
Sheridan		4,000	1,710
Gove		4,000	2,947
Trego		4,500	1,608
Ellis	C-6	25,500	6,002
Rush		5,000	2,500
Barton		30,900	9,368
Ellsworth		6,200	2,062
Rice		12,000	4,515

Sources: U.S. Bureau of the Census 1978, 1979b.

Section 3.A.4 of this report and in the Threatened and Endangered Species Technical Report (WCC 1981e).

In Colorado, no confirmed sightings of the black-footed ferret have been made recently. A single skull of a ferret estimated to be from the 1960s was found in northeastern Colorado (Kit Carson County, about 30 miles south of Colorado alternative MP C-340) (Bissel et al. 1978). Since black-tailed prairie dog colonies are numerous in eastern Colorado, potential ferret habitat is abundant along the Colorado alternative corridor (Bissell et al. 1978, 1979).

Before the 1950s, few peregrine falcon eyries were known in Colorado, but in 1978, 31 active eyries were recorded (Colorado Division of Wildlife 1978). Most of the sites presently occupied are situated in mountainous locations. All 31 sites recorded by the Colorado Division of Wildlife were located in the central and western portions of the state. The eastern range limit of the peregrine's hunting and nesting areas in Colorado includes portions of Larimer, Boulder, Jefferson, and El Paso counties (Colorado Division of Wildlife 1978). Peregrines may occur infrequently over construction sites in eastern Colorado.

Since 1974, two active bald eagle nests have been located in Colorado; neither is in an area that would be affected by the Colorado alternative. Wintering bald eagles could be encountered at the South Platte River crossing.

Whooping cranes have historically visited eastern Colorado as accidental migrants (Colorado Division of Wildlife 1978). However, in Kansas the Colorado alternative would pass approximately 7 miles north of Cheyenne Bottoms State Waterfowl Refuge, which is critical habitat for the whooping crane.

Between MP C-315 and MP C-325 (northwest of Wray, Colorado), there is a remnant population of greater prairie chickens. The greater prairie chicken is listed as endangered by state-level endangered species legislation in Colorado.

3.D.5 AQUATIC BIOLOGY

Coal Slurry Pipelines and Pump Stations

Fish. In Wyoming, approximately 8 permanent and 78 intermittent streams would be crossed by the Colorado alternative coal slurry pipeline system. The Wyoming Game and Fish Commission (1971) considers the North Platte River (at the crossing location) to be a Class III river: "important trout water, fishery of regional importance." All other Wyoming river crossing locations are classified as "low-production waters" (Wyoming Game and Fish Commission 1971). The fish faunas of these eastern Wyoming drainages are described in Section 3.A.5.

In Colorado, approximately 6 permanent and 27 intermittent or ephemeral streams and rivers would be crossed by the Colorado alternative coal slurry pipeline system. The major perennial rivers that would be crossed include the South Platte, North Fork Republican, and Arikaree rivers. The fishes of these drainages are similar to the fauna of eastern Wyoming stream systems, as described in Section 3.A.5.

In Kansas, approximately 15 permanent and 121 intermittent or ephemeral streams would be crossed by the Colorado alternative pipeline system. The fish fauna of the potentially affected drainages are described in Section 3.A.5.

Aquatic Invertebrates. The general discussions of aquatic invertebrates in Section 3.A.5 adequately describe the west-central fauna that would be expected to occur in the Wyoming, Colorado, and Kansas drainages to be crossed by the Colorado alternative coal slurry pipelines.

Threatened and Endangered Species. The plains orangethroat darter is considered threatened by the Colorado Division of Wildlife (1978) and is known to occur in Chief Creek (MP C-328.5), in the North Fork Republican River near the Colorado alternative pipeline crossing location (MP C-331.5), and in the Arikaree River near the crossing location (MP C-347).

The Topeka shiner is considered threatened by the state of Kansas and was reported as occurring in Cherry Creek in Cheyenne County, Kansas, near the Colorado alternative slurry pipeline crossing location (MP 364.5) (Minckley and Cross 1959).

3.D.6 CULTURAL RESOURCES AND PALEONTOLOGY

This alternative route lies within the Plains Culture Area. The discussion for Wyoming and Kansas in the proposed action section (3.A.6) also applies to this alternative. In Colorado, all drainages and alluvial valleys, especially the South Platte, the Republican, the Arikaree rivers and their tributaries, are sensitive. The numerous springs that dot the area are also sensitive. Site types that can be expected in this area of Colorado are seasonal to semipermanent camps (or small villages) with associated lithic and ceramic scatters and tipi rings. Permanent settlements may be encountered in alluvial valleys of larger drainages. Twenty eight sites are located within this 1424 square mile study area. Approximate numbers of sites that may be encountered are 0.02 site per square mile or 1 site per 51 square miles. This small number of sites reflects the relative lack of previous cultural resource inventories. The area has a great potential for Paleoindian sites, especially in Yuma County. No prehistoric sites are listed for this area in the National Register of Historic Places.

In Wyoming an open cattle ranch and the site of Jireh College are located near MP C-117. At about MP C-115 the route passes near Fort Laramie National Historic Site and other associated sites. Several variants of the Oregon Trail are crossed by the route at MP C-112.9, C-113.3, and C-114.1. The Cheyenne-Deadwood Trail is crossed near MP C-115.

3.D.7 AGRICULTURE

The Colorado alternative would include six pump stations that are not associated with the proposed action or the market alternative. One of these six pump stations would be located on potential prime agricultural land in Kansas (Table 3-41). Refer to Table 4-16 in Section 4.A.4 for acreages and mileages of cropland affected.

3.D.8 RECREATION RESOURCES

The slurry pipeline route for this alternative would pass Fort Laramie National Historic Site in Wyoming near MP C-115. In addition, at MP C-308 in Colorado, this alternative route would cross the Arikaree River, which has been identified in the Nationwide Rivers Inventory, Phase I (HCRS 1981a). Rivers included in the inventory possess values that have been identified as being nationally significant, and may be eligible for inclusion in the National Wild and Scenic Rivers System.

The pipeline would also cross the Pawnee Butte potential National Natural Landmark site at MP C-220 through C-228

TABLE 3-41

PUMP STATIONS ON PRIME AGRICULTURAL LAND: COLORADO ALTERNATIVE

Pump Station Designation	Milepost	Soil Association or Series	Land Use	Potential Prime Agricultural Land	Notes
C-2*	C-60.0	Mitchell-Keota-Epping[a]	Grazing/Wildlife Habitat	No[b]	
C-3	C-80.0	Wendover-Lambman-Rock Outcrop[a]	Grazing/Wildlife Habitat/ Nonirrigated Cropland	No[b]	
C-4	C-228.0	Epping-Thedlund-Keota[c]	Grazing	No[c]	
C-5	C-345.0	Colby-Ulysses-Keith[d]	Grazing	No[d]	
C-6	C-519.0	Harney[e]	Nonirrigated Cropland/Grazing/ Irrigated Cropland	Yes[f]	Must have an adequate irrigation system to qualify as prime agricultural land.

Note: Land use for each pump station was determined from Soil Conservation Service (SCS) surveys, maps, publications, and 1:40,000 scale aerial photographs (where available). The potential for prime agricultural land was determined from soil surveys (SCS) or lists and/or publications (SCS), which list on a state-wide or county basis those soil series or associations that meet the criteria to be considered potential prime agricultural land. Some areas that qualify as potential prime agricultural land are not actually prime, due to factors such as present land use, lack of an adequate irrigation system, or high frequency of flooding.

*The first pump station is PMBC-1 which is also part of the proposed action (See Table 3-21)

Sources:

a SCS 1978c.
b SCS 1978b.
c SCS 1979d.
d SCS 1976.
e SCS 1975c.
f SCS 1979b.

in Weld County, Colorado. The U.S. Forest Service has tentative plans to develop Pawnee Buttes as a high-intensity recreational area (HCRS 1980a).

Additionally, the Colorado alternative pipeline route would cross two existing historic trails under the National Trails System Act in southeastern Wyoming: The Mormon Pioneer and Oregon National Historic trails.

A microwave communication tower along the alternative pipeline route would be located at MP C-506. This communication tower site is adjacent to Cedar Bluff State Park.

3.D.9 VISUAL RESOURCES

MP C-220 to C-228. The Pawnee Buttes and adjoining escarpment in Weld County, Colorado, are two erosional buttes that rise 150-200 feet above the valley of tributaries to South Pawnee Creek and offer visual contrast to the nearby flat prairie grasslands. The escarpment contains a variety of vegetation, including limber pine, ponderosa pine, and Rocky Mountain juniper, as well as a diversity of high plains flora. All offer unusual scenic qualities to the otherwise common landscape. The buttes themselves provide the dominant form in the landscape. This area of 25,400 acres has been inventoried by the former Heritage Conservation and Recreation Service (Mid-Continent Region) for study as a potential National Natural Landmark, and by the U.S. Forest Service as a high-intensity recreational area.

MP C-345 to C-350. The Arikaree River crossing in Yuma County, Colorado, has been identified by the former Heritage Conservation and Recreation Service (Mid-Continent Region) as having values of national significance that may qualify it for inclusion in the Wild and Scenic Rivers System. This portion of the river offers high-quality visual resources because of the steep banks and dominant line and form of the landscape.

3.E COAL CLEANING OPERATION ALTERNATIVE

This alternative would be located at the preparation plants and would affect the same environmental resources discussed for these sites for the proposed action.

3.F CROOK COUNTY ALTERNATIVE WATER SUPPLY SYSTEM

The water gathering line from the North Rawhide preparation plant to the Jacobs Ranch and North Antelope preparation plants would have the same affected area as that discussed for the proposed-action water supply system. Only the affected area for the Crook County well field and pump station and the water gathering line to the North Rawhide preparation plant is described in this section.

The affected area for water resources, air quality, and recreation is essentially the same or similar to that already discussed for the Niobrara County well field (Sections 3.A.1, 3.A.8, and 3.A.9, respectively) and is not discussed further in this section.

3.F.1 SOCIOECONOMIC CONSIDERATIONS

In addition to the Wyoming counties and communities identified as potentially affected by the proposed action, Crook County and the communities of Moorcroft, Sundance, and Hulett would be affected by this alternative. Population data for the county and these communities are given in Table 3-42. As shown in Table 3-43, rental housing units are relatively unavailable, and planned new housing construction will do little to change this situation.

TABLE 3-42

SUMMARY OF POPULATION PROJECTIONS, CROOK COUNTY, WYOMING

Community	1978	1979	1980	1981	1982	1983	1984	1985
Hulett	340	345	355	360	370	375	386	390
Moorcroft	1,400	1,475	1,550	1,650	1,750	1,900	2,025	2,175
Sundance	1,400	1,450	1,475	1,525	1,575	1,650	1,725	1,800
Rural	2,260	2,280	2,370	2,415	2,455	2,475	2,540	2,585
Crook County	5,400	5,550	5,750	5,950	6,150	6,400	6,676	6,950

Source: Stuart/Nichols Associates 1978c.

TABLE 3-43

TEMPORARY HOUSING AVAILABLE IN 1980
AT MOORCROFT, SUNDANCE, AND HULETT, WYOMING

Community	Existing Hotel/Motel Rooms	Hotel/Motel Construction (rooms)	Existing Rental Units (Apts. & Homes)	Rental Vacancy Rate	Rental Units Planned or Under Construction	Existing Mobile Home Parks	Existing R.V. Parks	Mobile Home Spaces Planned or Under Construction
Moorcroft	63	0	425	5%	12	12	0	0
Sundance	120	0	25	1-2%	2	4	4	80
Hulett	30-40	0	NA	NA	NA	3	NA	NA

Sources: Schroder 1980b; Westover 1980.

NA = Information not available.

3.F.2 VEGETATION

The Crook County alternative water supply line would traverse or have permanent surface facilities located on agricultural lands, midgrass prairie, and ponderosa pine forest (Table 4-16 in Section 4.A.4). This area is used primarily for grazing and wildlife habitat.

3.F.3 WILDLIFE

Primary concerns exist for the potential occurrence of the black-footed ferret at surface facilities and along the delivery pipeline corridor. The bald eagle and peregrine falcon could occur over the affected area; however, no nests or roosts are known in the area that would be affected.

3.F.4 AQUATIC BIOLOGY

The delivery pipeline would cross 1 perennial and 19 intermittent or ephemeral streams in the Little Missouri and Powder River basins in Wyoming. The fishes of the region are described in Section 3.A.5.

3.F.5 CULTURAL RESOURCES AND PALEONTOLOGY

This alternative water supply system lies in the Plains Culture Area. Twenty prehistoric sites have been recorded within the wellfield boundary. Sites are primarily large camps located along the North Fork Little Missouri and the Little Missouri rivers and their tributaries. One of the sites, the Bush/Bunger Site, is a prehistoric antelope trap and has been nominated for the National Register of Historic Places (NRHP). All drainages and alluvial valleys, particularly the Little Missouri and its tributaries, are sensitive. Upland areas and ridges may contain evidence of camps or small temporary villages. Eighteen sites are located within the 460-square mile delivery pipeline study area. Approximate numbers of sites that may be encountered are 0.002 site per square mile, or 1 site per 26 square miles.

No historic sites are recorded.

3.F.6 AGRICULTURE

The Crook County alternative water supply system would not be located on prime agricultural land. The entire water supply system would be located on soils that are used primarily for grazing and wildlife habitat. See Table 4-16 in Section 4.A.4 for acreages and mileages of cropland affected.

3.F.7 TRANSPORTATION NETWORKS

Access to the Crook County well field would be via U.S. 14/16, Interstate 90, and state or county roads from Gillette. All major roads are paved and capable of carrying heavy traffic and equipment. State and county roads are limited to 40 tons, and approximately 10 percent are hard-surfaced. Despite the fact that many of the roads are carrying loads beyond their capacity, they have withstood the use because of the stabilization material in the asphalt. Unpaved roads are less able to withstand the abuse of heavy equipment and regular traffic.

3.G COMBINED WELL-FIELD ALTERNATIVE WATER SUPPLY SYSTEM

The affected environment for this alternative water supply system would be the same as that discussed for the Niobrara and Crook County well fields (Sections 3.A and 3.F).

3.H OAHE ALTERNATIVE WATER SUPPLY SYSTEM

The affected environment for this alternative, from the Oahe Reservoir in South Dakota to the North Rawhide preparation plant, is discussed below. From

North Rawhide, the water lines described for the proposed action would transport water to the other two preparation plants.

Although the water could be purchased from either the state of South Dakota or directly from the Water and Power Resources Service, the same route would be used and the affected environment would be very similar for both Oahe options.

3.H.1 WATER PURCHASE FROM SOUTH DAKOTA

Water Resources

This alternative would cross 106 more intermittent creeks, 10 more minor and 2 more major perennial streams and rivers compared with the proposed water supply system (WCC 1981c, Table 2-1).

Socioeconomic Considerations

The Oahe alternative water supply system would require a 276-mile water pipeline from the Oahe Reservoir, near Pierre, South Dakota, to Gillette, Wyoming. It would pass through five counties in South Dakota (Stanley, Haakon, Pennington, Meade, Lawrence) and two counties in Wyoming (Crook, Campbell). Since Pierre, the principal city near Oahe Reservoir, is situated in Hughes County, data are also provided for that county. There are several small communities along the 280-mile route and three principal service towns: Pierre, Rapid City, and Gillette. The population of each of the counties and selected communities is shown in Table 3-44.

Employment data for six South Dakota counties show the Rapid City area (Pennington County) to be the largest source of construction workers for the water pipeline in South Dakota (Table 3-45). In 1977, some 1953 persons were employed in construction in Pennington County and another 165 in Meade County, the two counties that make up the Rapid City Standard Metropolitan Statistical Area (SMSA).

The existing socioeconomic conditions for the Gillette area are described in the Proposed Action section.

For construction workers (perhaps three-quarters of those to be employed) who would move in from outside the area to construct the water pipeline, Pierre, Rapid City, and Gillette would be preferred for temporary housing. Availability of temporary housing in these communities is shown in Table 3-46.

No significant impacts on local public services and facilities are expected from construction of the Oahe alternative water supply system (see Chapter 7 of the Socioeconomics Technical Report [WCC 1981d]). Therefore no data on existing conditions are presented.

Vegetation

The Oahe alternative water supply system would traverse or have permanent facilities located on agricultural lands, midgrass prairie, shrub and brush rangeland, ponderosa pine forest, forested wetlands, and barren land (Table 4-16 in Section 4.A.4). These areas are used mainly for agriculture, livestock grazing, wildlife habitat, and recreation.

Wildlife

Wildlife species of special concern that could occur along the Oahe alternative in Wyoming and South Dakota include mule deer, black-footed ferret, northern swift fox, bald eagle, whooping crane, and interior least tern.

Mule Deer. Between approximately MP O-195 and O-220 in Wyoming, the Oahe alternative would traverse important winter range area for the mule deer (Nimick 1980).

Black-Footed Ferret. In South Dakota more sightings of black-footed ferrets have been made in historical times than any other state; more than 400 sightings have been reported since 1889 (Linder

TABLE 3-44

POPULATIONS OF COUNTIES AND COMMUNITIES WITHIN COMMUTING DISTANCE OF PROJECT COMPONENTS: OAHE ALTERNATIVE WATER SUPPLY SYSTEM

County	Community	Census 1970 Population	1975 Population	Population Change 1970-1975 (percent)
South Dakota				
Hughes		11,632	13,268	16.3
	Pierre		11,444 ('75)	
Stanley		2,457	2,520	3.3
	Ft. Pierre		1,800 ('79)	
Haakon		2,802	2,809	.2
	Phillip		1,000 ('79)	
Pennington		59,349	65,918	13.5
	Wall		820 ('70)	
	Wasta		120 ('79)	
	New Underwood		519 ('79)	
	Box Elder		867 ('79)	
	Rapid City		43,875 ('79)	
Mead		17,020	18,291	7.6
	Sturgis			
Lawrence		17,453	17,005	-4.1
	Whitewood		875	
6-County Total			119,811	
Wyoming				
Crook		4,535	4,883	7.2
	Sundance		2,500	
	Moorcroft		1,150	1.0
Campbell		12,957	13,090	1.0
	Gillette		8,215	

Sources: U.S. Bureau of Census 1978. Community population estimates are from the South Dakota Department of Economic Development and Tourism 1980.

TABLE 3-45

EMPLOYMENT IN SOUTH DAKOTA COUNTIES

County	Total Employment 1979	Construction 1977
Hughes	8,344	394
Stanley	1,096	76
Haakon	1,524	21
Pennington	37,265	1,953
Meade	5,265	165
Lawrence	7,795	301

Source: U.S. Bureau of Economic Analysis 1979.

TABLE 3-46

TEMPORARY HOUSING AVAILABLE IN 1980 FOR LIKELY PIPELINE CONSTRUCTION SPREAD HEADQUARTERS: OAHE ALTERNATIVE WATER SUPPLY SYSTEM

Community	Existing Hotel/Motel Rooms	Hotel/Motel Construction (units)	Existing Rental Units (Apartments and Houses)	Rental Vacancy Rate	Rental Units Planned or Under Construction	Existing Mobile Home Park Spaces	Existing R.V. Park Spaces	Mobile Home Spaces Planned or Under Construction
Gillette, Wyoming	560	60	815	5%	252	1391	NA	471
Pierre, South Dakota	711[a]	Hotel complex in Ft. Pierre in planning stages	NA	Low	31	300	0	0
Rapid City, South Dakota	3140[b]	290	NA	10-15%	A few small units	1161	NA	NA

Sources: Campbell County Chamber of Commerce 1980, Pierre Area Chamber of Commerce 1980, Rapid City Chamber of Commerce 1980.

NA = Data not available

[a]Pierre Area Chamber of Commerce 1979.

[b]Sixth District Council of Local Governments 1978.

and Hillman 1973). Most of these occurred in the western half of the state, with the greatest number in Mellette and Washabaugh counties (Linder and Hillman 1973). From 1964 to 1973, black-footed ferrets were seen as follows: at 17 different prairie dog towns in Mellette County; at 2 different towns in Washabaugh County; and at 1 in Shannon County. The Oahe alternative in South Dakota would be located approximately 45 to 65 miles north of these sightings. The most recent confirmed sighting of a ferret was made on March 28, 1979, near Okreek in Mellette County, about 75 miles south of what would be the beginning of the Oahe alternative in South Dakota (Anderson 1980). In addition to the ferret sightings, the greatest concentration of black-tailed prairie dog towns in South Dakota occurs in counties south of the proposed Oahe alternative. From east to west, counties that would be traversed by the Oahe alternative have the following estimated acreages of dog towns (Henderson et al. 1974): Stanley County (south of the Cheyenne River), 500 acres; Haakon County (south of the Cheyenne River), 800 acres; Meade County, 2500 acres; and Lawrence County, 100 acres. The status of the black-footed ferret in Wyoming is described in Section 3.A.4.

Bald Eagle. Overwintering bald eagles could be encountered at the proposed Cheyenne River crossing (MP O-103) and at the Oahe Reservoir. The status of the bald eagle in Wyoming is described in Section 3.A.4.

Whooping Crane. The whooping crane is a regular spring and fall visitor in South Dakota. Observations of whooping cranes have been reported from the prairie edges of the Black Hills to near the eastern border of South Dakota (Anderson 1980). However, most sightings occur within a north-south corridor 100 miles east and 150 miles west of Pierre. Approximately 170 miles of the Oahe alternative water pipeline would cross the whooping crane's migrating corridor through South Dakota. Whooping cranes have been observed at the Oahe Reservoir.

According to Anderson (1980), whooping cranes are present in South Dakota from early April through May and from early September through the first 10 days of November. Some data suggest that the whooping crane may have used the Cheyenne River as a staging area about 15 years ago (Anderson 1980).

Presently, whooping cranes are not known to occur on rivers and streams that would be traversed by the Oahe alternative. Whooping cranes would occur primarily as migrants in the affected area.

Northern Swift Fox. The northern swift fox is a state-listed threatened species in South Dakota. The swift fox has recently been sighted near two locations of the proposed Oahe alternative in South Dakota, near MP 38 in Stanley County and south of MP 60 in Haakon County (Sharps 1980). Dens have not been located. According to Sharps (1980), the northern swift fox could occur wherever the Oahe alternative traverses prairie dog towns.

Interior Least Tern. The interior least tern is a state-listed endangered species in South Dakota. It nests on river sandbars, sandflats, and other similar habitat in June and July (South Dakota Ornithologists Union 1978). In South Dakota the interior least tern could be encountered where the Oahe alternative would cross the Cheyenne River at MP O-103.

Aquatic Biology

Fish. Oahe Reservoir is a 375,000-acre mainstem impoundment of the Missouri

River, which extends approximately 250 miles upstream from its dam at Pierre, South Dakota (Hassler 1970). Walleye, white bass, northern pike, channel catfish, and recently introduced lake trout provide good sport fishing opportunities, particularly in reservoir embayments and tributary streams. Recent investigations by Nelson and Beckman (1979) indicate that larval (newly hatched) yellow perch, buffalo, and shiners are susceptible to entrainment by presently operating irrigation water intakes in Lake Oahe.

In South Dakota, approximately 4 perennial and 109 intermittent or ephemeral streams would be crossed by the Oahe alternative water supply pipeline. In Wyoming, approximately 8 permanent and 29 intermittent streams would be crossed (WCC 1981c, Table 2-1).

The Oahe alternative water supply pipeline generally lies in the Cheyenne River basin. The physical and fisheries characteristics of the Cheyenne River and many of its tributaries are described in Section 3.A.5. In addition, many of the streams in west-central South Dakota and northeastern Wyoming are located in the Black Hills region, which is an area prized for its pristine streams and productive trout fisheries. Spearfish Creek in South Dakota and Sand Creek in Wyoming are considered two of the best trout fisheries in the region. In addition, many Black Hills streams have small instream impoundments with good walleye and panfish fishing.

Because of the presence of trout, general spawning activity extends intermittently from February through July.

Aquatic Invertebrates. Most of the streams located east of the Cheyenne River that would be crossed by the proposed Oahe water supply pipeline are intermittent plains (low-gradient) streams or shifting-substrate perennial streams with a limited macroinvertebrate fauna.

Many of the streams located west of the Cheyenne River are intermittent or perennial high-gradient streams with coarse substrates and dense, diverse, and productive macroinvertebrate communities dominated by mayflies, caddisflies, stoneflies, and flies that serve as important food sources for the highly valued trout fishery.

Threatened and Endangered Species. Four fishes listed as threatened by the South Dakota Department of Game, Fish and Parks (Scalet 1980) may be affected by this alternative water supply pipeline. The finescale dace is known to occur in the Redwater Creek drainage (approximately MP O-193) (Baxter and Simon 1970; Bailey and Allum 1962). The longnose sucker is known to occur in the Redwater Creek drainage (MP O-193) and Spearfish Creek (MP O-188) (Baxter and Simon 1970). The sturgeon chub prefers large silty streams with moderate current and gravel substrates (Baxter and Simon 1970) and has been collected from the Cheyenne River in the general vicinity of the proposed crossing location (MP O-103). The northern redbelly dace has been reported in Spearfish Creek (MP O-188), Crow Creek (MP O-188.5), and tributaries to Redwater Creek (approximately MP O-193) (Scalet 1980). Spawning seasons for these species extend from March through July.

Cultural Resources and Paleontology

This alternative lies within the Plains Culture Area. All drainages and alluvial valleys, particularly the Missouri River, are sensitive. Bluff tops and terraces associated with the Missouri River are also sensitive. Within South Dakota, 93 sites are located within the 1940-square-mile study area. Forty-eight of these sites have been inundated by the existing Oahe Reservoir.

Within Wyoming, 20 sites are located within the 710-square-mile study area. Approximate numbers of sites that may be encountered are 0.04 site per square mile or 1 site per 24 square miles.

Native American groups recorded as having occupied this region are the Crow, Teton Dakota, Arikara, Mandar, Hidatsa, and Pawnee. Site types that may be encountered are bison kill and butchering sites, campsites, ceremonial areas, earthen lodges, and village remains with associated defense ditches and earthen walls.

Fort Pierre - Deadwood Road and stage stations are located in the vicinity of the Oahe alternative in South Dakota. Stage stations along this route are located approximately 2 miles south of MP O-7 and 3 miles south of MP O-38. The road-stage route is crossed by the Oahe alternative near MP O-12 and MP O-30. Between MP O-163 and MP O-166 the alternative lies within the Bear Butte Historic District. Historic sites in the vicinity of the Oahe alternative also have been recorded in Wyoming. They represent early ranching, milling, and westward expansion. Coal mining has been a part of Wyoming's history since the early 1900s as evidenced by the Wyodak Coal Mine near MP O-274.

Sites in the vicinity of this alternative that are listed in the NRHP are listed in Table F-5, Appendix F.

Agriculture

Two of the eight pump stations along the Oahe alternative water pipeline in South Dakota and Wyoming would be loated on potential prime agricultural land (Table 3-47). See Table 4-16 in Section 4.A.4 for acreages and mileages of cropland affected.

Recreation Resources

The proposed Oahe alternative water pipeline route would begin at the Oahe Reservoir, where water-related recreation activities such as boating, fishing, and swimming take place. Other recreation areas along the water pipeline route include Bear Butte State Park (MP O-163) and Black Hills National Forest in Wyoming. In addition, the water pipeline would cross the Cheyenne River at MP O-103 in Meade County, South Dakota, which has been identified for possible future study in the Nationwide Rivers Inventory, Phase I, by the former Heritage and Conservation Recreation Service (1981a). (The inventory program is now under the jurisdiction of the National Park Service.) Rivers included in the inventory possess values that have been identified as being nationally significant, and may be eligible for inclusion in the National Wild and Scenic Rivers System.

The alternative water pipeline route in Crook and Converse counties, Wyoming, traverses the Western Black Hills Volcanic Intrusion, which currently is in the designation process for inclusion into the National Natural Landmarks system. Also, the alternative water pipeline route passes near the Bear Butte in Meade County, South Dakota, which is a registered National Natural Landmark.

Transportation Networks

The delivery pipeline from the Oahe Reservoir to the Gillette well field would cross the following transportation routes: U.S. 14, State 73 and 34, and U.S. 85 from east to west in South Dakota; and State 111/U.S. 14 in the Black Hills National Forest of Crook County, Wyoming. The pipeline would also cross a number of county and private roads.

3.H.2 WATER PURCHASE FROM WATER AND POWER RESOURCES SERVICE

The affected environment for this option is nearly the same as that discussed in Section 3.H.1, since both options would use the same route. The

TABLE 3-47

PUMP STATIONS ON PRIME AGRICULTURAL LAND: OAHE ALTERNATIVE WATER SUPPLY SYSTEM

Pump Station Designation	Mile-post	Soil Association or Series	Land Use	Potential Prime Agricultural Land
Water Purchase from South Dakota				
0-1	0-0	Sansarl-Opal	Grazing	No
0-2	0-45	Pierre-Samsil	Grazing	No
0-3	0-96	Samsil-Lismas-Pierre	Grazing/Nonirrigated Cropland	No
0-4	0-138	Kyle-Pierre-Hisle	Grazing/Nonirrigated Cropland	No
0-5	0-163	Canyon-Lakoa-Maitland	Grazing	No
0-6	0-174	Butche-Santanta-Boneek	Grazing	No
0-7	0-196	Nevee-Vale-Tilford	Nonirrigated Cropland/Grazing	Yes
0-8	0-214	Nevee-Vale-Tilford	Nonirrigated Cropland/Grazing	Yes
Water Purchase from WPRS[a]				
0-1A	0-0	Sansarl-Opal	Grazing	No
0-2A	0-43	Pierre-Samsil	Grazing	No
0-3A	0-96	Samsil-Lismas-Pierre	Grazing/Nonirrigated Cropland	No
0-4A	0-161	St. Onge-Keith	Nonirrigated Cropland	Yes
0-5A	0-207	Nevee-Vale-Tilford	Nonirrigated Cropland/Grazing	Yes

Sources: SCS 1974b, 1975d, 1978b, 1978f, 1978g, 1979e, 1979f.

Note: Land use for each pump station location was determined from Soil Conservation Service (SCS) surveys, maps, and publications. The potential for prime agricultural land was determined from soil surveys (SCS) or lists and/or publications (SCS) which list on a statewide or county basis those soil series or associations that meet the criteria to be considered potential prime agricultural land. Some areas that qualify as potential prime agricultural land are not actually prime, due to factors such as present land use, lack of an adequate irrigation system, or high frequency of flooding.

[a]WPRS = Water and Power Resources Service.

only difference is in agricultural land that might be affected, since pump stations would be at different locations.

Agriculture

Two of the five pump stations would be located on potential prime agricultural land (Table 3-47).

3.I TREATED WASTEWATER ALTERNATIVE WATER SUPPLY SYSTEM

3.I.1 WATER RESOURCES

The alternative wastewater water supply system would require a 160-mile pipeline from Box Elder, South Dakota, to Gillette, Wyoming. The wastewater that otherwise would be discharged to four streams and rivers would be transported to Gillette. The locations of these receiving waters, along with background water quality conditions, is presented in Table 3-48.

The pipeline route for this alternative would cross 97 more creeks, streams, and rivers, compared with the Niobrara well-field water supply system (WCC 1981c, Table 2-1).

3.J SLURRY PIPELINE WATER DISCHARGE ALTERNATIVE

Discharge locations would be in the vicinity of the proposed dewatering plants, whose affected areas have been previously discussed for the proposed action and market alternative, except for water resources as discussed below.

3.J.1 WATER RESOURCES

Discharge Facilities

Surface Water Quantity and Quality. The sites at which dewatering plant effluent would be discharged are shown in Table 3-49. All of these sites are freshwater streams or rivers.

Table 3-50 presents the estimated low flow occurring at these sites, based on USGS water resources data. The 7-day, 2-year flow is shown for the sites in Oklahoma, and the 7-day, 10-year low flow is shown for sites in Arkansas. The lowest recorded historical flows are shown for the sites in Louisiana. Table 3-50 also shows the estimated concentrations of total dissolved solids (TDS), chloride (Cl), and sulfate (SO_4) during these low-flow conditions, which are derived from water quality records at USGS gaging stations nearest to the proposed discharge, during applicable low-flow periods.

3.K FORT SMITH, ARKANSAS, ROUTE-VARIATION ALTERNATIVE

The affected environment for this route variation is essentially the same as the affected environment discussed for the proposed action in the vicinity of Fort Smith, Arkansas (about MP P-892 to P-920) (see Section 3.A).

3.L NO-ACTION ALTERNATIVE

The preliminary impact assessment for the no-action alternative indicated that the only environmental resources affected by this alternative would be socioeconomics, wildlife, and air quality. The affected environments for these resource topics are described below for the all-rail route and the rail-barge route. More detailed information regarding the environmental assessment of the no-action alternative is found in the No-Action Alternative Technical Report (WCC 1981i).

3.L.1 SOCIOECONOMIC CONSIDERATIONS

All-Rail Alternative

The rail routes of the no-action all-rail alternative are shown on Map 1-1. Rail delivery of coal to these markets

TABLE 3-48

RECEIVING STREAMS FOR EXISTING WASTEWATER DISCHARGERS

Discharger	Receiving Stream	Background Conditions (mg/l)							
		DO	BOD_5	SS	TDS	NH_3	SO_4	Cl	Fecal Coliform
Rapid City[a]	Rapid Creek	11	NA	NA	220	0.03	40	3	NA
Ellsworth Air Force Base	Box Elder Creek	NA	NA	NA	NA	NA	NA	NA	NA
Box Elder	Box Elder Creek	NA	NA	NA	NA	NA	NA	NA	NA
Rapid Valley[a]	Rapid Creek	11	NA	NA	220	0.03	40	3	NA
Lead/Deadwood[b]	Whitewood Creek	9.6	NA	NA	520	NA		NA	NA
Homestake[c]	Whitewood Creek	11	NA	NA	280	0.04	67	8.0	NA
Whitewood[d]	Whitewood Creek No discharge	11	7.1	NA	480	0.98	160	21	55,000
Spearfish	f								
Belle Fourche[e]	Belle Fourche River	9.6	4.3	NA	1500	0.07	800	15	14,000

Source: EPA 1981a.

Note: DO = dissolved oxygen; BOD_5 = biological oxygen demand; SS = suspended solids; TDS = total dissolved solids; NH_3 = ammonia; SO_4 = sulfate; Cl = chloride; fecal coliform measured as most probable number per 100 ml; NA = not available.

[a]Background conditions are mean values recorded for the period of record at station No. 460669.

[b]Background conditions are mean values recorded for the period of record at station No. 460685.

[c]Background conditions are mean values recorded for the period of record at station No. 460658.

[d]Background conditions are mean values recorded for the period of record at station No. 460652.

[e]Background conditions are mean values recorded for the period of record at station No. 460890.

[f]Not presently discharged into a stream.

TABLE 3-49

LOCATIONS OF DEWATERING PLANT EFFLUENT DISCHARGES

Site	Discharge Location
Ponca City, OK[a]	Arkansas River, 29 miles downstream from Ponca City
Oologah, OK[b,c]	Verdigris River, below Oologah Dam
Pryor, OK[a,b,c]	Neosho River (Grand River) 40 miles upstream from confluence with Arkansas River
Muskogee, OK[a]	Arkansas River, 4 miles downstream from confluence with Neosho River (Grand River)
Independence, AR[a,b,c]	White River, 20 miles downstream from Lock 4, Dam 1, at Batesville
White Bluff, AR[a,b,c]	Arkansas River, 25 miles downstream of Little Rock, between Lock and Dam 5 and 6
Cypress Bend, AR[c]	Mississippi River, Louisiana state line, and Arkansas River, 25 miles upstream from Greenville
New Roads, LA[a,b]	Mississippi River, 35 miles upstream from Baton Rouge, Louisiana
Baton Rouge, LA[b]	Mississippi River at Baton Rouge, Louisiana.
Boyce, LA[a,b]	Red River, 3 miles upstream from Boyce, Louisiana
Wilton, LA[a,b]	Mississippi River, 13 miles downstream from Donaldsville, Louisiana
Lake Charles, LA[a,b]	Calcasieu River, Lake Charles, Louisiana

[a]Potential proposed action site.

[b]Potential market alternative site.

[c]Potential Cypress Bend pipeline-barge alternative site.

TABLE 3-50

ESTIMATED WATER QUALITY DURING LOW FLOW CONDITIONS AT ALTERNATIVE DISCHARGE LOCATIONS

Site	Background Low Flow (cfs)[a]	Water Quality During Low Flow (mg/l)[b]		
		TDS	CL	SO_4
Ponca City[c]	598	902	354	113
Pryor[c]	151	154	18	34
Oologah[c]	1.26	225	35	35
Muskogee[c]	2,270	850	363	92
Independence[d]	264	196	8	14
White Bluff[d]	750	549	242	76
Cypress Bend[d]	28,750	239	25	66
New Roads[e]	100,000	259	26	63
Baton Rouge[e]	100,000	280	35	65
Lake Charles[e]	204	1798	642	101
Boyce[e]	1,650	716	210	136
Wilton[e]	100,000	286	30	60

Source: Plummer and Associates 1981.

Note: Potential markets for the proposed action, market alternative, and Cypress Bend pipeline-barge alternative are listed. See Table 3-49 for an explanation of which sites are markets for a particular alternative.

[a] Cubic feet per second.

[b] Milligrams per liter.

[c] Seven-day, 2-year low flow.

[d] Twenty-five percent of 7-day 10-year low flow, as specified by state standards.

[e] Historical low flow.

would cover 3626 unduplicated miles of track, all of which is category A or B mainline track (DOT 1977a). There is existing rail access to all six coal mines and all power plant sites.

The rail route passes through 136 counties in seven states and would affect a minimum of 2.5 million people in at least 600 communities. Table 3-51 lists the numbers of towns and people that would be affected for each route segment. Table 3-52 lists those towns where the train would stop either for a crew change or a maintenance inspection. By implication, all towns along the proposed route would be affected. Those singled out for a crew change or maintenance stop were identified by the railroads involved. Details of these railroad operations are found in Appendices A and B of the No-Action Alternative Technical Report (WCC 1981i).

It should be noted that many of these towns owe their existence to the presence of the railroad, having developed around it for the transportation and freight services it provided. Precise figures on the number of people in each town employed by the railroad are difficult to obtain. At one extreme there are towns like Alliance, Nebraska, which can be characterized as a "railroad town." Most of this town's population is employed by the railroad, and the town owes its recent population boom almost exclusively to the building of a large maintenance facility by Burlington Northern (BN). Other towns, like Kansas City, a large, diversified metropolitan area, are major centers for railroad activities, but the economy is less dependent upon railroad activities. Because of the number of communities traversed by the railroad, it is impossible to discuss each one. Towns along the BN segment of the route from Wyoming to Kansas City were selected at random and analyzed in a study by Peat, Marwick, Mitchell (1979). The 13 communities examined in detail below were selected as being representative of nearly all community types along both the northern and southern portions of the rail route.

Torrington, Wyoming. Torrington (population 4700) is bisected by the BN, with about 85 percent of the population located north of the BN tracks and 15 percent located south of the tracks. All services, including the schools, are north of the tracks (PMM 1979). No satellite fire, police, or ambulance facilities are located south of the tracks. Located within 500 feet of the center line are a church, the library, and a home for juveniles.

Scottsbluff, Nebraska. Scottsbluff (population 12,700) is another city that is bisected by the BN. Approximately 20 percent of the population lives south of the tracks and 80 percent lives north of the tracks, where the major services are located (PMM 1979).

Police, fire, and ambulance services report that the risk of delay is greatest for ambulance services or health emergencies. Valley Ambulance Service crossed the railroad tracks on 443 calls out of the 1400 runs made during 1977. Less than one-fourth of fire department responses within the city involve crossing any tracks, although more than a third of rural station runs cross over tracks. The police department has a beat on the south side of the railroad, so there are fewer problems with blocked crossings (PMM 1979).

Alliance, Nebraska. The BN skirts the west and south sides of Alliance (population 7000). Industrial development south of the tracks is primarily on BN property, and the residential development west of the tracks can be served by the U.S. 385 overpass (PMM 1979).

Broken Bow, Nebraska. The BN bisects Broken Bow (population 4000) about

TABLE 3-51

AFFECTED POPULATION, BY ROUTE SEGMENT

Route Segment	Number of Counties/ Parishes	Number of Towns[a]	Estimated Minimum Population[b]
Wyoming Mines to Kansas City	28	102	813,451
Kansas City to Ponca City	9	30	102,855
Kansas City to Independence	15	76	208,090
Kansas City to Pryor	9	29	58,773
Kansas City to Muskogee	12	46	108,900
Muskogee to White Bluff	10	49	132,927
White Bluff to Alexandria	12	63	194,405
Alexandria to Boyce	1	1	50,744
Alexandria to New Roads	8	25	327,598
Kansas City to Shreveport	18	83	315,749
Shreveport to Lake Charles	6	36	108,562
Shreveport to Wilton	8	42	58,806
TOTAL	136	684	2,482,860

[a]For a complete list of the major towns traversed by the route, see Appendix C in the No-Action Alternative Technical Report (WCC 1981i).

[b]Population estimates include towns for which U.S. census data are available.

TABLE 3-52

CREW CHANGES AND MAINTENANCE STOPS FOR THE ROUTES OF THE PROPOSED ACTION

Railroad	State	County/Parish	Town	Population
BN	Wyoming	Platte	Guernsey (2)	838
	Nebraska	Box Butte	Alliance (1,2)	6,990
		Buffalo	Ravenna (2)	1,250
		Lancaster	Lincoln (1,2)	163,112
	Missouri	Buchanan	St. Joseph (2)	77,679
		Jackson	Kansas City (1,2)	472,529
MP	Kansas	Miami	Osawatomie (1,2)	4,156
			Dixon (1)	
		Montgomery	Coffeyville (1,2)	15,537
	Oklahoma	Rogers	Claremore (1)	9,897
			Cookson (1)	
			Upson (1)	
	Arkansas	Crawford	Van Buren (1,2)	9,452
		Franklin	Alix (1)	
		Conway	Morrilton (1)	6,814
		Pulaski	North Little Rock (1,2)	61,768
		Jefferson	Pine Bluff (1)	57,389
		Desha	McGehee (1,2)	5,413
			Sunshine (1)	
	Louisiana	Morehouse	Collinston (1)	428
		Ouachita	Monroe (1,2)	61,016
		Caldwell	Grayson (1)	601
		Grant	Georgetown (1)	305
			Texmo Junction (1)	
		Rapides	Alexandria (2)	
			Meeker (1)	
		Avoyelles	Bunkie (1)	5,129
	Missouri	Cass	Pleasant Hill (1)	3,475
		Cass	Ore (1)	
		Bates	Rich Hill (1)	1,590
		Vernon	Sheldon (1)	483
		Barton	Lamar (1)	3,791
		Jasper	Carthage (2)	10,928
		Stone	Crane (1)	1,108
		Taney	Branson (1)	2,642
	Arkansas	Boone	Bergman (1)	294
		Baxter	Cotter (1,2)	949
		Izard	Calico Rock (1)	928
		Independence	Batesville (1)	7,209
KCS	Kansas	Crawford	Pittsburg (2)	18,375
	Oklahoma	Adair	Watts (2)	346
		LeFlore	Heavener (1,2)	2,585
	Arkansas	Sevier	DeQueen (2)	4,083

TABLE 3-52 Concluded

Railroad	State	County/Parish	Town	Population
KCS	Louisiana	Caddo	Shreveport (1,2)	185,711
		Vernon	Leesville (2)	8,473
		Calcasieu	Lake Charles (1)	76,087
		Rapides	Alexandria (2)	49,481
		E. Baton Rouge	Baton Rouge (2)	444,600
AT&SF	Kansas	Lyon	Emporia (2)	23,447
		Cowley	Arkansas City (1,2)	13,791
MKT	Kansas	LaBette	Parsons (1,2)	12,356

1 = Maintenance stop.
2 = Inspection stop.

BN = Burlington Northern
MP = Missouri Pacific
KCS = Kansas City Southern
AT&SF = Atchison, Topeka and Sante Fe
MKT = Missouri-Kansas-Texas

equally. According to one of the Broken Bow citizens, grade separations are a major issue with most citizens. All emergency services are south of the tracks, which means that about 50 percent of the population could be cut off from the services by the passage of a train because there are no grade-separated rail-highway crossings (PMM 1979).

Ravenna, Nebraska. Ravenna (population 1300) is a major crew-change town for the BN. Many fast-food restaurants derive significant income from the 48 BN living units. All of the town's population and services are located north of the tracks. No quiet facilities are within 1000 feet of the BN right-of-way, and most are beyond 2000 feet. Services are not a major problem, except for the BN crew-change quarters, which are south of the tracks (PMM 1979).

Grand Island, Nebraska. According to local officials, facilities in Grand Island (population 33,000) that would be affected by increased BN traffic include two schools, a veterans' home, a hospital, a church, and a recreation park/little league ball field. Most of the city is south of the tracks, with the older part of the city north of the tracks. The BN traffic is considered well scheduled, with particular attention paid to scheduling of traffic to avoid blocking grade crossings (PMM 1979).

Lincoln, Nebraska. The impacts of increased coal traffic in the Lincoln area (population 163,000) are likely to be perceived as a major problem, as evidenced by numerous newspaper articles on this subject and by at least one major environmental impact statement (U.S. DOT 1977b) and a more recent (U.S. DOT 1978) supplement to it. Particular concern has focused on the more than 400 at-grade rail crossings in the town (U.S. DOT 1977b) and the relatively high accident rate at these crossings. While the town can trace much of its development to the presence of the railroads, some of which date from the late 1800s, current urban development has resulted in problems that the citizens of Lincoln are actively trying to have remedied.

Greenwood, Nebraska. Greenwood (population 500) may be affected by increased rail traffic. Approximately 60 percent of the population lives northwest of the tracks, while the other 40 percent lives to the southeast. Since all highway crossings are at grade, this 40 percent of the population could be cut off from fire, ambulance, and police services by the passage of a train. Children from 60 percent of the population must cross the tracks to reach school. The nearest hospital is to the east, so 60 percent of the population could be cut off from the hospital as well (PMM 1979).

The city's future plans will further diminish fire service accessibility because the city has purchased land for a new fire station to be located southeast of the tracks. Most of the fire volunteers, however, live northeast of the tracks, which could exacerbate the problem (PMM 1979).

Kansas City, Missouri. Kansas City (population 473,000) is served by 12 railroads that average 272 freight train trips daily. These railroads are Chicago and North Western, St. Louis-San Francisco, Illinois Central Gulf, Kansas City Southern, Milwaukee Road, Missouri-Kansas-Texas, Missouri Pacific, Rock Island, Santa Fe, Union Pacific, Norfolk and Western, and Burlington Northern (Missouri Division of Employment Security 1979).

Vehicle delay due to at-grade crossings should not be a problem in Kansas City. The city has a hilly topography, so most of the crossings are grade-separated. There are, however, two crossings where problems with regard to emergency services could develop. One crossing is in the southern part of the city where State Highway 150 crosses the Kansas City Southern tracks. The second crossing is where Jackson County route 10S crosses the Missouri Pacific tracks. There is a fire station within one-half mile of the crossing and the alternate grade-separated crossings are more than a mile to the north (I-435) and south (Blue Ridge Blvd.), both of which are considerably out of the way.

Pryor, Oklahoma. Pryor has a population of 7800, with 3000 people employed in 47 manufacturing companies, most of which are located just south of the city in a 10,000-acre industrial park. The Missouri-Kansas-Texas (MKT) stops and picks up freight two hours per day. The railroad is located on the western fringes of the city, paralleling U.S. Highway 69. Most residential areas and all of the city's services are located east of the railroad tracks. The police, fire, and sheriff's offices are located within one block of the tracks (Oklahoma Community Data Sheet for Pryor 1979).

Muskogee, Oklahoma. Muskogee (population 37,313) has 690 retail establishments employing 3216 people and 150 wholesale establishments employing 625 people. The city's 15 largest manufacturing companies employ an additional 3200 people (Oklahoma Gas and Electric 1979).

Muskogee is served by three railroads: Missouri-Kansas-Texas Railroad, Missouri Pacific (Texas Pacific) Railroad Company, and St. Louis-San Francisco Railway Company. Each railroad has two trains per day which stop to pick up freight (Oklahoma Gas and Electric 1979).

The MKT traverses the city in a general north-south direction and among the three railroads has the greatest effect on vehicular movement. Located on the east side of the railroad are the major residential and industrial areas. On the west side of the railroad are located the major commercial areas and public emergency facilities. The railroad has become a major physical barrier to traffic flows in an east-west direction. There are only five at-grade crossings and one grade-separated crossing (constructed in 1913) serving the major development (Oklahoma Gas and Electric 1979).

Several major tracks through the city are owned by Missouri Pacific. One parallels the MKT through the major portion of the city and then branches off to the west. Another Missouri Pacific line runs through the eastern part of the city, and a third runs through the northern portion of Muskogee, bypassing much of the city.

Newport, Arkansas. Newport (population 7900) has 2650 people employed in manufacturing industries and 1350 people employed in agriculture. The city serves as a maintenance/crew change stop for the Missouri Pacific. The railroad passes through the northwestern part of town and continues south along Front Street directly across from the White River (Arkansas State Highway and Transportation Department 1975a). The police and fire departments as well as the public library and a hospital are located one block from Front Street. These facilities would be affected by additional rail traffic and coal trains (Arkansas Department of Local Services 1977).

Dumas, Arkansas. Dumas (population 5300) has about 2000 people employed in eight manufacturing industries, including wood products and small appliances. The Missouri Pacific passes through Dumas. The Missouri Pacific tracks parallel Main Street and divide the town into east and west portions (Arkansas State Highway and Transportation Department 1975b). Most of the residential areas, along with the health facilities, are located on the west side of town. All other services are located on the east side of town. Directly affected facilities within four blocks of the Missouri Pacific tracks include schools, three churches, the public library, and the Desha County Hospital (Arkansas Department of Local Services 1977).

Rail-Barge Alternative

The area uniquely affected by this alternative is defined as those counties and towns along the rail route from Lincoln, Nebraska, east to St. Louis, Missouri, and from Kansas City to Pryor and Oologah, Oklahoma. This includes 36 counties in Nebraska, Iowa, Missouri, and Oklahoma and at least 88 towns, with a minimum total population of 692,000. Towns between Lincoln and St. Louis have average rail traffic of approximately 30 trains per day.

The towns identified as those most likely to be affected by this alternative are Lincoln, Nebraska; St. Louis, Missouri; and Kansas City, Missouri.

St. Louis now has only one rail-to-barge transshipment facility. This is the Hall Street terminal owned by American Commercial Barge Line-Western. It is located on 45 acres of a 70-acre site adjacent to BN tracks. There are no current plans for expansion, though the remaining land could be used for expanding the existing facility (White 1980). Studies are underway for development of these and other sites in the St. Louis harbor (Mankus 1980). Land for other facilities is available, especially on the east side of the river.

The capacity of this terminal is 10 MMTA, of which 60 percent is contracted for with Cajun Electric Company in Baton Rouge, Louisiana, which at present is processing approximately 3 MMTA (Barker 1980). The remaining capacity is uncommitted.

The Corps of Engineers has proposed rebuilding Lock 26 north of St. Louis at Alton, Illinois. Rebuilding the lock would relieve the waiting times experienced at this facility, which now are as much as 72 hours. A lock is considered at capacity when average delay times reach 150 minutes (ICC 1979, p. 4-27). The average at lock 26 is said to be as little as 24 hours (Dutt 1980) and as much as 3.5 days (Mankus 1980). To the extent that this project is delayed and the demand for coal in the south continues to increase, there will be increased pressure for the development of transshipment facilities in St. Louis.

3.L.2 AIR QUALITY AND NOISE

The railroad alternative routes would cross about 19 different air quality control regions, as designated by the U.S. Environmental Protection Agency (1972). Currently, nearly all of these regions are designated as being "better than national standards" or "cannot be classified" for total suspended particulates (TSP). Portions of Wyandotte County, Kansas, Tulsa and Mayes counties in Oklahoma, and parts of Pulaski and Ashley counties in Arkansas are the only regions that are presently not in attainment of the National Air Quality Standards for TSP. Air quality monitoring data representative of the railroad alternative routes should be similar to those discussed for the proposed slurry pipeline route (Section 3.A.8).

Existing noise levels along the railroad alternative route are dependent upon train speed, the number of trains passing a given site, topography, and the type of track. Maximum sound levels may range from 50 to 100 decibels, A-weighted scale (dBA), at a distance of 50 feet (OTA 1977). It is estimated that current rail traffic causes noise levels to exceed the EPA guideline level of 55 dBA within about 400 to 800 feet of the tracks.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES, MITIGATION MEASURES, AND MONITORING PROGRAMS

ENVIRONMENTAL CONSEQUENCES

This section discusses the environmental consequences (commonly referred to as impacts) of implementing the proposed action or alternatives. The affected environment is described in Chapter 3. The impacts are discussed to a level commensurate with the degree or severity of impact. Thus significant impacts are discussed in detail and insignificant impacts are merely summarized. As discussed below, not all resources would be affected by the proposed action or alternatives.

- Wilderness. No impacts on wilderness would result from construction or operation of the proposed action or alternatives, because no designated Wilderness Study Areas, Roadless Area Review and Evaluation (RARE II) areas, or state wilderness/natural areas would be crossed by the pipeline or would have construction closer to its boundary than an existing road or trail.

- Threatened or endangered plant species. The construction, operation, and maintenance of the proposed action or alternatives would not affect any federal- or state-listed species (FWS 1980a). Two species that may be listed at some future time may be affected by the Colorado alternative. These are discussed in Section 4.D.3.

- Noise. Noise levels generated by the proposed action or alternatives (except for the no-action alternative) were found to be insufficient to produce impacts, assuming implementation of the standard operating procedures described in Appendix C-1. The impact of noise from the no-action alternative is discussed in Section 4.L.4.

- Geology and topography. Construction of the proposed action or alternatives would result in only minor subsurface disturbance. Thus no impacts to geologic formations would occur. Although some sidehill cuts may be made, topographic features would not be altered or affected.

- Soils. Soils would be affected by the proposed action and the pipeline and water-source alternatives. Impacts would be minimized or eliminated by implementation of the reclamation procedures described in the Erosion Control and Revegetation Plan in Appendix C-1, which is part of the standard operating procedures. The effectiveness of this plan was evaluated and any problems were described in the Surface Water Quality, Vegetation, or Agriculture section. Because any residual impacts on soils are reflected in other resources, a separate soils section was not included.

- Mineral resources. Although various kinds of mineral resources may be present under some affected lands, construction would not preclude future development of these resources. Therefore no impact would result.

Impacts discussed for the proposed action (or specific components) also apply to portions of all of one or more of the alternatives. For the topics mentioned below, the impact discussion is not repeated for the alternatives:

- Ruptures and spills. The magnitude and type of impacts discussed for the proposed action would also apply to the market alternative, Cypress Bend pipeline-barge alternative, and Colorado alternative.

- Vegetation. Reclamation discussions presented for the proposed action also apply to disturbed areas for all of the alternatives.

- Wildlife. Impacts to wildlife for the Cypress Bend pipeline-barge alternative are similar to those discussed for the pipeline route in Arkansas for the proposed action.

- Agriculture. Discussions regarding concerns, impacts, and restoration of cropland production and grazing on native rangeland for the proposed action will also apply to disturbed areas for all the alternatives.

- Aquatic Biology. Impacts to aquatic biota for the market alternative and Cypress Bend pipeline-barge alternative are similar to those described for the proposed action, except at the Cypress Bend site. The impacts associated with the Oahe alternative water supply system are similar to those discussed for the Crook County alternative, except for the intake structure at the Oahe Reservoir. The water treatment facilities for the water discharge alternative would not result in any additional impacts to the aquatic resources already discussed for the dewatering plants.

- Air quality. The impacts to air quality for the market alternative are not substantially different from those discussed for the proposed action.

- Cultural resources. The discussion of impacts to cultural resources for the proposed action would apply to any of the other alternatives where ground disturbances would occur as a result of construction.

The impacts discussed in this chapter for the proposed action and alternatives are summarized in Chapter 2 and compared by alternative (see Tables 2-3 and 2-4).

IMPACT SIGNIFICANCE CRITERIA

The following criteria were used to determine the significance of impacts on each resource.

- Water resources. Impacts on the hydrology of the Madison aquifer system would be considered potentially significant if drawdowns in the potentiometric surface exceeded 25 feet, if stream flow was reduced by more than 0.5 cfs, or if measurable water quality changes occurred as a result of ETSI's ground-water withdrawals.

- Socioeconomics. Impacts were considered significant if they would exceed the following criteria:

  - Population. A permanent change in the local population greater than 5 percent as a result of combined direct and indirect employment, or a temporary change in the local population greater than 15 percent in the area where the construction work force would reside.

  - Housing. A demand for permanent housing greater than 10 percent of the local permanent housing market or a demand for temporary housing which would exhaust the local market.

  - Other infrastructure. The creation of a permanent demand in infrastructure greater than 10 percent, or the temporary creation of a demand which would exhaust the excess capacity of infrastructures in the areas where the crews would live, or a change in local tax revenues greater than 10 percent.

- Economics. An employment demand on the local work force greater than 15 percent or a permanent shift in any local industry greater than 5 percent.

In addition, the impacts were considered significant if the work force would be a considerably different social group than the residents of the area in which the crew would reside, or if the work force would present a conflict in social mores and attitudes.

- Vegetation. Impacts on vegetation resulting from removal of cover and from surface disturbance would be considered significant if, following construction, there would be a low probability of establishing adequate vegetative cover to minimize soil erosion with the implementation of the revegetation and erosion control plan. Any impacts to threatened or endangered plant species would be considered significant.

- Wildlife. Impacts on wildlife would be significant if any crucial habitats were affected during the season of use or if the habitat disturbance were expected to be greater than 1 percent of the habitat within a geographic region. Impacts to wetlands would be significant. Impacts to threatened or endangered species would be considered significant if the Fish and Wildlife Service finds that the project would jeopardize the species. If a significant amount of crucial habitat is destroyed, the dependent species would be significantly affected whether it is present at the time of construction or not. Different parts of an animal's habitat have different values or levels of importance. Habitat disturbances which comprise less than 1 percent of an animal's habitat may be significant if the disturbance is located in an area of high value (e.g., denning or nesting sites, brooding habitat, crucial winter range).

- Aquatic Biology. Impacts on aquatic biological resources would be significant if numerous fishes or macroinvertebrates would be killed or displaced as a direct result of permanent or temporary habitat loss due to project construction or operation.

- Cultural resources. Impacts would be considered significant if there is a reasonable possibility that a scientifically or culturally important site could be damaged or destroyed as a result of the proposed action or alternatives.

- Agriculture. Impacts on agricultural lands would be considered significant if these lands were irreversibly converted to other uses or if the viability of the lands were significantly diminished as a result of the proposed action or alternatives.

- Air quality. Impacts to air quality would be considered significant if one of the following criteria could be met by the proposed action or alternatives.

1. Temporary or localized impacts from construction would affect regional and/or long-term air quality.

2. Estimated emission rates at the pump stations would exceed the following:

   - Carbon monoxide, 100 tons/year

   - Nitrogen dioxide, 10 tons/year

- Sulfur dioxide, 10 tons/year
- Total suspended particulates, 10 tons/year
- Ozone, 10 tons/year of volatile organic compounds

3. Estimated concentration increases of pollutants which exceeded the rates expressed in item 2 above would exceed the following:

- Carbon monoxide, 500 $\mu g/m^3$, 8-hour average
- Nitrogen dioxide, 1 $\mu g/m^3$, annual average
- Sulfur dioxide, 5 $\mu g/m^3$, 24-hour average
- Total suspended particulates, 5 $\mu g/m^3$, 24-hour average

4. Predicted ambient concentration (pollutant increases exceeding the criteria in item 3 plus existing levels of pollutants) would exceed one-fourth of applicable federal standards.

- Recreation. A recreation impact is considered significant if it permanently removes part of the recreation area from its prior use or if it alters the extent or quality of recreational experiences possible at a particular area. Temporary (1 or 2 visitor seasons) disturbance of an area is not usually considered a significant impact, nor is disturbance in an area that is considered inaccessible and thus not regularly used, even though it is in the managed area (e.g., dispersed recreation areas in a national forest).

- Transportation. Transportation impacts are judged to be significant if the traffic is at a level where a further increase, particularly over the long term, would cause an instability of traffic flow, noticeable congestion, and/or a substantial increase in average travel time. Impacts would be considered significant if there would be any permanent impact on road or rail networks, if the local traffic would increase more than 30 percent, or if annual traffic accident rates would increase more than 3 percent.

- Visual resources. Impacts would be considered significant if long-term (greater than 5 years) changes would occur in the form, line, color, or texture of the existing visual resources near human use areas or areas having high scenic quality. Changes that would be temporary due to successful revegetation would be considered insignificant.

4.A PROPOSED ACTION

4.A.1 WATER RESOURCES

Ground Water

The impacts that would occur as a result of pumping from the proposed ETSI well-field sites were calculated by simulating the Madison aquifer system as a multilayer aquifer system using a digital model. The Madison aquifer system was conceptualized as a six-layer aquifer system that was numerically modeled using the program for simulation of three-dimensional ground-water flow by Trescott and Larson (1976). Following is a summary describing how the Madison aquifer system was numerically simulated. The results of these simulations are presented in the subsection Niobrara County Well Field and in subsequent sections. The hydrogeology of the Madison aquifer system and the methods used to calculate potential impacts are discussed in detail in the Well-Field Hydrology Technical Report (WCC 1981b).

The major components in the multilayer Madison aquifer system model used in this study (Figure 4-1) were defined to be:

- The Red River aquifer unit, defined as the Ordovician-age carbonates, consisting of the Red River Formation and equivalents

- The Madison aquifer unit, defined as the Mississippian-age carbonates, consisting of the Madison Group, the lower clastic member of the Minnelusa (the Bell Sand) and equivalents, and the Devonian- and Silurian-age carbonates

- The Minnelusa confining unit, defined as the Pennsylvanian-age carbonates of the Minnelusa Formation and the Permian-age carbonates and evaporites of the Minnelusa Formation below the continuous sandstones of the upper member of the Minnelusa

- The upper Minnelusa aquifer unit, defined as the laterally continuous sandstones of the upper Minnelusa Formation, the Converse Sands, and equivalents

- The Upper Confining unit, defined as the strata between the Minnelusa Formation and the Inyan Kara Group

- The Inyan Kara aquifer unit, defined as the Inyan Kara Group

The Madison aquifer system, composed of six subunits, was defined after a careful review of available information on the geologic and hydrogeologic characteristics of the strata in the study area, and after receipt of public comment on the Draft EIS. The aquifer system was characterized explicitly for simulating the response of the aquifer system to long-term pumping from the Madison aquifer. These six units were chosen so that interformational movements of water could be analyzed when water is pumped from the Madison aquifer by ETSI.

In the Draft EIS, the Madison aquifer system was defined to consist of five units, with the Inyan Kara Group combined with the Upper Confining unit. This conceptualization of the aquifer system was adequate for calculating drawdowns in the Madison aquifer, but was not adequate for calculating drawdowns in the shallower Inyan Kara Group. For this Final EIS, the Inyan Kara was defined explicitly as a sixth unit, making it possible to calculate meaningful drawdowns in the Inyan Kara Group as well as in the Madison aquifer. This change had an insignificant effect on drawdowns calculated for the Madison aquifer.

The six-layer conceptual model of the Madison aquifer system was translated into a five-layer numerical model (Figure 4-1). The five layers in the numerical model are: (1) the Red River aquifer unit, (2) the Madison aquifer unit, (3) the upper Minnelusa aquifer unit, (4) the Upper Confining unit, and (5) the Inyan Kara Group. The input parameters used in the numerical model were transmissivity and storage coefficients for each layer, and a leakage coefficient for each set of adjacent layers. Leakage coefficients were specified between each set of layers as a function of the vertical hydraulic conductivities of the adjacent layers if no confining bed separates the layers, or as a function of the confining bed properties. The estimated values of the aquifer parameters that were used to characterize the Madison aquifer system within the study region are listed in Table 4-1.

The best estimates of the aquifer characteristics were used as input parameters for calculating the Madison aquifer drawdowns presented in this EIS

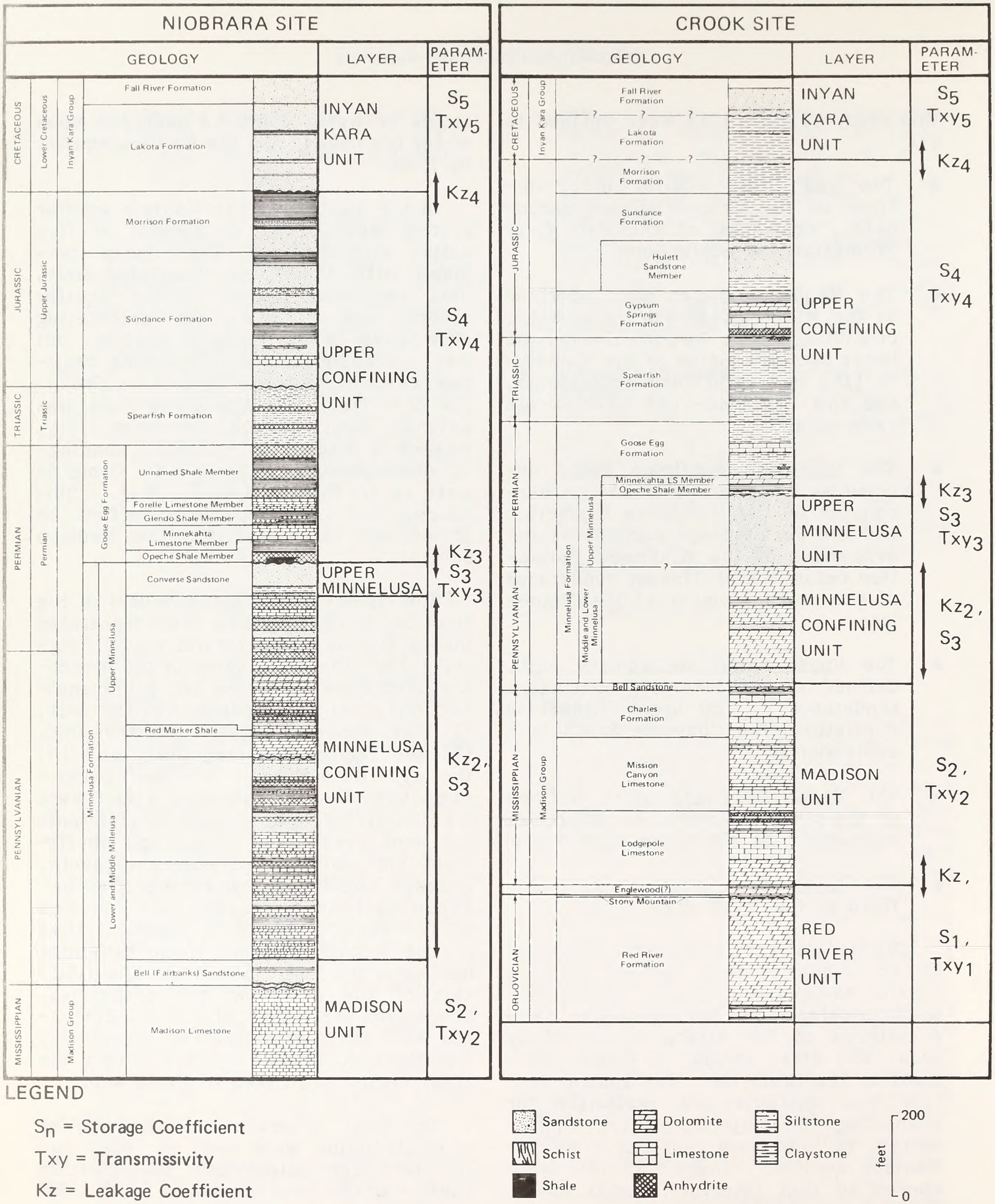


Figure 4-1. RELATIONSHIPS BETWEEN THE GEOLOGY, THE CORRESPONDING LAYERS, AND PARAMETERS USED IN THE NUMERICAL MODEL AT THE NIOBRARA AND CROOK COUNTY WELL FIELDS

TABLE 4-1

PARAMETER ESTIMATES USED IN THE MADISON AQUIFER MODEL

Layer	Parameter[a]	Estimated Value[b]	Probable Range in Parameter Estimates	Supporting Evidence
Inyan Kara Aquifer Unit	Transmissivity	0.003 ft^2/sec	---	Whitcomb 1963, Whitcomb and Morris 1964.
	Storage coefficient	$b \times 3.3 \times 10^{-4}$	$b \times 10^{-7}$ to $b \times 10^{-6}$	Lohman's (1972) estimate of storage coefficient for a typical confined aquifer.
	Leakage Coefficient	$10^{-13} sec^{-1}$	---	Bredehoeft and Neuzil 1980.
Upper Confining Unit	Transmissivity	0.00015 ft^2/sec	---	The parameter was arbitrarily set at a very low value.
	Storage coefficient	3.3×10^{-4}	---	The estimate is based on an idealized unit thickness of 1000 feet, and a storage coefficient of $b \times 10^{-7}$.
	Leakage coefficient	$4 \times 10^{-12} sec^{-1}$	4×10^{-11} to $4 \times 10^{-13} sec^{-1}$	The estimate is derived from the steady-state model. The range was defined on the basis of reasonable aquifer response.
Upper Minnelusa	Transmissivity[a]	0.003 ft^2/sec where upper Minnelusa contains 50% clastics 0.0003 ft^2/sec where upper Minnelusa contains 50% clastics	10^{-4} to 10^{-2} ft^2/sec	The estimates of transmissivity are derived from USGS Madison test well No. 1 test data, flow and specific capacity data from Whitcomb and Morris (1964), permeability data from Eisen and others (1980), and lithologic considerations.
	Storage coefficient[c]	$b \times 3.3 \times 10^{-7}$	$b \times 10^{-7}$ to $b \times 10^{-6}$	The parameter estimate is based on Lohman's (1972) estimates of storage coefficients for a typical confined aquifer.
	Leakage coefficient	$10^{-10} sec^{-1}$ where the upper member of the Minnelusa Formation contains 50% clastics $10^{-11} sec^{-1}$ where the upper member of the Minnelusa Formation contains 50% clastics	10^{-9} to $10^{-11} sec^{-1}$ 10^{-10} to $10^{-12} sec^{-1}$	The estimates are based on the steady-state model and on lithologic considerations.

TABLE 4-1 Concluded

Layer	Parameter[a]	Estimated Value[b]	Probable Range in Parameter Estimates	Supporting Evidence
Madison	Transmissivity[a]	0.03 ft^2/sec	0.01 to 0.09 ft^2/sec	The estimate is based on our model of aquifer tests at Gillette and Niobrara well fields, pump tests at many wells in western Black Hills region, long-term response of aquifer to pumping in western Black Hills region, and steady-state model.
	Storage coefficient[c]	b x 3.3 x 10^7	b x 10^{-7} to b x 10^{-6}	Refer to discussion of Red River storage coefficient estimate.
	Leakage coefficient	10^{-9} sec^{-1}	10^{-8} to 10^{-10} sec^{-1}	The estimate is based upon an effective vertical hydraulic conductivity of 5 x 10^{-7} ft/sec and a thickness of 500 feet between the midpoints of the Madison and Red River units.
Red River	Transmissivity[a]	b x 0.00375 ft/sec	b x 0.002 to b x 0.015 ft/sec	The estimate is based on test data from USGS test well No. 1.
	Storage coefficient	b x 3.3 x 10^{-7}	b x 10^{-7} to b x 10^{-6}	The estimate is based on a porosity of 10% and a matrix compressibility of 1.1 x 10^{-11} M^2/N. The matrix compressibility may be larger.

[a] Along the Black Hills monocline, the Fanny Peak monocline and lineament, the Shawnee flexure, the Rawhide fault, and the Cascade monocline, transmissivity in all layers (except the Upper Confining unit) was reduced by 0.01. The basis for this reduction was the model calibration procedure and geologic and water quality data that suggest a low-transmissivity zone along the structures. North of the Lake Basin fault zone, transmissivity was reduced by 0.1 in all layers except the upper. The basis for this reduction was the low transmissivity reported at USGS test well No. 2 and specific capacity data and water quality data in Miller (1976).

[b] b=thickness of unit, as determined from the isopachous maps presented in Appendix A of the Well-Field Hydrology Technical Report (WCC 1981b).

[c] The storage coefficient in outcrop areas of the Madison and upper Minnelusa were specified as 0.1.

(see Section 5.A.1). Data on these parameter estimates, especially on those pertaining to the hydraulic connection between the Madison aquifer and the Minnelusa Formation, were very limited. Consequently, uncertainty is associated with each of these parameter estimates. In an attempt to evaluate the effect of this uncertainty on the predicted drawdowns, a Monte Carlo technique was used to calculate the likelihood that drawdowns would be greater than or less than those drawdowns calculated using the best estimates of aquifer characteristics (see Chapter 7 of the Well-Field Hydrology Technical Report, WCC 1981b).

The following steps were taken to assess the reliability of the calculated drawdowns:

1. A log-normal probability distribution was specified for each of the model parameters.

2. One hundred sets of parameter combinations were randomly drawn from the specified log-normal distributions.

3. Transient simulations of the ETSI withdrawals for a 50-year period were made for each of the 100 combinations generated in step 2.

4. The drawdowns calculated in the 100 simulation runs were statistically analyzed to calculate the probability that a specified drawdown would be exceeded.

The probability distributions of drawdowns at specific locations in the Madison aquifer calculated from the Monte Carlo simulations of the proposed ETSI withdrawals showed that in all of the cases that were examined the drawdowns calculated using the best estimates of the aquifer characteristics were greater than the values having a 50 percent exceedance probability. For example, the calculated probabilities of drawdowns at Edgemont for Plan 1 show that there is a 98 percent chance that drawdowns would be greater than 150 feet, a 50 percent chance that drawdowns would be greater than 260 feet, and a 2 percent chance that drawdowns would be greater than 440 feet (Figure 4-2). Thus the drawdown calculated for Section 4.A.1 and presented in Table 4-2 is about 290 feet and, from this analysis, has an exceedance probability of 28 percent. Chapter 7 of the Well-Field Hydrology Technical Report (WCC 1981b) discusses these probabilities in more detail.

Six pumping scenarios (or plans) are also discussed (Table 4-3). Plans 1 and 2 refer to the proposed action and are discussed in this section. Two other plans (3 and 4) refer to the Crook County alternative water supply system and are discussed in Section 4.F.1. The remaining two plans (5 and 6) are combination pumping plans and are discussed only for the cumulative case in Section 5.A.1.

For the proposed action, the impacts associated with obtaining up to 20,500 acre-feet of water (Table 4-3) from the Niobrara County well field (Plan 1) and from a combination of pumping (Plan 2) from the Niobrara well field and the Gillette well field (now under construction by the city of Gillette) were predicted based on calculated drawdowns in the potentiometric surface of the Madison aquifer. The capacity of the coal slurry system would be 37.4 million (short) tons of coal per year, requiring 20,000 acre-feet of water per year for slurry make-up and an additional 200 to 500 acre-feet for coal preparation. Thus this analysis considered the withdrawal of 20,500 acre-feet of ground water from the Madison aquifer for a period of 50 years, or a total of 1,025,000

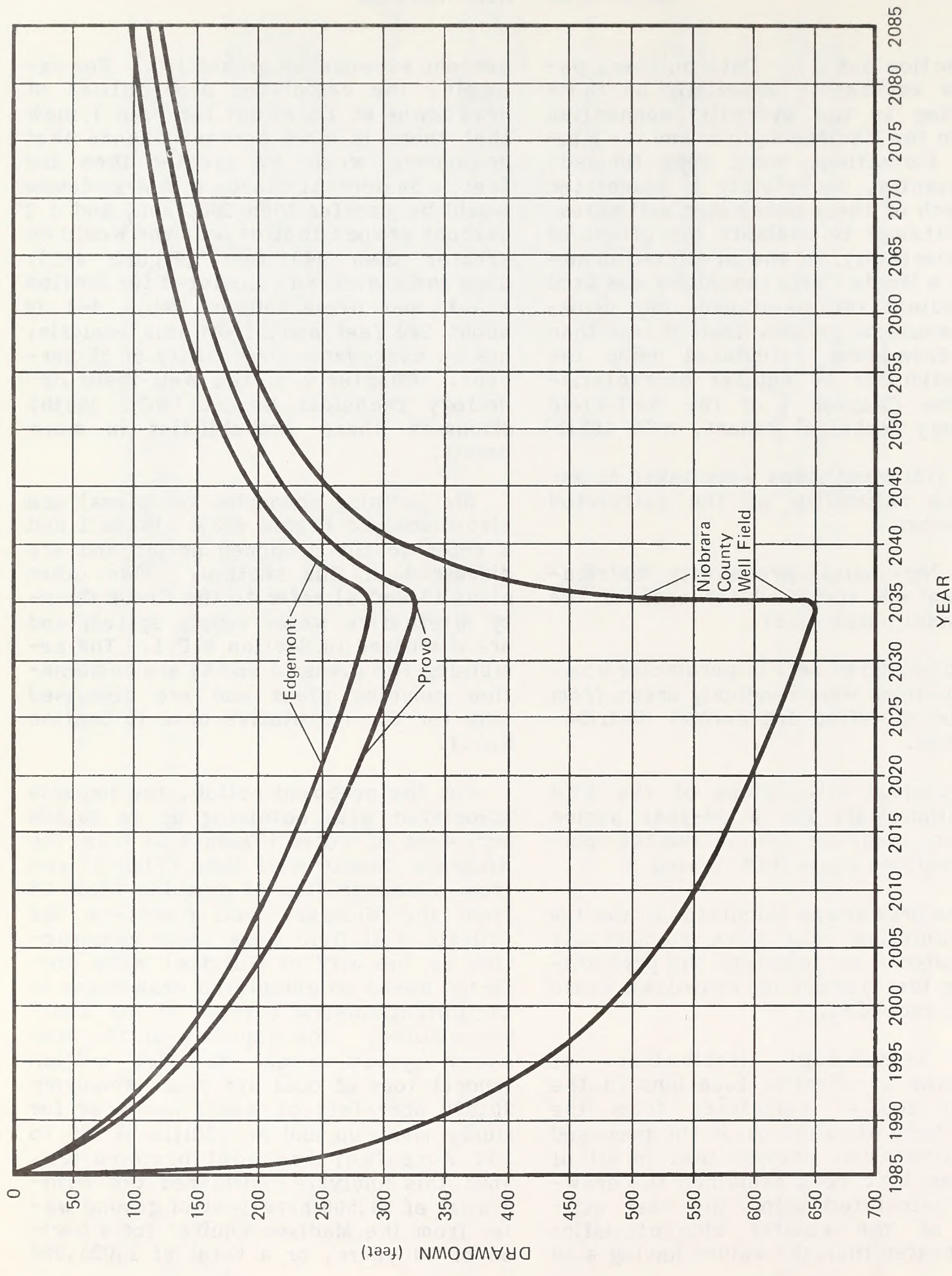


Figure 4-2. TIME-DRAWDOWN PLOT WITH PUMPING FROM NIOBRARA COUNTY WELL FIELD ONLY (PLAN 1)

TABLE 4-2

CALCULATED DRAWDOWNS IN THE MADISON POTENTIOMETRIC SURFACE

Approximate Location[b]	Location No. (See Map 3-9)	Calculated Drawdowns (feet): Current Use Only		Existing Users Plus Planned Use	Plan 1: Niobrara Well Field Only		Plan 2: Niobrara Well Field Plus Gillette Well Field		Plan 3: Crook Well Field Only		Plan 4: Crook Well Field Plus Gillette Well Field	
		1900-1980 Time Period	1985-2035 Time Period	1985-2035 Time Period	ETSI Only	ETSI Plus Existing Users	ETSI Only	ETSI Plus Existing Users	ETSI Only	ETSI Plus Existing Users	ETSI Only	ETSI Plus Existing Users
Niobrara County Well Field, WY	1	18	9	9	660	670	460	470	-	a	-	a
Edgemont, SD	2	44	8	8	290	300	200	210	-	a	-	a
Provo, SD	3	31	8	8	320	330	220	230	-	a	-	a
Hot Springs, SD	4	1	1	1	7	8	5	6	-	a	-	a
Cascade Springs, SD	5	3	3	3	31	34	21	24	-	a	-	a
Lusk, WY	6	-	1	1	5	6	4	5	-	a	-	a
Newcastle, WY	7	130	18	32	1	20	1	20	3	21	7	26
Osage, WY	8	68	14	76	-	a	24	38	17	31	35	50
Upton, WY	9	32	13	67	-	a	55	69	37	51	80	93
Sundance, WY	10	5	8	36	-	a	32	40	30	38	52	60
Gillette Well Field, WY	11	11	10	140	-	a	190	200	90	100	250	260
Devils Tower, WY	12	8	10	65	-	a	75	85	130	140	170	180
Hulett, WY[d]	13	7	9	53	-	a	59	69	120	130	140	150
Crook County Well-Field, WY	14	10	10	29	-	a	29	40	370	380	280	290
Bell Creek, MT	15	30	10	18	-	a	14	25	150	160	120	130
Belle Fourche, SD	16	2	4	12	-	a	11	15	44	48	40	44
Spearfish, SD	17	1	2	6	-	a	5	7	26	28	25	27

Note: Numbers in the columns have been rounded to two significant figures and may not add exactly in the rows because of this rounding. A dash (-) indicates a calculated water-level decline of less than 1 foot. Pumping schedules used in drawdown calculations are listed in Tables 3-4 and 4-3.

[a]ETSI's pumping would not increase effects caused by existing users.

TABLE 4-3

PUMPING SCHEDULES FOR THE VARIOUS WELL-FIELD COMBINATIONS: PLANS 1, 2, 3, 4, 5, AND 6

Plan Number and Name	Time Period (years)	Pumping Rate in cfs (acre-feet per year)
Plan 1: Niobrara Well Field Only	1985-2035	28.31 (20,500)
Plan 2:* Niobrara Well Field	1985-1995	16.90 (12,240)
	1995-2005	18.62 (13,480)
	2005-2015	19.48 (14,100)
	2015-2025	19.94 (14,440)
	2025-2035	20.17 (14,610)
City of Gillette Well Field	1985-1995	11.41 (8,260)
(amount of water supplied	1995-2005	9.69 (7,020)
to ETSI only)	2005-2015	8.83 (6,390)
	2015-2025	8.37 (6,060)
	2025-2035	8.14 (5,890)
Plan 3: Crook Well Field Only	1985-2035	28.31 (20,500)
Plan 4:* Crook Well Field	1985-1995	16.90 (12,240)
	1995-2005	18.62 (13,480)
	2005-2015	19.48 (14,100)
	2015-2025	19.94 (14,440)
	2025-2035	20.17 (14,610)
City of Gillette Well Field	1985-1995	11.41 (8,260)
(amount of water supplied	1995-2005	9.69 (7,020)
to ETSI only)	2005-2015	8.83 (6,390)
	2015-2025	8.37 (6,060)
	2025-2035	8.14 (5,890)
Plans 5 and 6: Combined Well Fields (described in Chapter 5 only)		
Niobrara Well Field	1985-2035	14.16 (10,250)
Crook Well Field	1985-2035	14.16 (10,250)

Note: The pumping intervals listed above were used to calculate drawdowns for each well-field pumping plan. The maximum rate of withdrawal by ETSI would be 28.3 cfs (20,500 acre-feet per year) when the coal cleaning operations would be conducted. Since the greatest impacts would be expected to occur with the largest pumping rate, the maximum rate (28.3 cfs) was used, and not a smaller rate.

These pumping schedules were used with the pumping schedules in Table 3-4 to simulate pumping by existing Madison ground-water users, as well as pumping by ETSI.

*Average annual rates for 50 years (acre-feet):

Niobrara - 13,700, Gillette - 6800
Crook - 13,700, Gillette - 6800

acre-feet of water for the permit and design life of the project.

The amount of water calculated to be available to ETSI from the Gillette well field was based on a schedule of projected water demands and supplies developed by James M. Montgomery, Consulting Engineers (1979), for the city of Gillette (Figure 4-5 in the Montgomery report). The difference between the projected maximum amount of water that would be pumped from the well field and the amount of water that would be expected to be used by the city of Gillette was used to calculate the amount of water that would be supplied to ETSI from the Gillette well field. This amount was used to represent the worst-case analysis.

The calculated declines in the Madison potentiometric surface during the period 1985-2035 as a result of continued water production at existing rates from water wells in use in 1980 (Table 3-4) would be small relative to the draw downs calculated to be caused by the proposed pumping by ETSI (Map 3-8, Table 3-5). Because the hydrologic impacts that would be caused by existing users are calculated to be so small (Tables 4-2, 4-4), only the impacts that would be caused by ETSI are considered here. These impacts include declines in ground water levels and reductions in spring and stream flow. These calculated impacts are listed in Tables 4-2 and 4-3.

Only the impacts caused by pumping from the Madison that would affect Madison water users, springs, and streams for Plans 1 through 4 are discussed in Chapter 4. The cumulative hydrologic impacts on the Madison and Inyan Kara aquifers, as well as other aquifer units, springs, and streams for Plans 1 through 6, are described in Section 5.A.1, because of the importance of knowing the potential cumulative impacts on other aquifers as well as the Madison.

Niobrara County Well Field.

Water Levels. Pumping approximately 1 million acre-feet of water from the Madison aquifer at the Niobrara well field over the ETSI project's 50-year design life (1985-2035) would result in large declines in the potentiometric surface of the Madison aquifer system (Map 4-1 and Table 4-2). However, only at the Madison wells located near Edgemont, South Dakota, would drawdowns in the Madison potentiometric surface exceed 25 feet. Water levels at the seven Madison wells used for municipal water supply at Edgemont were calculated to decline by about 290 feet, from their present level of 200 feet above land surface, after 50 years of pumping. The calculated probability distribution of drawdowns at Edgemont shows that there is a 98 percent chance that drawdowns would be greater than 150 feet, a 50 percent chance that drawdowns would be greater than 260 feet, and a 2 percent chance that drawdowns would be greater than 440 feet (Figure 4-2). Water levels in the Madison wells at Provo, South Dakota, were calculated to decline by about 340 feet, from the present level of 200 feet above land surface to about 140 feet below land surface.

This possible change in water levels would occur over time, as shown on Figure 4-3. Depending on the need for water at the time the flow recedes below ground level, pumps may or may not be required. As a consequence of growth, other water sources may have been developed by that time. Therefore it is impossible at this time to predict what the possible impacts may be on the municipal water supply districts or local governments. The most that can be said is that if the predicted impacts occur

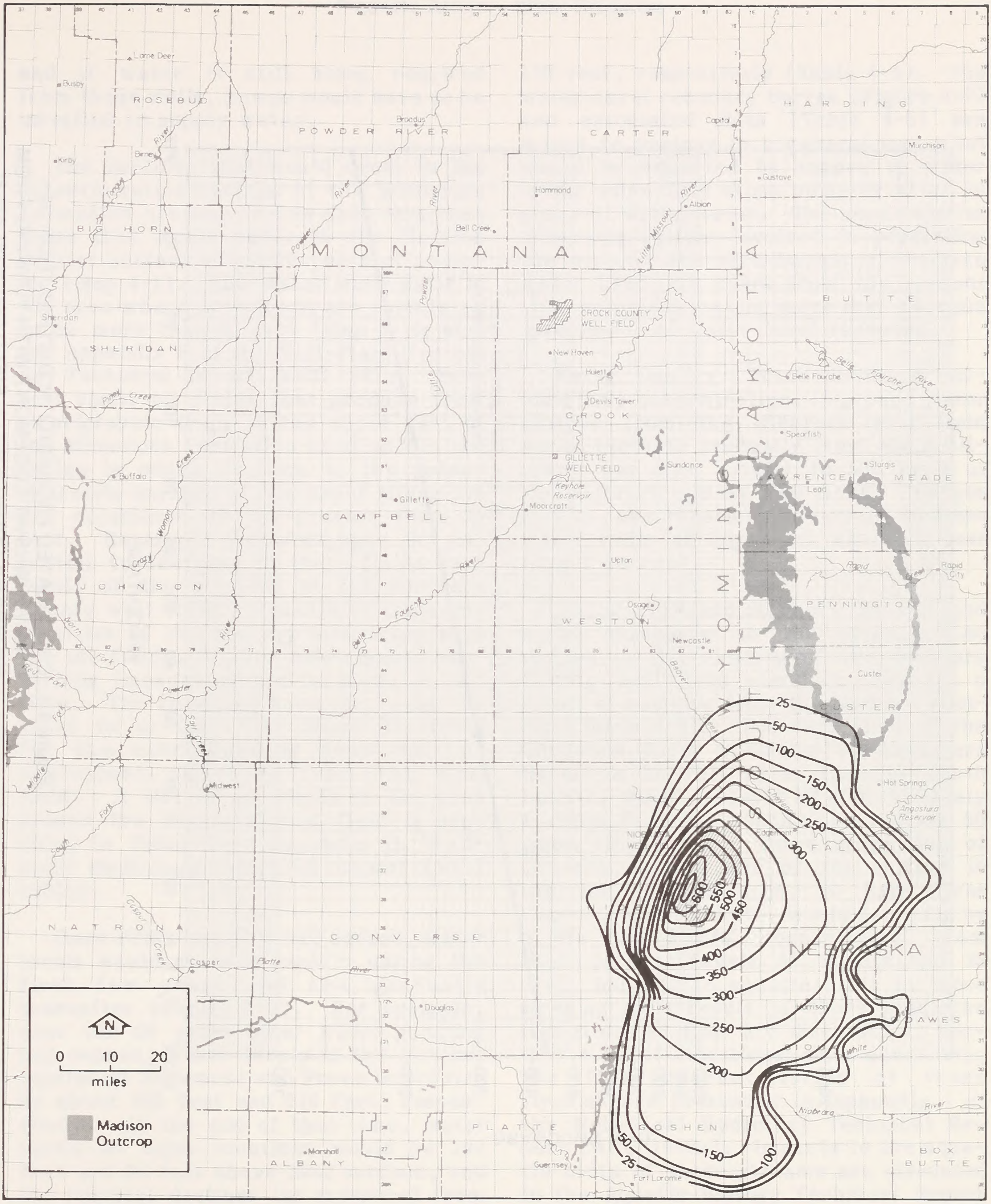
TABLE 4-4

CALCULATED CHANGES IN GROUND-WATER DISCHARGE RATES TO THE MAJOR STREAMS AND SPRINGS IN THE BLACK HILLS REGION AS A RESULT OF WITHDRAWALS FROM THE MADISON AQUIFER DURING THE PERIOD 1985 to 2035

Approximate Location	Location No. (see Map 3-9)	Existing Users Only, 1985-2035 Time Period	Calculated Change in Discharge Rate (cfs)							
			Plan 1: Niobrara W.F. Only		Plan 2: Niobrara W.F. Plus Gillette W.F.		Plan 3: Crook W.F. Only		Plan 4: Crook W.F. Plus Gillette W.F.	
			ETSI Only	ETSI Plus Existing Users	ETSI Only	ETSI Plus Existing Users	ETSI Only	ETSI Plus Existing Users	ETSI Only	ETSI Plus Existing Users
Little Missouri River at the Montana-Wyoming State Line	18	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1	1	1	1
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	< 0.5	< 0.5	< 0.5	1	1	4	4	4	4
Sand Creek (entire drainage basin)	20	< 0.5	< 0.5	< 0.5	2	2	3	4	4	4
Crow Creek Springs, SD	21	< 0.5	< 0.5	< 0.5	1	1	2	2	2	2
Spearfish Creek (entire drainage basin)	22	< 0.5	< 0.5	< 0.5	1	1	1	1	1	1
Stockade-Beaver Creek (entire drainage basin)	23	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1	1
Cheyenne River (upstream of Angostura Reservoir)	25	< 0.5	1	1	1	1	< 0.5	< 0.5	< 0.5	< 0.5
Cascade Springs, SD	26	< 0.5	4	4	3	3	< 0.5	< 0.5	< 0.5	< 0.5
Hot Springs, SD	27	< 0.5	2	2	1	1	< 0.5	< 0.5	< 0.5	< 0.5

Note: Numbers in the columns above are rounded to the nearest whole number and may not add exactly. W.F. = well field.

Pumping schedules used in drawdown calculations are listed in Tables 3-4 and 4-3.



Map 4-1. CALCULATED WATER-LEVEL DECLINES IN THE MADISON AQUIFER POTENTIOMETRIC SURFACE AFTER 50 YEARS (1985-2035) OF PUMPING FROM NIOBRARA COUNTY WELL FIELD ONLY (PLAN 1)

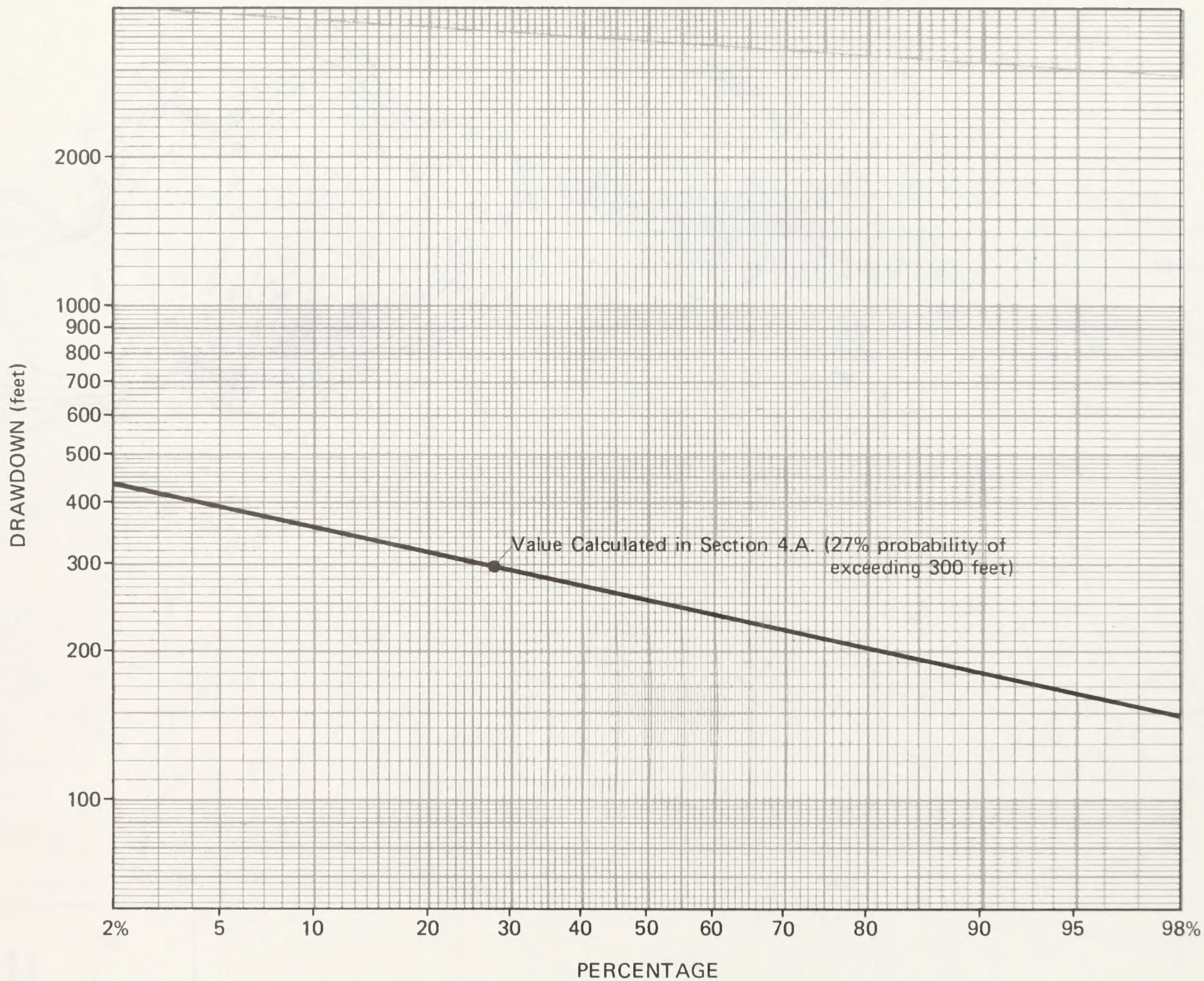


Figure 4-3. CALCULATED PROBABILITY DISTRIBUTION OF DRAWDOWNS AT EDGEMONT WITH PUMPING FROM NIOBRARA COUNTY WELL FIELD ONLY (PLAN 1)

and if water is still being required from these wells, pumps would have to be installed to supply water.

The declines that would occur in the potentiometric surface of the Minnelusa Formation are only a few feet less than those that would occur in the Madison aquifer surface after 50 years of pumping (Map 4-1). Few water wells exist in the area where drawdowns are calculated to be more than 25 feet (Map 3-10; also see Appendix F of the Well-Field Hydrology Technical Report, WCC 1981b). Several small oil fields that produce from stratigraphic traps in the upper part of the Minnelusa Formation exist within the region in which declines in the potentiometric surface of the upper Minnelusa are calculated to be greater than 25 feet. Reservoir pressures have the potential to decrease in these fields as a result of the pumping at the Niobrara County well field. Because of the complexities of the geology associated with the oil fields, further refinements concerning impacts cannot be made at this time. The impacts, however, would be equal to or less than those predicted for the corresponding rock unit at equivalent distances from the well field. A list of oil fields in the area around the Niobrara well field is provided in Table G-1, Appendix G, Well-Field Hydrology Technical Report (WCC 1981b).

Once ETSI's pumping had ceased, water levels would recover rapidly during the first few years and rise gradually thereafter (Figure 4-3). For example, over the 50 years after ETSI's pumping had ceased, water levels in the Madison aquifer at Edgemont and Provo would rise by about 200 feet and 210 feet, respectively. At the end of that time, water levels at these locations would be 100 feet and 90 feet above land surface, and the residual declines (as measured from the 1985 levels) would be 98 feet and 110 feet, respectively (Table 4-5). The water-level recovery curves (Figure 4-2) and associated data (Table 4-5) are meant to portray in a general way what would be expected to happen to water levels when ETSI stops pumping after 50 years of withdrawals. The uncertainties and complexities involved in predicting the amount and distribution of Madison water used 100 years from the present time precludes making more than a simple assessment of water-level recovery.

<u>Water Quality</u>. Total dissolved solids (TDS) concentrations in ground water pumped from the Niobrara well field would increase gradually from 500 milligrams per liter (mg/l) to 560 mg/l at the Niobrara County well field. Changes in TDS concentrations at current Madison water wells at Edgemont would be less than 1 percent.

<u>Spring Flow and Stream Flow</u>. Ground water discharge to the streams and springs in the vicinity of the Niobrara County well field would decrease as a result of pumping from the Madison aquifer (Table 4-4). The base flow of the Cheyenne River upstream of Angostura Reservoir in Fall River County, South Dakota, would decrease by approximately 1 cubic foot per second (cfs) after 50 years of pumping. The average flow of Cascade Springs and of the springs in the Hot Springs area, in Fall River County, South Dakota, would decrease by 4 cfs and 2 cfs, respectively, from their present levels of 22 cfs and 25 cfs. Impacts to aquatic biota in these streams as a result of these predicted reductions in flow are discussed in Section 4.A.6. Additional data concerning the flow characteristics of these streams are presented in Appendix I of the Well-Field Hydrology Technical Report (WCC 1980b). Impacts to the aquatic biota of these streams are discussed in the Aquatic Biology Technical Report (WCC 1981g).

TABLE 4-5

CALCULATED MADISON GROUND-WATER LEVEL DECLINES
50 YEARS AFTER ETSI WOULD HAVE STOPPED PUMPING
(CALENDAR YEAR 2035)

Approximate Location[a]	Location No. (see Map 3-9)	Calculated Decline Remaining 50 Years after ETSI Stopped Pumping: Plan 1: Niobrara County Well Field Only (ETSI pumping only)	Plan 3: Crook County Well Field Only (ETSI pumping only)
Niobrara County Well Field, WY	1	122	—
Edgemont, SD	2	98	—
Provo, SD	3	110	—
Hot Springs, SD	4	7	—
Cascade Springs, SD	5	29	—
Lusk, WY	6	6	—
Newcastle, WY	7	5	4
Osage, WY	8	—	14
Upton, WY	9	—	27
Sundance, WY	10	—	37
Gillette Well Field, WY	11	—	40
Devils Tower, WY	12	—	15
Hulett, WY[b]	13	—	44
Crook County Well Field, WY	14	—	56
Bell Creek, WY	15	—	58
Belle Fourche, SD	16	—	32
Spearfish, SD	17	—	12

Note: A dash (—) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations as shown on Map 3-9.

[b]Drawdown calculated in the Minnelusa aquifer unit.

Niobrara County Well Field with Gillette Supplemental Water.

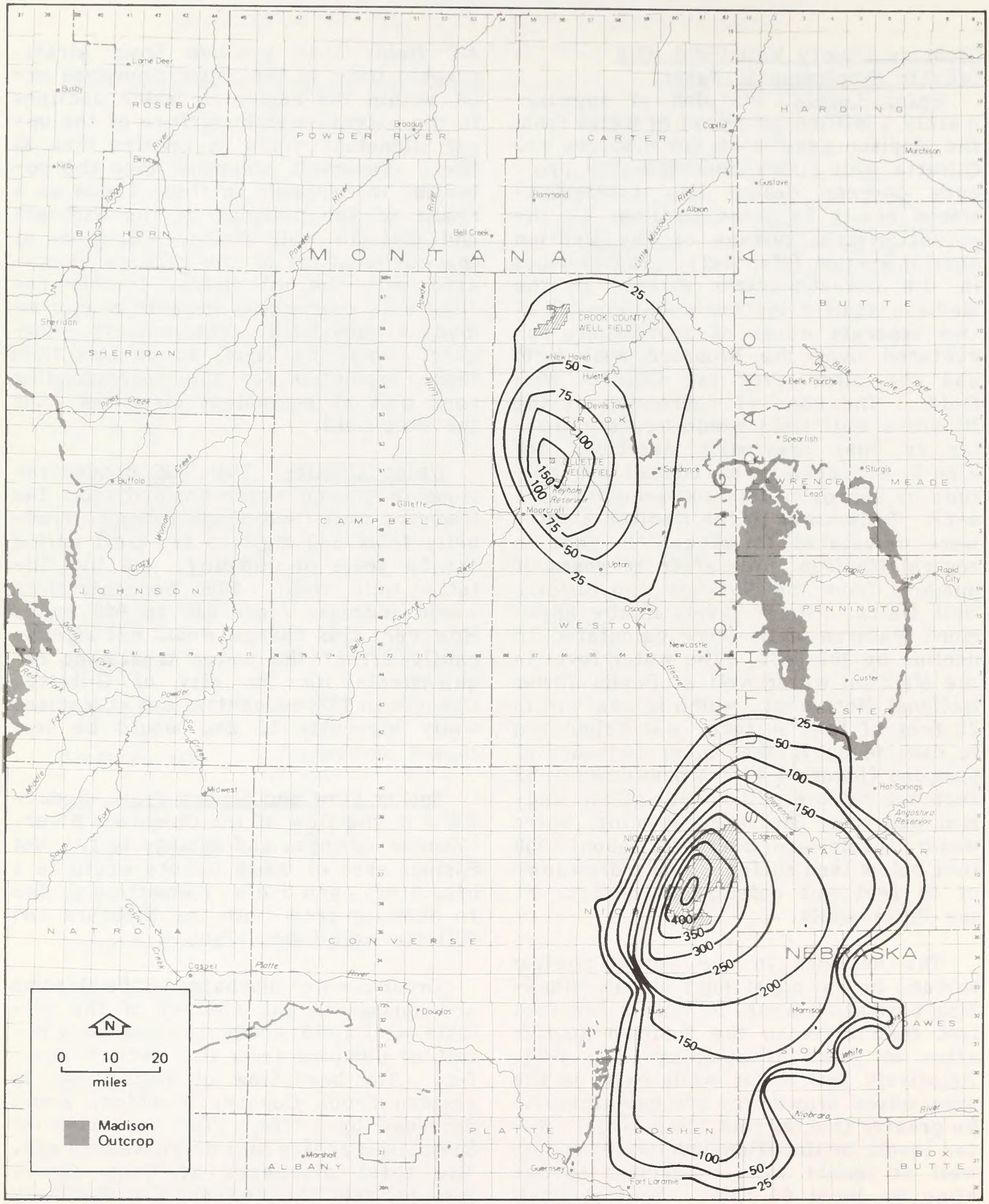
Water Levels. Pumping of approximately 1 million acre-feet of water from the Madison aquifer at the Niobrara and Gillette well fields over the ETSI project's 50-year design life (1985-2035) would result in large declines in the potentiometric surface of the Madison aquifer system (Map 4-2). The declines in the potentiometric surface in the Madison aquifer system would consist of two separate cones of depression, one centered over the Niobrara well field and the other over the Gillette well field. The cone of depression at the Niobrara well field would be very similar to that previously described for Plan 1, with drawdowns reduced in magnitude by approximately 30 percent (Table 4-2). Drawdowns in the Madison aquifer were calculated to exceed 25 feet in several Madison wells after 50 years of pumping from the Niobrara and Gillette well fields. Water levels in the Edgemont Madison wells were calculated to decline by 200 feet. The water level in the Madison water well at Devils Tower National Monument, which is now within 20 feet of land surface, was calculated to decline by 75 feet after 50 years of pumping (Figure 4-4). A drawdown of 32 feet was calculated to occur at the Madison wells near Sundance, Wyoming, where water levels are currently about 400 feet below land surface, and a drawdown of 55 feet was calculated to occur at the Upton wells.

The declines in the potentiometric surface in the upper part of the Minnelusa Formation would be only a few feet less than those in the Madison aquifer after 50 years of pumping (Map 4-2). Relatively few water wells exist in the area where drawdowns are calculated to be greater than 25 feet (Map 3-10). Water levels in the Minnelusa water supply well at Hulett were calculated to decline by about 60 feet. Several small oil fields that produce from stratigraphic traps in the upper Minnelusa exist within the region in which declines in the potentiometric surface of the upper Minnelusa would be greater than 25 feet. Reservoir pressures have the potential to decrease in these fields as a result of the pumping at the Niobrara and Gillette well fields. Because of the complexities of the geology associated with the oil fields, further refinements concerning impacts cannot be made at this time. The impacts, however, would be equal to or less than those predicted for the corresponding rock unit at equivalent distances from the well field.

Water Quality. The TDS concentrations in ground water pumped from the Niobrara well field would increase gradually from 500 mg/l to 540 mg/l during the 50 years of pumping. At the Gillette well field, TDS concentrations would increase from 600 to 620 mg/l. However, this change would not significantly affect the water treatment requirements for the city of Gillette. Changes in TDS concentrations at Madison wells currently in use would be less than 1 percent.

Spring Flow and Stream Flow. Reductions in the flow of the Cheyenne River, Cascade Springs, and springs in the Hot Springs area of South Dakota would be 1 cfs, 3 cfs, and 1 cfs, respectively, due to pumping from both the Niobrara and Gillette well fields (Table 4-4).

Ground-water discharge to the streams and springs in the vicinity of the Gillette well field would decrease as a result of pumping from the Madison aquifer. The base flow of Sand Creek in eastern Crook County, Wyoming, would decrease by 2 cfs. The base flow of Spearfish Creek would decrease by 1 cfs. The total discharge of Crow Creek Springs, near the McNenny Fish Hatchery



Map 4-2. CALCULATED WATER-LEVEL DECLINES IN THE MADISON AQUIFER POTENTIOMETRIC SURFACE AFTER 50 YEARS (1985-2035) OF PUMPING FROM NIOBRARA COUNTY AND GILLETTE WELL FIELDS (PLAN 2)

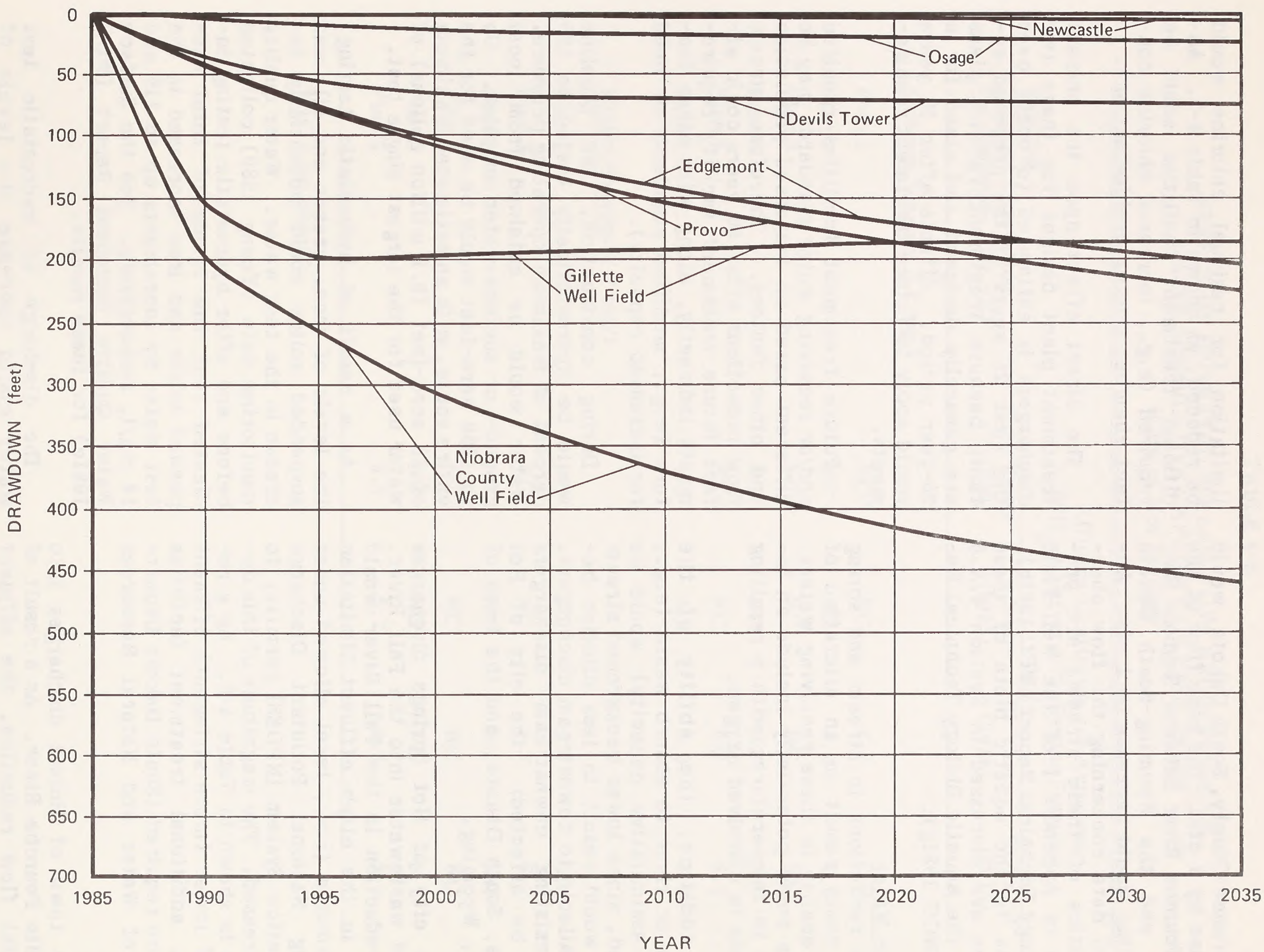


Figure 4-4. TIME-DRAWDOWN PLOT WITH PUMPING FROM NIOBRARA COUNTY AND GILLETTE WELL FIELDS (PLAN 2)

in Lawrence County, South Dakota, would decrease by 1 cfs. The base flow of the Belle Fourche River between Keyhole Reservoir and the Wyoming-South Dakota state line would decrease by 1 cfs. Additional data concerning the flow characteristics of these streams are presented in Appendix I of the Well-Field Hydrology Technical Report (WCC 1981b). Impacts to the aquatic biota of these streams are discussed in Section 4.A.6 and in the Aquatic Biology Technical Report (WCC 1981g).

Surface Water

The reductions in stream and spring flows could result in an alteration of water quality in these receiving waters. Effects could potentially include an increase in temperature, with a resulting decrease in dissolved oxygen.

In addition, the ability of the stream or river to absorb waste (e.g., waste assimilative capacity) would be reduced, since lower background stream flows would result in less dilution being available to downstream dischargers. Two existing downstream dischargers would be affected: the city of Hot Springs, South Dakota, and the town of Hulett, Wyoming.

The city of Hot Springs discharges treated wastewater into the Fall River. Flow reduction in the Fall River would result in the city's effluent limitation for ammonia (i.e., level allowed under existing National Pollutant Discharge Elimination System [NPDES] permits) to be decreased. The magnitude of this decrease is shown in Table 4-6. As a result of lower (more stringent) effluent limits, additional treatment facilities would be required (South Dakota Department of Water and Natural Resources 1981).

The town of Hulett discharges into the Belle Fourche River. As a result of potential flow reduction, the effluent limitation for residual chlorine would be reduced, as shown in Table 4-7. Additional treatment facilities could be required (e.g., increased chlorine contact chamber size or dechlorination).

The direct effect upon the present treatment plant designs for these two dischargers is estimated to occur over the first 25 years of the proposed action, because treatment facility plans are generally designed and sized for a 20-year period. Effects after 50 years would apply to future treatment requirements.

Future treatment facilities required and/or receiving water standards may be different based on increased population and other factors. Therefore stream flow reductions after 50 years could affect future treatment facility requirements indirectly, along with other factors (e.g., modified standards or need for increased capacity).

During construction, the pipeline would be hydrostatically tested to 125 percent of maximum operating pressure. Water would be obtained from local ground- or surface-water supplies. Up to 1650 acre-feet would be used for the entire route, with an estimated maximum of 28 acre-feet (9.1 million gallons) of water used for the largest single test.

As a result of hydrostatic testing, the levels of iron, grease and oil, and suspended solids could potentially increase in the test water. Water quality monitoring data (Young 1980) collected before and after hydrostatic testing indicated that the levels of total suspended solids and iron increased in the test water by increments up to 110 and 14 mg/l, respectively. See the Surface Water Quality Technical Report (WCC 1981c) for these results.

The discharge of hydrostatic test water could increase the levels of

TABLE 4-6

EFFECT OF ESTIMATED STREAM FLOW REDUCTIONS ON WASTE ASSIMILATIVE CAPACITY OF FALL RIVER
(City of Hot Springs)

Existing Effluent Limitation for Ammonia (NH_3-N)	Effluent Limitation for Ammonia (NH_3-N) after ETSI Begins Pumping (mg/l) 5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Summer Season: 6.8 mg/l				
Plan 1	NC*	NC	4.2	3.9
Plan 2	NC	NC	4.2	4.2
Plan 3	NC	NC	NC	NC
Plan 4	NC	NC	NC	NC
Plan 5	NC	NC	NC	4.2
Plan 6	4.2	4.2	3.9	3.9
Winter Season: 7.7 mg/l				
Plan 1	NC	NC	5.7	5.3
Plan 2	NC	NC	5.7	5.7
Plan 3	NC	NC	NC	NC
Plan 4	NC	NC	NC	NC
Plan 5	NC	NC	NC	5.7
Plan 6	5.7	5.7	5.3	5.3

*NC = No change.

TABLE 4-7

EFFECT OF ESTIMATED STREAM FLOW REDUCTIONS ON WASTE ASSIMILATIVE CAPACITY OF BELLE FOURCHE RIVER
(Town of Hulett)

	Effluent Limitation for Residual Chlorine after ETSI Begins Pumping (mg/l)			
	5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Plan 1	0.22	0.22	0.19	0.19
Plan 2	0.19	0.19	0.19	0.15
Plan 3	0.19	0.15	0.12	0.12
Plan 4	0.19	0.15	0.12	0.12
Plan 5	0.19	0.19	0.15	0.12
Plan 6	0.19	0.19	0.15	0.12

Existing effluent limitation for residual chlorine: 0.25 mg/l.

suspended solids and turbidity, iron, and oil and grease, and could decrease the levels of dissolved oxygen in receiving waters. The specific effects would depend upon site-specific conditions such as the quantity and quality of local water used. Receiving-water impacts would be especially significant in low-flowing surface waters, which have low assimilative capacities. Uncontrolled discharge could also result in erosion at local discharge sites. For the highest volume of test water required (9.1 million gallons), uncontrolled (instantaneous) discharge over a short period could significantly increase local surface-water flow. Discharge of this entire volume over 24 hours, for example, would represent a continuous discharge of more than 14 cfs. This rate of discharge could exceed the total background stream flow at most of the streams and rivers crossed, except for the major perennial rivers.

Executive Order 11988 requires that federal agencies avoid direct or indirect support of floodplain development wherever there is a practical alternative and avoid, to the extent possible, the long- and short-term adverse impacts to property and the environment associated with occupancy or modification of floodplains.

The proposed action pipeline would cross the floodplains of numerous creeks, streams, and rivers. Stream crossing construction is scheduled to occur during periods of low flow, minimizing the likelihood of flooding during construction. If a major flood were to occur during construction, however, damage to or loss of equipment could occur. Construction debris of fuel could be added to downstream flood flows, and an increase in sediment load with downstream deposition could occur. In accordance with existing regulatory requirements, the pipeline would be buried beneath the maximum expected scour depth at all river crossings, minimizing potential flooding effects following construction.

Certain surface facilities, including pump stations and dewatering plants, could be located in potential 100-year floodplains (see Table 3-6). The location and elevation of proposed surface facilities, and specific design characteristics, have not yet been precisely determined (e.g., they are located within approximately 1-square-mile areas). Preparation plants and pump stations would be designed to provide protection from the 100-year flood by the siting of facilities at sufficient elevation, using elevated pads or dikes where necessary.

Dewatering plants would be located within the boundaries of existing or future power plants and would thus receive the same level of protection as the power plants. At dewatering plants located within power plant boundaries without 100-year-flood protection, conveyors, buildings, and process facilities could be damaged or destroyed. Overtopping of clariflocculator tanks could release coal slurry into floodwaters. Oil, fuel, or other process wastestreams could also reach floodwaters.

The construction of surface facilities in the 100-year floodplain would permanently remove several natural vegetation types, as described in Section 4.A.4 and further detailed in the Terrestrial Biology Technical Report (WCC 1981e). This could result in increased erosion at these sites. The surface facility flood protection measures (diking or pad elevation) could also result in potentially higher flood velocities or flood peaks at these sites. Potential upstream effects include increased stage heights and increased area of floodplains. The specific magnitude of these effects would depend upon final facility siting and design characteristics, as well as the level of flood protection provided at existing and future power plant sites. Because of the relatively small areas involved and the existing topography at most sites, upstream effects would probably be negligible.

Construction activities at perennial streams, wetlands, and bayous would result in a temporary increase in suspended sediments. Immediately downstream from construction, these levels could exceed 10,000 mg/l. Increases in background levels are expected for up to an additional 1000 feet at most crossings.

During construction of the proposed well field, all drilling fluids would be discharged into a mud pit to evaporate, minimizing potential water quality effects in local surface waters. During construction activities at preparation and dewatering plant sites, sedimentation (detention) basins, and/or straw bale filters would be constructed to prevent suspended sediments or other potential pollutants from reaching downstream receiving waters. At preparation plants, all process water would be incorporated into the slurry makeup water, preventing discharge into local receiving waters. Water removed from the slurry at dewatering plants would be used as power plant makeup, and no discharges to local waters would occur. Drainage facilities (e.g., settling basins, pH control, etc.) would be designed to treat coal pile runoff so the resulting discharge would meet existing effluent limitation guidelines promulgated under the Clean Water Act for the steam electric power generating industry (EPA 1974a, 1980a).

4.A.2 SOCIOECONOMIC CONSIDERATIONS

Socioeconomic impacts were evaluated in terms of added employment, population, and housing. A second, but equally critical, level of impacts evaluated was the additional burden placed on existing public facilities and the ability (financially and institutionally) of the local communities to provide the services demanded by the influx of population. The general approach used to estimate these impacts was as follows:

- Analyze the schedule of quarterly manpower needs by project component to estimate in-migration and residential distribution patterns as well as population and household characteristics.
- Evaluate the family structure and housing preferences of various elements of the work force (e.g., preference differences between more stable fixed-site construction workers against the more transient pipeline workers).
- Determine by county, and where appropriate by community, the settlement patterns of new-to-the-area workers, induced employment, population, housing, and demand for public services.
- Estimate the incremental impacts to the baseline.
- Identify potential problem areas such as limited carrying capacity of capital facilities (wastewater, water, and schools).
- Estimate the net fiscal impacts, where appropriate and feasible, of the combined developments in the region and the marginal impacts due to ETSI.

Project Components in Wyoming

Construction. The major construction activities would include the building of the three preparation plants, the water supply system, slurry gathering lines, and the first 100 miles of the main slurry pipeline. Preparation plant construction would take place from 1983 through 1989, with peak employment demand occurring in the second quarter of 1984. Construction of the slurry gathering lines from the preparation plants and the water supply system would require more than two years. Construction of the northernmost 100 miles of the main slurry pipeline is estimated to require a little over three months and is scheduled to take place during the fourth quarter of 1984. The combined fixed-site and pipeline construction work force would peak at 1015 workers in the fourth quarter of 1984 (Table 4-8).

Induced Employment. Expenditures by construction workers and contractors locally would generate additional income and employment in the area. Estimates of nonbasic or service-sector employment were based on the following assumptions:

- All the service workers would be newcomers. Reasons for this assumption are outlined in the Socioeconomics Technical Report (WCC 1981d).

- Fixed-site construction jobs would generate or induce new service-related jobs by a ratio of 5:2 (a multiplier of 0.6) (see Chapter 4 in WCC 1981d). It is difficult to assess the induced effects of pipeline construction workers, since there is little information regarding expenditure patterns, propensity to consume, or the ability of the service sector to respond. However, the same multiplier (0.6) was used in this case to determine the worst-case condition.

- Permanent nonlocal workers would generate or induce new service-related jobs in a ratio of 10:8 (a multiplier of 1.2) (RSWA-Denver 1980).

Secondary employment generated by the construction project would be about 600 workers, at maximum.

Residential Location of Construction Work Force. Principal factors influencing residential location for fixed-site construction workers are community size, availability of adequate housing and services, distance from work site, transportation service, and recent experiences in the region. The estimated distribution of the construction work force to the principal communities, by construction activity, is given in Table 4-9 (Wyoming DEPAD 1980).

Population. Estimates of the population increase associated with the combined construction and service activities are given in Table 4-10. For each type of worker, the following assumptions were used to develop these estimates:

- Nonlocal fixed-site construction workers
  - 48.9 percent would be accompanied by their families; average household size would be 3.61 persons (RSWA-Denver 1980).
  - Total transient population would be 2.28 times the number of construction workers (Mountain West Research 1975).

- Nonlocal pipeline construction workers
  - 16.3 percent would be accompanied by their families; average household size would be 2.83 persons (Northern Tier Pipeline 1979).

TABLE 4-8

CONSTRUCTION WORK FORCE ESTIMATES FOR WYOMING, BY QUARTER

Project Component	1982		1983				1984				1985			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
North Rawhide Prep. Plant		5	19	29	43	63	72	80	68	38	5	9	20	14
Jacobs Ranch Prep. Plant		24	95	131	176	224	260	278	200	114	11	24	50	31
North Antelope Prep. Plant		5	15	29	40	55	70	82	70	50	60	50	25	12
Subtotal		34	129	189	259	342	402	440	338	202	76	83	95	57
Water Lines and Slurry Gathering Lines			60	360	360	60	90	260	260	30	15			
Well Field			41	41	41	41	41	41	41	41				
Water Pump Station				8	22	23	20	18	17	12				
Slurry Pump Station P-2				20	49	49	39	39	38	30				
Slurry Pump Station P-3		—	—	20	49	49	39	39	38	30	—	—	—	—
Subtotal		34	230	638	780	564	631	837	732	345	91	83	95	57
Main Pipeline Construction		—	—	—	—	—	—	—	—	670	—	—	—	—
Total		34	230	638	780	564	631	837	732	1015	91	83	95	57

TABLE 4-8 Concluded

Project Component	1986				1987				1988				1989			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
North Rawhide Prep. Plant	7	20	18	8	2	5	11	8								
Jacobs Ranch Prep. Plant	60	69	52	35	35	31	29	20	15	15						
North Antelope Prep Plant	14	18	21	49	56	25	18	5	5	11	21	49	56	25	18	5
Subtotal	81	107	91	92	93	61	58	33	20	26	21	49	56	25	18	5
Water Lines and Slurry Gathering Lines																
Well Field																
Water Pump Station																
Slurry Pump Station P-2																
Slurry Pump Station P-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	81	107	91	92	93	61	58	33	20	26	21	49	56	25	18	5
Main Pipeline Construction	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	81	107	91	92	93	61	58	33	20	26	21	49	56	25	18	5

TABLE 4-9

ESTIMATED RESIDENTIAL LOCATION CHOICES OF CONSTRUCTION WORKERS
(Percent)

Project Component	Campbell County		Converse County	Weston County	Niobrara County
	Gillette Planning Area	Wright			
North Rawhide Prep. Plant	100	-	-	-	-
Jacobs Ranch Prep. Plant	40	40	-	20	-
North Antelope Prep. Plant	35	30	20	15	-
Water Pipelines	65	25	-	-	10
Well Field	-	-	20	-	80
Pump stations	15	15	-	-	70
Main Slurry Pipeline	100[a]	-	(50)[a]	-	(50)[a]

Note: Location pattern is based on (1) heuristic analysis of available transportation, housing by type, and services; (2) review of several permit applications to the Wyoming Industrial Siting Council; and (3) review of the Mineral Development Monitoring System maintained by Stuart-Nichols Associates for the Wyoming Department of Economic Planning and Development.

[a] Transient work force for the main slurry pipeline (spread crew I) would more than likely locate first in Niobrara and Converse counties and then relocate in the Gillette Planning Area.

TABLE 4-10

PEAK ETSI-RELATED POPULATION FOR CONSTRUCTION AND SERVICE SECTORS (1984)

Area or Community and Project Component	Quarter 1	2	3	4
Gillette Planning Area				
• Fixed-Site	885	1297	1146	428
• Main Pipeline (100%)				1500[a]
Total				1928
Wright				
• Fixed-Site	521	692	579	254
Converse County				
• Fixed-Site	71	78	71	58
• Main Pipeline (50%)				750[a]
Total				808
Weston County				
• Fixed-Site	203	216	164	96
Niobrara County				
• Fixed-Site	351	405	399	273
• Main Pipeline (50%)				750[a]
Total				1023

Note: A more detailed explanation of these calculations is given in the Appendix H.

[a] Transient workers for the pipeline (and their families) would probably locate first in Niobrara and Converse counties and then relocate in the Gillette Planning Area.

- Total transient population would be 1.30 times the number of pipeline workers (Northern Tier Pipeline 1979).

- Nonbasic workers

  - There would be 1.6 service workers per service worker household; average household size would be 2.5 persons (RSWA-Denver 1980).

Housing. Peak housing requirements resulting from ETSI construction would probably occur in 1984, with the most significant of the demands taking place in the Gillette Planning Area (GPA) (Table 4-11). The spread crew building the main slurry pipeline would require approximately 921 units, most of which would be temporary quarters such as motels. This group is anticipated to remain in southern Niobrara and Converse counties for about 6 to 8 weeks and then move to the Gillette area.

While the incremental impact of this pipeline construction crew would be large, it would last for only 6 to 8 weeks per community. It is expected that through the use of travel trailers and campers and the sharing of rooms by construction workers, the influx of workers could be accommodated.

Housing for the fixed-site workers presents a different and longer-term problem. Residential distribution patterns (see Table 4-11) indicate that construction workers would tend to locate in a number of communities such as the Gillette Planning Area. Housing in these communities is already limited, in terms of both the actual supply and the cost of housing. Recently, (late 1979 and 1980), new housing construction has been constrained by very high mortgage rates and the unavailability of mortgage financing in Wyoming, and in the Gillette region in particular.

The short-term remedy for many of these communities has been to add more mobile homes to relieve demands, but this action does not help to increase the permanent housing supply.

Summary of Construction Impacts. In summary, construction of the ETSI project components in Wyoming would generate over 1000 fixed-site and pipeline construction jobs (Table 4-8) and an additional 600 secondary (nonbasic) jobs (using a basic/nonbasic ratio of 0.6) during the peak period (fourth quarter 1984). This construction would cause an increase in population of about 2600 in the four-county region. The population increase estimate, from Table 4-10, is arrived at by adding the increase in population from fixed-site components (1109 during fourth quarter 1984) to the total 1500 population from the main pipeline components (1500 people would locate first in Niobrara and Converse counties and relocate in the GPA). Aggregate increases in employment and population associated with construction of the proposed action would exert a positive but not significant impact on the regional economy. The differential construction impacts of increased employment and population on the counties and major communities are summarized in Table 4-12 and are discussed below.

- Campbell County, Gillette Planning Area, Gillette, and Wright. The projected GPA population base is 31,700 by 1984 (Table 3-12). ETSI would not cause significant impacts on Campbell County or the Gillette Planning area.

  - The economic base and population will have grown large enough to absorb the increases due to ETSI (Table 4-20 in WCC 1981d).

  - Communities are anticipating the overall growth and have expanded or plan to expand community

TABLE 4-11

ETSI-RELATED HOUSING REQUIREMENTS
DURING PEAK CONSTRUCTION PERIOD (1984)

Area or Community and Project Component	Quarter 1	2	3	4
Gillette Planning Area				
• Fixed-Site	378	554	490	183
• Main Pipeline (100%)				921
Total				1104
Wright				
• Fixed-Site	223	296	243	109
Converse County				
• Fixed-Site	30	33	30	25
• Main Pipeline (50%)				461
Total				486
Weston County				
• Fixed-Site	87	92	70	41
Niobrara County				
• Fixed-Site	150	173	170	116
• Main Pipeline (50%)				461
Total				577

Note: A more detailed explanation of these calculations is given in Appendix H.

TABLE 4-12

SUMMARY OF SOCIAL AND ECONOMIC EFFECTS OF CONSTRUCTION IN WYOMING DURING PEAK CONSTRUCTION PERIOD (1984): PROPOSED ACTION

County	Community	Project Component[a]	Baseline 1984 Total Employment	Total Peak Fixed-Site Employment[b,c] (2nd quarter 1984)	Total Peak Pipeline Employment[c,d] (4th quarter 1984)	Estimated Peak Population In-migration	
						Fixed-Site	Pipeline
Campbell	Gillette Planning Area	PP, WGL, PL, PS	14,000	645	1072	1297	1500
Converse	Douglas Glenrock	PL	7,600[e]	38	536	78	750
Weston	Newcastle	PL	3,300[e]	107	0	216	0
Niobrara	Lusk	WGL, WF, PS, PL	1,450[e]	202	536	405	750

TABLE 4-12 Concluded

County	Estimated Peak Housing Unit Demand		Hotel-Motel Units in Area Avail./Under Construction	Public Services		
	Fixed-Site	Pipeline		Wastewater	Water	Schools
Campbell	554	921	620/Gillette 51/Wright	Excess capacity	Excess capacity	Excess capacity
Converse	33	461[d]	360/Douglas 54/Glenrock	Excess capacity	Excess capacity	Excess capacity
Weston	92	0	210/Newcastle	Adequate	Adequate	Adequate
Niobrara	173	461[d]	150/Lusk	Excess capacity	Excess capacity	Excess capacity

[a] PP = preparation plant
WGL = water gathering line
PL = pipeline
WF = well field
PS = pump station

[b] Peak period ranging from 1983 to 1984.

[c] Includes construction and service sectors. Assumes all employees will be nonlocal.

[d] Transient work force for the pipeline and their families would probably first locate in Niobrara and Converse counties and then relocate in the Gillette Planning Area.

[e] Employment estimates are countywide figures.

facilities and services to accommodate growth (Table 4-20 in WCC 1981d).

- While no significant overburden on community facilities would be anticipated, the city of Gillette and the Campbell County School District would experience adverse fiscal impacts beyond 1984 due in part to ETSI, since it would contribute a lesser proportion of tax revenues to these entities because of the tax structure (discussed later in this section) (Table 4-22 in WCC 1981d).

- Substantial short-term housing shortages are anticipated in the GPA, especially during the peak construction period of late 1984, (page 4-50 in WCC 1981d).

- Niobrara County and Lusk. Socioeconomic effects of construction of the ETSI pipeline facilities in Niobrara County are mixed. Most of the revenues generated from ETSI components would go to the county. On the other hand, most of the in-migrating population would locate in Lusk, but since ETSI facilities would be located outside the town, Lusk would not receive much of the increase in the tax base.

  - Location of ETSI facilities would increase the county's property tax base by 52 percent from a fiscal year 1980 base of $1.5 million.

  - Peak ETSI fixed-site construction population (405) would increase the county's 1984 population of 3200 by 1 percent.

  - Most of the new-to-the area people would locate in Lusk. Although the in-migrating population in absolute terms would be only 405 people and would be expected to remain in the area for more than 2 to 3 years, the net increase in the town population would be a substantial 21.3 percent.

  - Lusk is planning to upgrade its wastewater and water facilities and is also expanding the treatment capacity in anticipation of population growth. As a result, the town faces substantial increases in wastewater treatment costs.

  - However, since ETSI facilities would be located outside the town limits in northern Niobrara County, the town would not receive much of the increase in the tax base to offset cost increases.

- Weston County, Newcastle, and Upton. No significant impact from ETSI is anticipated. ETSI-related population would increase the population of the county by 2.3 percent and the population of Newcastle by 4 percent. Both communities are planning to expand public services.

- Converse County, Douglas, and Glenrock. No significant impacts are anticipated. At the most, temporary pipeline construction workers might add only 4 percent of the county's population base for a period of only 6 to 8 weeks. The increase in population due to fixed-site workers would be less than 1 percent. No significant problems are anticipated in the provision of water, wastewater, or school facilities.

Operation and Maintenance. The western district operations office would be located at Jacobs Ranch. In addition, there would be preparation plant employees at North Rawhide and North Antelope. A total of approximately 243 operations personnel would commute to work from the five nearby counties in Wyoming (Campbell, Converse, Crook, Weston, and Niobrara).

Operation of the proposed project would begin in January 1985. At this point there would be a substantial labor pool available both from the completion of ETSI construction projects and from construction of other energy projects. A substantial drop-off in construction-related jobs after 1984 is expected, resulting in a substantial increase in the rate of unemployment (Tables 4-9 and 4-10, WCC 1981d). Although a large portion of the preparation plant jobs would be filled by in-migrants, many jobs would be filled by local residents.

Assuming all preparation plant personnel are nonlocal (a worst-case situation), the net effect on regional employment, population, housing, and services would be as discussed below.

Employment. No significant impact is anticipated. At the end of 1984, between 600 and 800 ETSI construction workers would be leaving the area, and an estimated 1000 workers from other construction jobs would also be leaving the area. The influx of 243 maintenance and operation personnel would fill only part of the void.

Population. No significant impact is anticipated. The departure of the ETSI construction workers would result in a population decrease of 900 to 1200 people. Operation of the preparation plants would result in an increase of 626 people.

Housing. No significant impact is anticipated, but operation could create a shift in the housing preference and a higher vacancy rate. Since permanent workers generally prefer detached, single-family units, an accelerated construction program would be necessary to satisfy the increased demand. Since departing workers would have lived in mobile homes and apartments, there could be a surplus of these units and higher vacancies if the increased construction program for permanent single-family units were realized.

Services. No significant impact is anticipated. Services such as sewers, water, and schools would have been expanded to meet the needs of the departing construction workers and their families. No new services would be required to serve the new residents. The number of departing construction workers is not considered sufficient to result in any significant economic impacts to the permanent population after their departure.

Tax Revenues. A significant impact is anticipated. Increased assessed valuations and property tax revenues from the ETSI project would have positive significant impacts on Converse, Weston, and Niobrara counties, but the proposed project would have a negative net fiscal impact on Campbell County, the city of Gillette, and the Campbell County School District (Tables 4-12 and 4-13). Projected deficits for Gillette and the school district are shown in Table 4-13.

Summary of Operation Impacts. Estimated maintenance and operation effects on each county and/or community are shown in Table 4-14 and are summarized below.

- Campbell County, Gillette Planning Area, Gillette, and Wright. Work crews associated with preparation plant operation would not

TABLE 4-13

NET FISCAL IMPACT OF ETSI PROJECT

	Annual Projected Surplus/Deficit (x $1000)		
	With ETSI	Without ETSI	Net Fiscal Impact of ETSI
Campbell County			
1984	+3,477	+3,534	-57
1990	+5,877	+5,913	-36
Total Impact (1984 through 1990)			+69
Gillette (general fund account)			
1984	+552	+498	+54
1990	-2,058	-1,917	-141
Total Impact (1984 through 1990)			-258
Campbell County School District			
1984	+25,429	+27,184	-1755
1990	+57,708	+58,750	-1042
Total Impact (1984 through 1990)			-6360
Net Total Impact of ETSI			-6549

TABLE 4-14

SUMMARY OF SOCIAL AND ECONOMIC EFFECTS OF OPERATION IN WYOMING: PROPOSED ACTION

County	Community	Project Component[a]	Employment: Direct Employment	Employment: Estimated Secondary Employment	Estimated Population In-Migration	Annual County Property Tax Revenues: 1976-77 Property Tax Revenues (x $1000)	Annual County Property Tax Revenues: Estimated ETSI Property Tax Revenues (1980 Dollars) (x $1000)	Annual County Property Tax Revenues: Percentage of 1976-77 Property Tax Revenues
Campbell[b]	Gillette Planning Area	PP, WGL, PL, PS	106[d]	127	465	39,198	1,621	4.1
Converse[c]	Douglas	PL	12	14	53	14,353	100	0.7
Weston[c]	Newcastle	PL	39	47	170	3,606	356	7.1
Niobrara[c]	Lusk	WGL, WF, PL, PS	9	11	40	2,530	1,321	52.2
Goshen		PL				3,279	128	3.9

[a]PP = preparation plant
WGL = water gathering line
PL = pipeline
WF = well field
PS = pump station

[b]Estimates for the Gillette Planning Area.

[c]Estimates are countywide figures.

[d]Does not include 77 jobs in Wright.

significantly affect local communities. The operating work crew would total 243 in all four counties, or one-fourth of the peak construction crew. Permanent workers would in effect replace construction crews; consequently, there would be no impact.

- Niobrara County and Lusk. In the long run, the impact of permanent workers on the county would not be significant. ETSI associated population would be 1.7 percent of the county's total population.

- Converse County, Douglas, and Glenrock. No significant impacts from the permanent work force are anticipated.

- Weston County, Newcastle, and Upton. ETSI operating employment would be insignificant. The increase in the population of the county would be about 1.5 percent; the increase in the population of Newcastle would be about 3 percent.

Abandonment. Socioeconomic impacts resulting from project abandonment are expected to be insignificant. Because of the mining activities in the area, it is anticipated that no long-term unemployment would be experienced by operating personnel when pipeline operations are discontinued. Wyoming counties, particularly Campbell, would have a reduction in property tax revenues as the property was depreciated, and revenues would approach zero upon abandonment. However, the property taxes accruing from the proposed project would be a relatively minor portion of the Campbell County budget.

Project Components Outside Wyoming

Slurry Pipelines and Pump Stations

This section discusses impacts to areas with pipeline and pump stations only, as shown in Table 4-15. Segments of pipeline and pump stations near dewatering plants are discussed in the Dewatering Plants section.

The potential impacts that the pipeline and pump station areas would be subjected to are as follows:

- Short-term impacts due to increased demand for incidental services, such as lodging, food, and fuel

- Short-term impacts through increasing sources of social interaction (annoyance may result from increases in noise and traffic congestion, or new sources for social interaction may result in welcome sense of social excitement)

- Long-term impacts through increases in tax revenues from project-related property taxes

The counties, parishes, and selected communities in the affected area were examined for their capacities to provide needed services for the short term. They were also examined to determine the potential for beneficial effects over the period of project operation. Details of specific demands and capacities are provided in the Socioeconomics Technical Report (WCC 1981d).

Minor impacts due to temporary increased demand for transient housing, food, and fuel would be experienced to some extent in those counties included in the affected environment. In no instance was the level of anticipated adverse effect on the environment determined to be significant.

Construction. Potential effects from pipeline construction are quite different from those associated with long-term, fixed-site construction projects. Pipeline crews move rapidly

TABLE 4-15

EFFECTS OF CONSTRUCTION ON AREAS OUTSIDE WYOMING WITH PIPELINE AND PUMP STATIONS ONLY: PROPOSED ACTION

Area	County/ Parish	1975 Pop.	Project Component[a]	Peak Fixed-Site Employment[b] Qtr/Yr	Peak Fixed-Site Employment[b] Total	Peak Fixed-Site Employment[b] Non-local	Peak Pipeline Employment Qtr/Yr	Peak Pipeline Employment Total[c]	Peak Pipeline Employment Non-local[c]	Estimated Peak Pop. In-Migration Fixed-Site	Estimated Peak Pop. In-Migration Pipeline[c]	Estimated Peak Housing Unit Demand Fixed-Site	Estimated Peak Housing Unit Demand Pipeline[c]	Hotel/Motel Units in Selected Communities
Northwest Nebraska	Sioux Box Butte Morrill Garden Deuel Scotts Bluff	2,000 12,400 6,100 2,900 2,400 36,200	PL, PS	4/83	49	38	2/84	748	562	insignificant	731	insignificant	337	500/Scottsbluff
Southwest Nebraska	Keith Perkins Chase Hayes Hitchcock Red Willow	10,100 3,500 4,800 1,500 4,000 12,800	PL, PS	4/83	49	38	2/84	748	562	insignificant	731	insignificant	337	280/Ogallala 217/McCook
North Kansas	Decatur Norton Graham Trego Ellis Rush Barton	5,100 6,700 4,400 4,400 27,400 4,800 31,600	PL, PS	4/83	49	25	3&4/83	748	374	insignificant	486	insignificant	226	741/Hays
South Kansas	Stafford Reno Kingman Harper Sumner	6,200 63,700 8,900 7,900 24,500	PL, PS	4/83	49	25	1&2/84	748	374	insignificant	486	insignificant	226	83/Kingman 4975/Wichita
Northwest Arkansas	Sequoyah, OK Crawford Sebastian Franklin	28,600 33,400 109,100 13,700	PL, PS	4/83	49	25	4/83 1/84	748	374	insignificant	486	insignificant	226	1111/Ft. Smith

TABLE 4-15 Concluded

Area	County/ Parish	1975 Pop.	Project Component[a]	Peak Fixed-Site Employment[b]			Pipeline Employment			Estimated Pop. In-Migration		Estimated Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total[c]	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
North-Central Arkansas	Johnson	17,100	PL, PS											
	Pope	36,100												
	Conway	18,600		4/83	49	25	2&3/84	688	344	insignificant	447	insignificant	206	420/Russellville
	Van Buren	11,800		4/83	42	21	3/83	260	130	insignificant	169	insignificant	80	250/Batesville
	Cleburne	15,800												
	Perry	7,400												
South Arkansas	Cleveland	6,900	PL, PS											
	Bradley	12,700												
	Ashley	26,400		4/83	49	25	1/84	615	307	insignificant	399	insignificant	184	450/Pine Bluff
North Louisiana	Morehouse	33,700	PL, PS	4/83	49	25	2&3/84	615	307	insignificant	399	insignificant	184	1500/Monroe
	Ouachita	130,700		4/83	49	25				insignificant		insignificant		
	Caldwell	10,200												
	La Salle	15,200												

Source: Population data are from U.S. Bureau of the Census 1978.

Note: See Table 4-16 for information on counties near the dewatering plants.

[a]PL = pipeline
PS = pump station

[b]Fixed-site employment includes construction and service sector employment.

[c]Assumes maximum (rough terrain) spread size as a worst case.

through areas in which the right-of-way extends. The right-of-way clearing crew may work as much as 25 miles ahead of the trenching and pipe-laying crews and as much as 40 miles ahead of the cleanup crew. Associated effects are therefore spread along a series of communities in proximity to the right-of-way at any one time.

Typically, few crew members are accompanied by other persons because of the speed of project activities. The construction work week is typically six days, 10 to 12 hours per day. Under these circumstances, few crew members bring their families; this is especially true for those workers having school-age children. Work on the pipeline would potentially affect a given area for no more than 4 months, and in most cases for only 2 to 3 months. For those segments in which a pump station would also be located, a separate crew of about 50 persons would be required for about 24 months. Table 4-15 shows 1975 county population, components to be built in the area, peak employment for pump stations and pipeline, estimated in-migrant population, estimated housing demand, and availability of hotel and motel units in selected communities for comparison.

Given the dispersion, duration, and magnitude of expected effects from pipeline construction and the existing capacities in the host counties and selected communities, no system strain is anticipated to occur for any given community within the affected environment.

Given the small peak work force (49 workers) and the minor population and income increases associated with pump station construction, no effects were determined to be of a significant magnitude.

Operation, Maintenance, and Abandonment. The operation and maintenance manpower requirements for the pipeline segments are small and would be distributed throughout the project area. Pump stations would be automated. Consequently, no noticeable effects would be associated with work-force requirements (Table 4-16).

The pipeline system would add to local tax bases and would offer local taxing jurisdictions a new source of property tax revenues. In some jurisdictions the increased tax base and potential revenues would be a significant benefit (Table 4-16).

Upon abandonment, employment and population effects in "pipeline-only" counties would be nil and property tax revenues from the pipeline system (already reduced by depreciation) would decline.

Dewatering Plants. This section discusses impacts of dewatering plants and their associated pipelines and pump stations as shown in Table 4-17.

Construction. Construction of a dewatering plant typically would take eight quarters and have a peak work force demand of 150 to 260 (Table 4-17). This requirement is relatively small compared with the work-force demands of the coal-fired power plants served by the dewatering plants. Some coal plants in the region, for example, have had a peak construction employment of 750 to 1500 workers. In general, the dewatering plants would be built adjacent to power plants and within easy commuting distance of cities or large metropolitan areas that have an available local construction labor pool (Table 4-17). Because of the moderate demand for construction labor and the availability of construction workers from local labor pools, construction of the dewatering plants is not expected to cause substantial in-migration of construction workers or to stimulate significant secondary employment. In no case would the

TABLE 4-16

EFFECTS OF OPERATION ON AREAS OUTSIDE WYOMING WITH PIPELINE AND PUMP STATIONS ONLY: PROPOSED ACTION

Area	County/ Parish[a]	Project Component[b]	Annual County Property Tax Revenues: 1976-77 Property Tax Revenues (x $1000)	Estimated[c] ETSI Property Tax Revenues (1980 Dollars) (x $1000)	Percentage of 1976-77 Property Tax Revenues
Northwest Nebraska	Sioux	PL	611	880	144
	Box Butte	PL	3,557	300	8
	Morrill	PL	2,295	1,190	52
	Garden	PL, PS	1,571	970	62
	Deuel	PS	1,410	110	8
Southwest Nebraska	Keith	PL	4,134	400	10
	Perkins	PL	2,022	630	31
	Chase	PL	2,743	350	13
	Hayes	PL	648	580	90
	Hitchcock	PL	2,201	290	13
	Red Willow	PL, PS	4,607	640	14
North Kansas	Decatur	PL, PS	2,192	710	32
	Norton	PL	2,452	70	3
	Graham	PL	3,145	860	40
	Trego	PL	1,608	230	14
	Ellis	PL	6,902	390	6
	Rush	PL	2,566	360	14
	Barton	PL	9,368	370	4
South Kansas	Stafford	PL, PS	3,100	550	18
	Reno	PL	18,236	300	2
	Kingman	PL	3,834	450	12
	Harper	PL	3,382	360	7
	Sumner	PL	7,213	540	7
Northwest Arkansas	Sequoyah, OK	PL	1,290	610	47
	Crawford	PL, PS	2,277	460	20
	Franklin	PL	1,270	210	17
North-Central Arkansas	Johnson	PL	1,220	300	25
	Pope	PL, PS	7,490	520	7
	Conway	PL	1,614	174	11
	Van Buren	PL, PS	692	130	19
	Cleburne	PL	1,462	90	6
	Perry	PL	556	120	22
South Arkansas	Cleveland	PL	476	190	40
	Bradley	PL, PS	1,089	420	39
	Ashley	PL	2,830	110	4
North Louisiana	Moorehouse	PL	3,496	150	5
	Ouachita	PL, PS	13,354	380	3
	Caldwell	PL	1,374	380	28
	La Salle	PL, PS	1,976	590	30

Notes: There would be no direct or secondary permanent employment and no population in-migration. See Table 4-17 for similar information for dewatering plants.

a Only counties in which components are to be located are listed.

b PL = pipeline
PS = pump station

c Estimated property taxes by county were estimated by ETSI for the EIS by extrapolating previously developed unit cost estimates for components and should in no way be construed as representing the cost estimate for the components. Values shown on this table were derived by ETSI as follows:

Sum of estimated cost of components in county (1980 dollars) X Statewide ratio of assessed value to market value X Percentage tax rate assumed for county = Estimated ETSI property tax revenues in 1980 dollars

TABLE 4-17

EFFECTS OF CONSTRUCTION ON AREAS WITH DEWATERING PLANTS: PROPOSED ACTION

Area	County/ Parish	Project Component[a]	Existing Construction Labor Pool	Peak Fixed-Site Employment[b]			Peak Pipeline Employment			Estimated Peak Pop. In-Migration		Estimated Peak Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
Ponca City, OK	Kay Noble Pawnee Payne	PL, PS	3,800 in 1981	1/84	195	0	2/84	670	335	none	435	none	200	600 Ponca City
Pryor, OK	Osage Washington Rogers Mayes Creek Tulsa	PL, DP, MB, PS	8,340 in 1981	1/85	195	0	3/83 4/84	670	335	none	435	none	200	100 Pryor 400 Bartlesville
Muskogee, OK	Wagoner Muskogee McIntosh Cherokee Okmulgee	PL, DP, PS	11,985 in 1981	1/84	262	0	4/83	670	335	none	435	none	200	745 Muskogee
Independence, AR	Independence Jackson	PL, DP	565 in 2 counties in 1974	1/84	160	32	3/83	260	130	85	170	35	80	512/2 counties
White Bluff, AR	Pulaski Saline Jefferson	PL, DP, MB, PS	20,917 in 3 counties in 1970	1/84	260	0	4/83 1/84	550	275	0	358	0	105	450 Pine Bluff

TABLE 4-17 Concluded

Area	County/ Parish	Project Component[a]	Existing Construction Labor Pool	Peak Fixed-Site Employment[b]			Peak Pipeline Employment			Estimated Pop. In-Migration		Estimated Peak Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
Boyce-Alexandria, LA	Rapides Grant Avoyelles	PL, DP, PS	3,250 in 3 counties in 1978	1/84	160	0	3/83 3/84	390 550	195 275	0	358	0	165	1425 Alexandria
Lake Charles, LA	Evangeline Allen Jefferson Davis Calcasieu	PL, DP	5,400 Calcasieu Parish in 1978	1/84	189	0	4/83	260	130	0	169	0	99	1000+ Lake Charles
New Roads, LA	St. Landry Pointe-Coupee W. Baton Rouge	PL, DP, MB, PS	24,675 in Baton Rouge labor mkt in 1978	1/84	150	0	2/84	390	195	0	254	0	115	3500 Baton Rouge
Wilton, LA	Iberville Ascension St. James	PL, DP	61,075 in Baton Rouge and New Orleans labor mkts in 1978	3/86	189	0	3/84	260	130	0	169	0	80	3500 Baton Rouge

Source: Labor pool data are from WCC 1981d.

[a]PL = pipeline
DP = dewatering plant
MB = maintenance base
PS = pump station

[b]Fixed-site employment includes construction and service sector employment.

[c]Assumes maximum (rough terrain) spread size as a worst case.

construction cause structural changes in any local economy.

Pipeline construction in the dewatering plant areas is not expected to cause significant socioeconomic effects, either independently or in combination with the dewatering plants. The short-term influx of workers for 2 to 4 months would generate increased demand for temporary rental housing in the dewatering plant areas, but sufficient numbers of apartment units and motel rooms are available in those areas and no deficiencies in temporary housing are expected. Although pipeline construction workers prefer short-term apartment rentals, they will rent motel rooms if less expensive lodging is not available.

Operation, Maintenance, and Abandonment. Operation and maintenance of the dewatering plants and the associated pipeline system would create some new direct employment at the dewatering plant sites. Approximately 502 workers would be required to operate and maintain the dewatering plants. This new direct employment would stimulate creation of some secondary employment, and the new in-migrant population would stimulate demand for housing and other private and public facilities and services. Even assuming all new direct permanent jobs were taken by nonlocals, the employment, population, and housing effects would be insignificant (Table 4-18).

The pipeline system and dewatering plants would add to local tax bases and would offer local taxing jurisdictions new sources of property tax revenues (Table 4-18). In some jurisdictions the increased tax base and potential revenues would be a significant benefit.

Upon abandonment, operation and maintenance positions at the dewatering plants and maintenance bases would be eliminated. Property tax revenues, already reduced due to depreciation of the capital facilities, would decline further.

Effect of Pipeline Operation on Railroads

Except for the Wilton site, all of the ETSI markets will be served by railroads prior to completion and operation of the pipeline. Thus, if a pipeline were constructed, there could be a loss of specific markets for the railroads. Due to the projections for continued overall increase in coal movement by the railroads (Section III.3 in WCC 1981i), it is not expected that over the total rail system there would be a decline in traffic and hence decreased employment. Most likely the railroads would replace the lost markets with new markets. What would result would be a shift in the rail routes used and a possible shift in employment from one rail line to another. These shifts cannot be estimated, as they would be affected by railroad marketing decisions and competitive conditions within the rail industry.

4.A.3 SLURRY PIPELINE RUPTURES AND SPILLS

Environmental impacts of a slurry pipeline rupture and spill are addressed for the proposed action but apply to all the alternatives containing pipelines, since a spill could occur along any part of a pipeline route. The impact assessment is derived from a detailed impact analysis of eight worst-case spill sites, as described in the Ruptures and Spills Technical Report (WCC 1981j), which is available from the Bureau of Land Management, Office of Special Projects, 555 Zang Street, Third Floor East, Denver, Colorado 80228. The sites are representative of the major types of environments encountered along the proposed pipeline route and alternatives. Of the eight sites, five are at stream

TABLE 4-18

EFFECTS OF OPERATION ON AREAS WITH DEWATERING PLANTS: PROPOSED ACTION

Area	County/ Parish[a]	Project Component[b]	Annual County Property Tax Revenues: 1976-77 Property Tax Revenues (x $1000)	Annual County Property Tax Revenues: Estimated[c,d] ETSI Property Tax Revenues (1980 dollars) (x $1000)	Annual County Property Tax Revenues: Estimated[c,d] Percentage of 1976-77 Property Tax Revenues
Ponca City, OK	Grant	PL	1,953	180	9
	Kay	PL	7,486	420	6
	Noble	PL,DP,PS	1,785	470	26
	Pawnee	PL	1,160	320	28
Pryor, OK	Osage	PL	3,208	650	20
	Washington	PL	5,945	200	3
	Rogers	PL	4,362	439	10
	Mayes	PL,DP,MB,PS	2,126	757	36
Muskogee, OK	Wagoner	PL	1,427	290	20
	Muskogee	PL,DP,PS	2,126	757	9
Independence, AR	Independence	PL,DP	1,427	290	20
White Bluff, AR	Saline	PL	3,555	140	0.6
	Pulaski	PL	47,811	290	4
	Jefferson	PL,DP,MB,PS	10,013	768	8
Boyce-Alexandria, LA	Rapides	PL,DP,PS	108,546	1,163	11
	Grant	PL	1,031	27	3
	Avoyelles	PL	1,290	70	6
Lake Charles, LA	Evangeline	PL	1,753	4	0.2
	Allen	PL,PS	1,728	280	16
	Jefferson Davis	PL	2,810	20	0.7
	Calcasieu	PL,DP	22,722	492	2
New Roads, LA	St. Landry	PL	3,915	140	4
	Pointe Coupee	PL,DP,MB,PS	665	220	33
	W. Baton Rouge	PL	2,562	127	5
Wilton, LA	Iberville	PL,PS	3,212	40	1
	Ascension	PL	3,731	20	0.5
	St. James	PL,DP	3,876	433	11

Note: There would be no direct or secondary permanent employment and no population in-migration.

[a] Only counties in which components are to be located are listed.

[b] PL = pipeline
DP = dewatering plant
PS = pump station
MB = maintenance base

[c] Pipeline only, does not include value of dewatering plant, plus terminal facilities.

[d] Estimated property taxes by county were estimated by ETSI for the EIS by extrapolating previously developed unit cost estimates for components and should in no way be construed as representing the cost estimate for the components. Values shown on this table were derived by ETSI as follows:

Sum of estimated cost of components in county (1980 dollars) x Statewide ratio of assessed value to market value x Percentage tax rate assumed for county = Estimated ETSI property tax revenues in 1980 dollars

crossings, one is at a reservoir, and two are on land.

The physical and biological impacts were assessed by analyzing the effects of the modeled spill volumes and movements on the potentially affected environmental components (i.e., surface waters, ground water, and land). Based on the results of analyses for these eight locations, generalizations were made as to the anticipated impacts of a coal slurry spill for a given location. Most of these impacts were deemed insignificant, with the exception of a few isolated cases. Generalizations of the more significant impacts are discussed below.

In order to put this assessment into perspective, a spill probability analysis was conducted resulting in a predicted median frequency of 1.8 spills per year, with a total magnitude averaging 8241 barrels of coal slurry for the entire system. It should be noted, however, that the predicted frequency was based on all interstate liquid pipelines, regardless of age or methods employed (if any) to minimize spills. Because the ETSI pipeline would be new and would utilize state-of-the-art technology to reduce spills, it is expected to operate at less than this spill frequency. An example is the 273-mile, 18-inch Black Mesa coal slurry pipeline in Arizona, which is the only operating coal slurry line in the United States. It has experienced only one rupture event during its 10 years in operation, which resulted in spills in two places. If the formula used in predicting spill frequencies for the ETSI pipeline were applied to the Black Mesa line, it would be expected to have had 2.73 spills over the 10-year period.

<u>Surface Waters</u>

The impact of coal slurry spilled into surface waters depends on the energy environment of the receiving water. Therefore this discussion has been divided into two parts: rivers and streams, and lakes.

<u>Rivers and Streams</u>. Concentrations of coal particles would generally be highest for complete pipeline ruptures into streams under low-flow conditions. Under high stream flow conditions the concentrations decrease with distance downstream due to mixing and dilution. In either case, high concentrations of coal particles in any one location are expected to be short-lived (1 to 24 hours).

Due to the turbulence, the coal particles are expected to settle out in back eddies and areas of low current velocity. The deposition could fill the channel and create major changes in flow; however, these conditions are expected to be short-lived (1 to 24 hours).

Water quality investigations completed to date indicate low or nondetectable levels of the designated EPA "priority pollutants" in the coal slurry water. None of the 114 organic priority pollutants were detected except methylene chloride, which was present in trace amounts, probably due to standard testing methods, and bis-(2-ethylhexyl) phthalate, which was present in trace levels, well below acceptable receiving water criteria. Several metals were detected in trace amounts, most of which were below drinking-water standards.

A spill could result in a temporary increase in the levels of several metals at the immediate spill site, which would be reduced to below drinking water standards shortly downstream (e.g., within 50 to 5000 feet, depending on the site).

In situations where the spill volume is large relative to the ambient stream flow, significant changes in water temperature could occur in addition to decreased dissolved oxygen levels and increased concentrations of total dissolved solids (TDS) and sulfates. No significant impacts are expected for spills involving streams during periods of high flow, except in those cases where already low dissolved oxygen levels may prevail and would be decreased even further.

Biological impacts resulting from an aquatic coal slurry spill would depend on the spill location, time of year, and sensitivity of the affected biota. The significant aquatic biological impacts could include the following:

- Mortality of a significant percentage of fish eggs and larvae in the affected river area.
- Smothering of bottom-dwelling organisms and substrate (lake, river, or stream bottom) habitat, or emigration from affected substrate areas.
- Fish and invertebrate deaths resulting from heat or cold shock.
- Low dissolved-oxygen stress.
- Decreases in invertebrate and fish productivity in the affected areas.

It should be noted, however, that these are worst-case analyses and it is not likely that even two of the above impacts would occur at any given spill location.

Lakes. Should a terrestrial coal slurry spill reach a lake or similar confined water body, the medium and coarse coal particles are expected to settle out near the spill's point of entry. This material may migrate through or be redistributed over the lake bed by forces associated with later events, such as storms or spring surges. The fine coal particles may stay in suspension and be redistributed. In cases where the retention time is long compared with settling time, the majority of coal particles would settle to the bottom and contribute to the permanent sediment structure.

Higher-density slurry could significantly deplete dissolved oxygen levels, cause relatively large increases in temperature, and result in elevated TDS and sulfate levels. The significance of these impacts depends primarily on the lake volume but also on detention time, thermal stratification, spill characteristics, background water quality, and other factor factors.

In situations where the spill volume is small relative to the capacity of the lake, the water quality impacts would be minimal, localized, and short-term. The same is true with respect to the quantity of solids entering the lake in the slurry water compared with the lake's annual sediment loading. If the opposite relationship occurs, impacts are expected to be severe--including temperature and oxygen stress, increased turbidity, and elevated levels of sulfates and total dissolved solids--but should not persist for extensive periods of time.

Where aerobic substrate conditions exist, settling coal particles could, dependent upon deposition depth, reduce or eliminate macroinvertebrate populations and habitats.

High concentrations of suspended solids could kill the affected biota or cause the more mobile organisms to emigrate to areas of lesser concentrations. Under worst-case conditions, it is anticipated that heat or cold shock and dissolved oxygen stress could also occur, in which case the affected biota would likely perish.

Ground Water

The impact of a pipeline rupture on ground-water quality, even in the most sensitive of environments, is not likely to be severe. Coal slurry spills are not expected to reach the majority of aquifers along the pipeline route. If a spill does reach an aquifer, the plume of contamination is not anticipated to spread beyond a very localized area. Under worst-case conditions, which assume no chemical reactions would occur and no contaminants would be absorbed by the soil, only the federal secondary drinking water standards for TDS and sulfates may be exceeded. The secondary standards are concerned primarily with aesthetics. These impacts would, however, be highly localized and persist only for a period of several days.

Land

The areal extent of contamination from a land spill of coal slurry depends primarily on the topography of the area and vegetation density. Areas of low relief and extensive vegetative cover would tend to inhibit spill flow and promote deposition near the source. Conversely, areas of high relief tend to channelize the flow, thus increasing the velocity and, in the absence of restrictions, the distance to exhaustion. Depending on the slope of the terrain, quantity spilled, and numerous other factors, the slurry can travel several miles before it becomes exhausted from deposition, ground infiltration, evaporation, and impoundment in natural depressions.

Biological impacts from a terrestrial coal slurry spill are considered insignificant. If the spill were large, it could result in the loss of some small animals (i.e., rodents) and displacement of others. Displaced animals could be subjected to competitive stress, but this is a localized and insignificant effect. Wildlife drinking the slurry water might experience a slight laxative effect (EPA 1976, p. 205).

Wetlands. A coal slurry spill in a wetland area could result in the destruction or permanent alteration of the wetland. Because of the scarcity of wetland habitat in a few regions, such a loss would be considered long-term and significant. For the majority of wetlands encountered along the proposed and alternate pipeline routes the impacts would be less severe. Rapid settling of the slurry particles near the point of entry due to the lack of water currents would limit the extent of impacts to only a portion of the wetland. Decreased productivity may occur in the affected area through localized mortality or emigration of aquatic biota. No direct impacts on displaced waterfowl or other wetland inhabitants are expected unless no nearby areas are available for relocation.

Socioeconomics

Short-term disruption of municipal or domestic withdrawals from surface waters contaminated by a coal slurry spill is the primary socioeconomic impact associated with ruptures and spills. A spill into a stream or river is expected to render it "contaminated" for a period roughly equivalent to the duration of the spill or a maximum of about 24 hours (see Surface Water section above). Local hardships could be experienced should the community have inadequate storage and/or no alternative sources of potable water (e.g., wells).

4.A.4 VEGETATION

Acreages permanently and temporarily altered by construction of the proposed action and alternatives are presented in Table 4-19. Mileages and acreages were summarized from U.S. Geological Survey land-use maps, Soil Conservation Service soil surveys and range sites, and other literature sources, and represent the vegetation types occurring at surface facilities and along the right-of-way. While vegetation concerns would be locally significant during construction, actual impacts on vegetation would be generally insignificant and for the most part temporary with a successful reclamation program. Successful revegetation and reestablishment of grazing would be expected to occur in most areas along the proposed pipeline route with implementation of the erosion control and revegetation plan outlined in Appendix C-1. From one to five years would be required for a stand of vegetation to become established. Longer periods of time may be required when unfavorable weather conditions occur. In some small areas partial success of revegetation would result in less dense vegetation.

Where the pipeline corridor would traverse woodlands, the preconstruction vegetation would be altered for the life of the project (50 years). Understory vegetation would be established and maintained along the right-of-way. However, trees would not be allowed to reestablish over a 25-foot area over the pipeline to permit pipeline maintenance. This would result in the loss of 1581 acres of woodland areas along 527 miles of the proposed route for the life of the project. Establishment of trees on remaining parts of the right-of-way would require up to 30 years or more. Due to the linear nature of the project and variable types of woodland and commerical value, losses of commerical wood products would be considered insignificant for the proposed action. Losses of woodland for the other alternatives would be much less than for the proposed action (Table 4-19).

In the Sand Hills of Nebraska, revegetation efforts would be less successful compared with most other areas that would be traversed. Soils in the Sand Hills are characteristically subjected to wind erosion when vegetative cover is removed. Revegetation is also hindered by low water-holding capacity of the sandy soils in the area. Consequently, vegetation density in the corridor after reclamation could be less than preconstruction levels in these sandy areas.

In other areas, revegetation success would vary. It would be least successful in areas with steep slopes susceptible to erosion, in areas with shallow and unfavorable soils, and in the more arid northern portions of the project where annual precipitation is less than 15 inches. Revegetated areas with lower vegetation densities would be susceptible to accelerated soil erosion and invasion of undesirable plants. These areas would require a longer period of time to revegetate, and controlled grazing to protect vegetation would be necessary. A few small areas where adequate vegetation cannot be established and maintained would require critical area treatment with continuing erosion control measures.

<u>Wetlands</u>

In the vicinity of MP PMB-1010 the proposed action pipeline corridor would likely traverse some wetlands habitat. According to Smith (1980), this wetland habitat has particular value to a

TABLE 4-19

SUMMARY OF VEGETATION TYPES AND CROPLAND FOR THE PROPOSED ACTION AND ALTERNATIVES

	Proposed Action				Market Alternative[d]				Cypress Bend Pipeline-Barge Alternative[d]				Colorado Alternative[d]			
	Right-of-Way (Temporary Disturbance)[b]		Surface Facilities[c] (Permanent Disturbance)		Right-of-Way (Temporary Disturbance)[b]		Surface Facilities (Permanent Disturbance)		Right-of-Way (Temporary Disturbance)[b]		Surface Facilities (Permanent Disturbance)		Right-of-Way (Temporary Disturbance)[b]		Surface Facilities (Permanent Disturbance)	
Vegetation Type[a]	Miles	Acres	Number	Acres	Miles	Acres	Number	Acres	Miles	Acres	Number	Acres	Miles	Acres	Number	Acres
Agriculture[f]	863	10,460	14	340	286	3466	3	75	46	558	1	25	309	3745	1	25
Short-Grass Prairie[g]	60	728	1	25									38	461	2	50
Midgrass Prairie[g]	357	3,758	56	413	137	1660	1	25					223	2703	3	75
Tall-Grass Prairie[g]	12	145											17	206		
Shrub and Brush Rangeland	6	73											1	12		
Ponderosa Pine Forest	13	158			1	12							5	61		
Nonforested Wetlands[h]	2	24														
Forested Wetlands[i]	63	764							3	36			3	36		
Cross Timbers	76	921			1	12										
Oak-Hickory Forest	149	1,806			64	776			24	291						
Southern Pine-Hardwood Forest	226	2,740	4	70					7	85						
Barren Lands	1	12							1	12			6	73		
Urban and Built-up Lands			3	105	4	48	4	70			1	205				
Total	1828	21,589	78	953	493	5974	8	170	81	982	2	230	602	7297	6	150

TABLE 4-19 (Continued)

	Niobrara Water Supply System[e]				Crook County Alternative Water Supply System				Combined Well-Field Alternative			
	Right-of-Way (Temporary Disturbance)[b]		Surface Facilities (Permanent Disturbance)		Right-of-Way (Temporary Disturbance)[b]		Surface Facilities (Permanent Disturbance)		Right-of-Way (Temporary Disturbance)[b]		Surface Facilities (Permanent Disturbance)	
Vegetation Type[a]	Miles	Acres	Number	Acres	Miles	Acres	Number	Acres	Miles	Acres	Number	Acres
Agriculture[f]	1	12							1	12	9	22
Short-Grass Prairie[g]							9	22				
Midgrass Prairie[g]	31	776	22	128	14	436			45	545	22	55
Tall-Grass Prairie[g]												
Shrub and Brush Rangeland	1	12							1	12		
Ponderosa Pine Forest	1	24			2	73			3	36		
Nonforested Wetlands[h]												
Forested Wetlands[i]												
Cross Timbers												
Oak-Hickory Forest												
Southern Pine-Hardwood Forest												
Barren Lands												
Urban and Built-up Lands												
Total	34	824	22	128	16	509	9	22	50	605	31	77

TABLE 4-19 (Concluded)

Disturbance)[b] Vegetation Type[a]	Oahe Alternative Water Supply System: Right-of-Way (Temporary Disturbance)[b] Miles	Acres	Surface Facilities (Permanent Disturbance) Number	Acres	Treated Wastewater Alternative: Right-of-Way (Temporary Disturbance)[b] Miles	Acres	Surface Facilities (Permanent Disturbance) Number	Acres
Agriculture[f]	87	1054	3	3	31	376	4	4
Short-Grass Prairie[g]								
Midgrass Prairie[g]	166	2012	5	5	110	1333	5	5
Tall-Grass Prairie[g]								
Shrub and Brush Rangeland	1	12			1	12		
Ponderosa Pine Forest	20	242			20	242		
Nonforested Wetlands[h]								
Forested Wetlands[i]	1	12						
Cross Timbers								
Oak-Hickory Forest								
Southern Pine-Hardwood Forest								
Barren Lands	1	12						
Urban and Built-up Lands	—	—	—	—	—	—	—	—
Total	276	3344	8	8	162	1963	9	9

Note: USGS 1:250,000-scale land use and cover maps, Soil Conservation Service soil surveys, and USGS quad sheets and other literature sources (see Appendix B of the Terrestrial Biology Technical Report [WCC 1981e]) were used to estimate the presence of a particular vegetation type. Vegetation types are listed by component and state in the Terrestrial Biology Technical Report.

a Vegetation types are described in detail in Appendix B of the Terrestrial Biology Technical Report.

b In woodland areas, temporary disturbance refers to understory vegetation.

c Permanent surface facilities include preparation plants, pump stations, and dewatering facilities that would cause a land use change for the life of the project. Number refers to the total number of sites in each vegetation type.

d Figures shown represent only the areas that would be different from the proposed action.

e The Niobrara County water supply system, although included as a component in all coal slurry systems, is listed here for comparison with alternative water supply systems.

f Agricultural land is defined as cropland and pasture in this table.

g Short-grass, midgrass, and tall-grass prairie and shrub and brush rangeland vegetation types were developed from USGS land use and cover maps, Soil Conservation Service soil survey publications and range site surveys for localized areas along the pipeline route, and other literature sources.

h Nonforested wetlands, based on the USGS land use category, may include marshes and other wetlands with no tree overstory.

i Forested wetlands, based on the USGS land use category, may include cottonwood and/or willow in the north and bottomland hardwoods in the South.

variety of wildlife species. Construction through these wetlands would have a locally significant impact on both vegetation and wildlife.

4.A.5 WILDLIFE

The proposed construction of the coal slurry pipeline project may directly or indirectly affect wildlife populations in several ways: by causing death, by destroying habitat, or by creating secondary disturbances such as harassment by personnel or equipment. Although the latter impact has a less severe connotation than death or displacement, it can be equally or more damaging to breeding populations. Procedures for reclaiming wildlife habitat on and along the pipeline right-of-way are discussed in Appendix C-1.

Only specific and significant impacts are discussed here under components of the proposed action and alternatives. The insignificant impacts are summarized in the last part of this section.

Significant Impacts

Significant impacts and potential impacts to protected species are discussed below, by proposed action component. The possible impacts to species of special concern are summarized by component for the proposed action and project alternatives in Table 4-20. Procedures outlined in Appendix D-4, which would be attached to any federal right-of-way permit, would have to be complied with before a Notice to Proceed could be issued for construction. These procedures would ensure that there would be no significant impacts to any federally listed threatened or endangered species.

Coal Slurry Preparation Plants and Water Supply System. Wildlife species of special concern that could be affected by construction, operation, maintenance, or abandonment of the coal slurry preparation plants and water supply system include the black-footed ferret and sage grouse (Table 4-20).

Prairie dog colonies could occur at the preparation plant sites and water supply lines. The presence of prairie dog towns would provide potential habitat for the black-footed ferret. If prairie dog towns do exist at the proposed coal slurry preparation sites, these towns would be disturbed for the life of the project (50 years). Prairie dog towns that would be traversed by water supply lines would be temporarily disturbed. Clearing of rights-of-way may be beneficial to prairie dogs (and therefore to ferrets) if, in fact, prairie dogs used such rights-of-way to expand their towns or to disperse.

The potential of entrapping a ferret in a burrow, running over one with machinery, or causing one to disperse from the area and thereby either to abandon young or not relocate to another suitable town are conceivable consequences of the proposed construction activity. Ferrets are mobile and could possibly move; however, they may seek shelter or hide in burrows. Thus the potential of destroying one exists if it sought refuge in the path of the ditching machinery. In most areas along the northern portion of the proposed right-of-way, prairie dog towns are rather extensive in number and acreage; therefore dispersal of adults, at least temporarily, to suitable habitat is possible.

Although the probability is extremely low that a black-footed ferret would be present within a single prairie dog town disturbed by construction, any prairie dog town within a quarter-mile of the right-of-way would be surveyed for black footed ferrets. This survey would be required as a stipulation to any right-of-way permits granted by the Bureau of Land Management and the Forest Service

TABLE 4-20

POSSIBLE IMPACTS TO WILDLIFE SPECIES OF SPECIAL CONCERN RESULTING FROM CONSTRUCTION, OPERATION, MAINTENANCE, OR ABANDONMENT OF COMPONENTS OF THE PROPOSED ACTION AND ALTERNATIVES

Project	Black Footed Ferret	Bald Eagle	Whooping Crane	Red-Cockaded Woodpecker	American Alligator	Northern Swift Fox	Greater Prairie Chicken	Interior Least Tern	Golden Eagle	Mule Deer	Sage Grouse
Proposed Action											
Coal Slurry Preparation Plants	X										X
Water Supply System	X										
Slurry Pipelines and Pump Stations	X	X		X	X	X	X	X	X		
Dewatering Plants[a]											
Market Alternative											
Coal Slurry Preparation Plants	X										
Water Supply System	X										
Slurry Pipeline System	X	X		X	X	X	X	X	X		
Dewatering Plants[a]											
Cypress Bend Pipeline-Barge Alternative											
Coal Slurry Preparation Plants	X										
Water Supply System	X										
Slurry Pipeline System	X	X		X	X	X	X[a]	X	X		X
Dewatering Plants[a]											
Colorado Alternative											
Coal Slurry Preparation Plants	X										
Water Supply System	X										
Slurry Pipeline System	X	X	b	X	X	X	X	X	X		
Dewatering Plants[a]											
Crook County Alternative Water Supply System											
Water Wells, Gathering Lines, and Pump Stations	X										
Main Water Pipeline	X										
Combined Well-Field Water Supply System											
Water Wells, Gathering Lines, and Pump Stations	X										
Main Water Pipeline	X										
Oahe Alternative Water Supply System											
Water Pipeline	X	X				X		X		X	
Pump Stations	X										
Treated Wastewater Alternative Water Supply System											
Gathering Lines and Pump Stations	X										
Main Water Pipelines	X									X	

a No significant impacts are expected.

b Impact to the whooping crane would not occur as a result of construction, operation, maintenance, or abandonment of the Colorado alternative. Significant impact would occur if the Colorado alternative pipeline ruptured and slurry spilled into Cheyenne Bottoms State Waterfowl Refuge in Barton County, Kansas.

as part of the Section 7 consultation process with the Fish and Wildlife Service. If the results of these ferret surveys failed to locate signs of ferret activity along the pipeline corridor, it would be assumed that the project would not significantly affect the black-footed ferret. If ferret signs were discovered along the pipeline right-of-way or at any other project component site, actions would be taken to avoid any impacts to ferrets.

Sage grouse strutting grounds could occur on or very near the North Rawhide water line at about milepost (MP) NR-17, NR-23, NR-28, and NR-31. Construction of the water pipeline is scheduled for January through April. Since such a construction schedule would not disturb the sage grouse courting period (April and May), no significant impact would be expected on this important game species (Harju 1980), although some strutting habitat may be temporarily altered.

No other areas of special concern for wildlife have been identified in the vicinity of the coal slurry preparation plants or water supply line.

As shown in Table 4-4, the flow of certain springs and streams could be reduced by pumping from the Niobrara well field.

It is the opinion of field personnel in the South Dakota Department of Game, Fish and Parks that one of the primary factors influencing population levels of big game animals and turkeys in the southern Black Hills area is a limited water supply (Kirk 1981).

If springs used by terrestrial wildlife species were eliminated, impacts to wildlife could include, but are not limited to, the following: a loss of many small ecotypes around springs; measurable reductions in small animal populations in areas around springs, and an accompanying reduction in prey base for raptors and other predators; changes in animal distribution patterns, resulting in competitive stress; accumulation of game animals in areas where they could cause depredation.

However, The southern Black Hills area has an average annual precipitation of about 17 inches, while areas in the desert southwest have average annual precipitation rates of about 6 inches or less. Both areas support populations of mule deer. Since both habitats support viable populations of these animals, it does not appear that water is the only limiting factor in the Black Hills area.

It is recognized that certain drought years might affect deer, elk, and turkeys in the Black Hills area for one year, but on the average, water would seem to be plentiful enough to maintain the populations.

In addition, there are other springs in this area that depend upon flows from aquifers other than the Madison, so there would always be some springs flowing during pumping of the Madison. There are presently no research data to support the contention of reduced populations due to a lack of water in the Black Hills area.

Slurry Pipelines and Pump Stations. Wildlife species of special interest that could occur along the proposed action pipeline corridor include the black-footed ferret, bald eagle, golden eagle, northern swift fox, interior least tern, greater prairie chicken, red cockaded woodpecker, and American alligator (Table 4-20).

The black-footed ferret could occur in prairie dog towns along the proposed action route in Wyoming, Nebraska, and

Kansas. The ferret is considered extinct in Oklahoma (FWS 1980b). Potential effects from construction of the proposed project on the black-footed ferret are summarized above in the Coal Slurry Preparation Plants and Water Supply System section.

According to federal and state agencies contacted, no bald eagles are known to nest near the route, but overwintering bald eagles may be encountered in all the states traversed by the proposed action route, especially near major rivers. Major rivers where bald eagles may be encountered include the Belle Fourche in Wyoming; the North Platte, South Platte, and Republican in Nebraska; and the Arkansas River in Kansas, Oklahoma, and Arkansas. Only one river crossing has been identified as a special concern because of a large concentration of overwintering bald eagles: the Arkansas River near Ponca City, Oklahoma, at MP P-720. Construction of the Arkansas River crossing is scheduled during August and September. According to the Fish and Wildlife Service (1980b), major concentrations of bald eagles usually occur in Oklahoma from November through March. Since no roost trees are known to exist at major river crossings, no impacts to the bald eagle are expected to occur. A bald eagle winter roost area is located approximately 3 miles east of the North Rawhide slurry gathering line at the proposed crossing of the Belle Fourche River. Construction in this area would coincide with the bald eagle's winter roosting period. Some eagles could be disturbed by construction activity and be displaced either up or down the river. However, such disturbances would be short-term and, since no roost trees would be destroyed at the crossing, the impact would be insignificant.

Golden Eagle. The golden eagle is protected by the Bald Eagle Act. The only known golden eagle nests near the proposed action route are in Nebraska to the north of MP PMB-233, PMB-237, and PMB-246 (L. Carlson 1980). Construction in these areas is scheduled for mid-March through mid-April. The golden eagle nests as early as late February in this area. Consequently, the potential exists for construction disturbing golden eagles during nesting in Nebraska. Until field surveys can determine the precise proximity of these nests to the actual construction corridor, impacts to golden eagles will not be fully known.

Northern Swift Fox. The northern swift fox, a state-designated endangered species in Nebraska, could occur near MP PMB-106 to PMB-115 (Nebraska Game and Parks Commission 1980). At this location in Nebraska, the route would pass near denning sites of the northern swift fox (L. Carlson 1980). Kilgore (1967) reported that the swift fox abandons dens, particularly those in which whelps are being reared, as a result of increased human activity. Construction is scheduled for early July in this section of Nebraska. Kilgore (1967) reported that swift fox whelps are nearly full grown in mid-July. Consequently, the chances of destroying a female and her whelps by construction in these areas are low. However, displacement could occur if dens were disturbed. Displacement of the swift fox may be temporary if dens are not destroyed. Destruction of a den may preclude the return of the swift fox to the den site.

Interior Least Tern. The interior least tern is a state-designated threatened species in Kansas. Platt et al. (1974) list the least tern as a summer resident. These terns nest on river sandbars, sandflats, and other similar habitat in June and July (South Dakota Ornithologists Union 1978). These birds have been reported to breed in Rooks, Barton, and Stafford counties, which are crossed by the proposed action route.

The Arkansas River is scheduled for crossing during August and September; the South Fork of the Solomon River would be traversed in early February. Since crossings at these locations would not coincide with interior least tern nesting, no impact is expected. Rattlesnake Creek would be crossed in late May or early June. Terns could be nesting at the crossing during this time. Some nests could be destroyed, while other nests in the vicinity of the crossing might be abandoned. However, given the small area that would be disturbed and the limited overlap between construction and nesting, impacts to the least tern would not be significant.

Greater Prairie Chicken. The greater prairie chicken could occur between MP P-690 and P-718 in Noble County and between MP P-810 and P-825 in Mayes and Wagoner counties, Oklahoma (Short 1980). Pipeline construction in these areas would not coincide with the April and May breeding activity of these birds; however, some breeding grounds (strutting grounds) could be altered temporarily or permanently.

Red-Cockaded Woodpecker. The red-cockaded woodpecker inhabits mature, open pine forests such as may be present along parts of the proposed action route in Arkansas and Louisiana. Construction of the pipeline through these areas could result in the loss of suitable habitat, as well as the destruction of active colonies. In addition, construction activity in April and May through these areas may force adult birds to abandon active nests. Field surveys would be conducted prior to construction along any rights-of-way through mature pine woods so that construction activities would have no impact on the red-cockaded woodpecker.

American Alligator. The American alligator is listed as endangered in Arkansas and portions of Louisiana and is listed as threatened in other portions of Louisiana. If any alligator nests were destroyed during construction, then the alligator population could be affected. However, the loss of a small number of eggs or hatchlings would not have a significant impact on the existing alligator population.

In addition to impacts to the protected and game species listed above, removal of riparian vegetation could be locally significant along some of the streams traversed, since this type of wildlife habitat is limited and wildlife species are concentrated in this habitat. The proposed action route would cross wetland habitat in Kansas at Rattlesnake Creek (MP P-551) and in Arkansas near MP PMB-1010. Other wetland habitat could also be crossed in Kansas near the North Fork Ninnescah River crossing (MP P-567) and the South Fork Ninnescah River crossing (MP P-593). Any loss of wetland habitat would be considered significant because of the limited amount remaining and its importance to wildlife, especially for nesting and brood rearing.

Insignificant Impacts

The most direct construction impact on wildlife would be the clearing of wildlife habitat (vegetation) from the pipeline right-of-way and facility sites. Other construction impacts on wildlife include interruption of the habitat continuum and secondary impacts associated with human presence and activity.

For much of the vegetative habitat that would be destroyed by construction activities, up to 5 years would be required for complete restoration as far as adequate wildlife habitat is concerned. The wildlife habitat after 5 years would not be composed of mature trees, since this would take 50 years or more. However, the brushy undergrowth would furnish wildlife food and cover for the life of the project.

Herbivores such as deer and pronghorn antelope would not be significantly affected by the proposed loss of habitat. Within a few weeks after construction ceases, these animals should become adjusted to the cleared areas. As grass and shrub species were restored, these species would be attracted to the right-of-way, and might be expected to again utilize the right-of-way vegetation as a food source. During spring construction some newborn or young animals might be killed or separated from or abandoned by the adults, although such losses would occur only rarely.

Large and small carnivores generally have large ranges over which they regularly move. Such areas may include several habitat types, particularly the riparian communities. The loss of a small portion of the range within the pipeline right-of-way would have a minimal impact. On the other hand, certain species, such as rabbits, tend to have small ranges and are generally restricted to the region immediately surrounding their burrows. Where the pipeline right of-way passes through these territories, the impact would be more severe, but temporary. Rabbits would return to the right-of-way soon after construction ceased, and the population might increase over preconstruction levels as grasses and shrubs revegetated in regions once dominated by forest. Populations of rabbit, coyote, and other abundant species should recover quickly to preconstruction levels.

Localized elimination of individual small mammals such as mice, ground squirrels, voles, shrews, and/or their habitats might result along the right-of way because these species have small ranges and tend to retreat to their burrows when disturbed or threatened. However, the impact would be short-term because of the high reproductive potential and short life cycle of most of these species.

Loss of habitat might affect game birds such as grouse, pheasant, dove, and quail. However, the impact would likely be minimal in terms of area population levels. The pipeline right-of-way would not directly affect a significant amount of habitat suitable for waterfowl and water-associated birds.

Nesting sites of birds that occur within the proposed right-ofway would be destroyed. Consequently, some eggs or young birds would be lost or abandoned. This impact is considered to be localized and temporary.

During construction, human activity would be likely to affect several species of wildlife. Generally, the more intense the human activity, the greater the impact on wildlife. Human activity would be most intense at construction sites and along the pipeline construction corridor.

While specific effects cannot be readily predicted, noise from human activity would have some effect. Much of the wildlife in areas adjacent to the construction corridor would be likely to move away from the noise sources initially.

Operation and maintenance of surface facility sites and the pipeline corridor in prairie habitats, rangeland, and agricultural areas would not generally require additional removal of vegetation, so associated wildlife would not be further affected by maintenance activities after recovery from short-term construction effects. In woodland and brushy areas, it would be necessary to periodically remove trees and brush and maintain a 50-foot grassy right-of-way. Thus some small but permanent change would occur because of the existence of this corridor through forested areas. Consequently, the local composition of wildlife along these corridors in wooded areas would change slightly. Such corridors would have a beneficial effect on some wildlife species by offering an edge-type habitat.

Another potential operational wildlife impact would be bird collisions with microwave towers along the pipeline route, which would range in height from 40 to 360 feet. The frequency of bird collisions involves variables such as structure height, illumination, weather, time of year, surrounding terrain, and location in migratory corridor. Most reported collisions have been at taller structures, and there have been fewer in the height range of the towers planned for the proposed action (Kemper 1964). While the effect cannot be predicted with certainty, it is anticipated that these towers would not result in significant bird mortality.

The Quivira Wildlife Refuge and the Kingman Wildlife Area in Kansas, the Fort Gibson Game Management Area in Oklahoma, the Harris Brake Wildlife Management Area in Arkansas, and the Georgia-Pacific Wildlife Management Area and Cities Service Wildlife Management Area in Louisiana would be traversed by the proposed action route. Impacts would be short-term, localized, and insignificant because of similar nearby habitats and populations and the fact that most affected species have high reproductive potentials and short lifespans. No adverse impacts are anticipated.

Several wildlife species appearing on the Fish and Wildlife Service's Section 7 consultation list would not be affected by construction, operation, maintenance, or abandonment of the coal slurry pipeline project. The Eskimo curlew, ivory-billed woodpecker, and Bachman's warbler are considered extinct in states that would contain coal slurry pipeline project components. The red wolf, although possibly still present in Louisiana, would occur well west of project components. Bats listed in the Section 7 consultation could occur in caves in counties that would contain project components; however, these caves are not located in the affected vicinity of the coal slurry pipeline project. The Florida panther's occurrence along the pipeline corridor is mostly a conjectural matter, and no effects are anticipated. The peregrine falcon could occur over much of the proposed pipeline corridor and in the vicinity of surface facilities, but since no nests occur in the affected area, no impacts are anticipated. Each of these species is discussed in detail in the Threatened and Endangered Species Technical Report (WCC 1981f).

4.A.6 AQUATIC BIOLOGY

Although all pertinent information is included here, a more detailed impact analysis is presented in the Aquatic Biology Technical Report (WCC 1981g). In addition, threatened and endangered species are analyzed in more detail in the Threatened and Endangered Species Technical Report (WCC 1981f).

Short-term (or temporary) impacts are considered to be biological disturbances that are anticipated to be detectable for a period of five years or less. Long-term biological impacts must be anticipated to be detectable for more than five years. Intermittent impacts are considered to be short-term, recurring biological disturbances. Impacts are considered significant when they are anticipated to kill or displace numerous fish or macroinvertebrates (whether or not they are sensitive classification species) as a direct or indirect result of project construction or operation.

Significant and insignificant impacts that are discussed in this section, and are anticipated to be similar in nature and extent for other proposed action or alternative project components, are not presented again under those component headings.

Significant Impacts

Coal Slurry Preparation Plants. During the operation and maintenance phases of the preparation plants, nonpoint source pollutants (including various quantities of fuels, roadway contaminants, erodible soils, and particulate coal fractions) would be washed into local drainages, primarily during rainstorms. Local rainfall characteristics generally suggest that the ephemeral and intermittent streams in the area will flow during the high-rainfall months of April, May, and June (Ecology Consultants, Inc. 1976). The temporary fish fauna that may become established in these streams during periods of flowing water would experience increased turbidity from soil and coal fractions and petrochemical contamination. It has been demonstrated that under natural conditions many fishes do not remain in areas of high turbidity and that turbidity-tolerant rough fish predominate under these conditions (Peters 1967; Herbert et al. 1961; Burnside 1967). Petrochemicals and assorted roadway contaminants would be expected to further stress these temporary fish populations.

It is likely that the total impact of these factors would be a reduction in the number of fishes capable of exploiting these temporary habitats. It is anticipated that these impacts would be detectable in the affected temporary streams for the life of the project, but these impacts would not result in significant changes in the fish fauna of the perennial rivers and streams in these drainages. Recovery of local fish populations would be anticipated within two to three years after abandonment of the preparation plants.

The temporary and limited fauna expected to utilize local intermittent streams (Williams and Hynes 1977) would be stressed by the same factors that would be expected to affect local fishes. Turbidity can decrease invertebrate population densities (Tebo 1955; Williams and Mundie 1978; Allan 1975; Barber and Kevern 1973), alter species composition (Conlan and Ellis 1979; Rosenberg and Wiens 1978), and modify behavior (White and Gammon 1977). The total effects of the preparation plant nonpoint source pollutants and coal mine operations would result in decreased population densities in the temporary streams, but would be expected to have no significant impact on invertebrate populations in permanent streams in the affected drainages.

These impacts would probably be detectable as decreased population densities in the affected temporary streams for the life of the project, but recovery of local invertebrate populations would be anticipated within two to three years following abandonment of the preparation plants. In that period of time it is likely that rainstorms would scour the accumulated sediments and pollutants out of the affected stream channels.

Water Supply System. Routine operation, maintenance, and abandonment of the proposed water supply system would be anticipated to cause no significant aquatic biological impacts. If the water supply pipeline were to rupture, however, significant aquatic biological impacts could result.

The main water supply pipeline would carry approximately 30 cubic feet per second (cfs) of water to the Jacobs

Ranch mine site from the proposed well field. The temperature of the supply water within the pipeline could play an important role in determining the extent of biological damage associated with spills into flowing temporary streams. The approximate subsurface soil temperature in Wyoming (estimated from mean annual air temperature) would be 46°F, and it is expected that pipeline water would maintain this same temperature during all seasons. If a pipeline rupture were to occur in a stream where stream discharge was less than 30 cfs and ambient water temperature was more than 15°F greater than the pipeline water temperature, it could reasonably be expected that a localized fish and invertebrate kill might occur as a result of a "cold shock." This cold shock phenomenon has recently been reported by Burton et al. (1979).

Similarly, if a rupture were to occur in a stream where stream discharge was less than 30 cfs and ambient water temperature was more than 15°F below the pipeline water temperature, a localized fish and invertebrate kill as a result of "heat shock" may ensue. This heat shock phenomenon has been addressed in a review of thermal effects by Talmage and Coutant (1978).

If aquatic populations were subjected to either heat shock or cold shock, it is likely that the effects would be localized, short-term, and biologically significant. The temporary nature of the streams which could be subjected to spill effects makes it reasonable to suggest that population recovery would be anticipated within one or two years of pipeline repair, since the affected populations would be replenished from contiguous permanent streams.

Streams and rivers in the Black Hills of South Dakota and Wyoming are presently suffering from an overallocation of water rights (Hanten and Talsma 1981). In most of these streams the recommended minimum flow requirements for maintenance of existing fish and wildlife equals the streams' present monthly flows (Glover 1979). In other words, any additional reductions in flow would violate recommended flows for maintenance of existing fish and wildlife populations.

Streams and rivers that traverse the area that could be subjected to surface-water flow reductions are listed in Appendix Table A-1 of the Aquatic Biology Technical Report (WCC 1981g). For estimated surface flow reductions in streams in this area, see Table 4-4. Before stream flow reductions can be predicted, adequate historical gaging data are necessary. Consequently, at the present time it is possible to predict surface stream flow reductions only in those streams listed in Table 4-4. It is not the intention to suggest that these are the only streams and rivers that could be affected, but rather that these are the only streams with adequate flow data to estimate quantitative reductions in flow. All streams and rivers listed in Table A-1 of the Aquatic Biology Technical Report (WCC 1981g) could be affected by flow reduction, but the degree of the severity of these impacts could not be modeled because of the lack of adequate gaging data.

A worst-case approach was used to analyze biological impacts to streams and rivers that could be affected by reduced stream flow. Lack of stream-specific gaging data for streams in the affected area necessitates this worst-case approach.

In generic terms, if dewatering of these streams occurred, it could cause all or some of the following impacts:

- Loss of usable aquatic habitat
- Loss of suitable spawning areas

- Competitive stress
- Loss of escape cover
- Loss of aquatic vegetation and riparian zones
- Increases in water temperature and reductions in dissolved oxygen
- Loss of food supply

Generally, these impacts could result in loss of stream productivity, and consequently in carrying capacity.

Existing gaging data allowed for the estimation of flow reduction in the Belle Fourche River at the Wyoming-South Dakota state line. Plan 1, the Niobrara well field alone, would not reduce surface flows in the Belle Fourche River at the Wyoming-South Dakota state line (Table 4-4). Consequently, Plan 1 would not affect this Class III fishery resource. Plan 2, a combination of the Niobrara and Gillette well fields, would reduce the discharge at the state line by 1 cfs. Seven-day, 10-year monthly low flows in the Belle Fource River at the Wyoming-South Dakota state line are reported by Glover (1979), who lists 100 percent of the 7-day, 10-year monthly low flow as the recommended minimum flow. Consequently, the 1 cfs reduction resulting from drawdowns in the Madison Formation would reduce flows below recommended levels for each month. According to Hanten and Talsma (1981), violation of minimum flow recommendations would cause significant impacts to the Belle Fourche River fishery. This 1 cfs loss of flow would constitute 71.4 percent of the 7-day, 10-year low flow for August, when the base flow is only 1.4 cfs.

Adequate gaging data also allow for analysis of impacts to Spearfish Creek. Plan 2 would result in a 1 cfs decrease in stream flow in the entire drainage basin. During January, February, March, October, November, and December the 1 cfs loss of surface flow would not reduce flows below Glover's (1979) recommended minimum stream flows. During the remaining months, Glover recommends 100 percent of the 7-day, 10-year monthly flows as the minimum. The 1 cfs loss during these months constitutes less than 4 percent of the base flow. However, Hanten and Talsma (1981) reported that this relatively small percentage would significantly affect Spearfish Creek's fishery resource.

Existing data also allow for analysis of potential impacts to the Cheyenne River. Glover has recommended 7-day, 10 year low flows for the Cheyenne River at Plainview, South Dakota, and at the Cherry Creek confluence. All plans could directly or indirectly reduce base flows in the Cheyenne River. Glover (1979) reports 100 percent of 7-day, 10-year low flow as the recommended minimum for all months at both locations. According to Hanten and Talsma (1981), any reduction below the recommended minimum flow in the Cheyenne River would cause long-term, significant impacts to the river's aquatic resources. Flows in the Cheyenne River would be reduced up to 3 cfs below the minimum stream flows recommended by Glover (1979) in sections above Angostura Reservoir because of cumulative reductions in flows from the Cheyenne River (1 cfs) and Cascade Springs (2 cfs). Reductions in flows below the reservoir would also reduce the flow below those recommended by Glover (1979) as Hot Springs would be reduced an estimated 4 cfs. The magnitude of the impacts to the fishery cannot be estimated at present levels of knowledge, but because the minimum stream flows that are recommended would be exceeded, impacts such as loss of habitat, loss of spawning areas, stress due to competition, loss of escape cover, loss of food supply, and water temperature increases and dissolved oxygen reductions would be significant. A 1 cfs decrease in stream flow could cause the annual dry streambed period in the Cheyenne River, above Angostura Reservoir, to increase from 14 to approximately 33 days. Hanten and Talsma (1981) reported that such an increase would have a serious effect on the river's fishery.

Based on data and opinions expressed by Hanten and Talsma (1981), operation of the Niobrara or the Niobrara and Gillette well fields could have a long-term impact on Black Hills fisheries, especially marginal fisheries resources. Whenever the drawdown would reduce the 7-day, 10-year low flow below the minimum stream flow recommendations made by the South Dakota Department of Game, Fish and Parks, the resulting impact would be significant and would limit fisheries productivity. This reduction in productivity would likely result in a reduction of about 25 percent in year-class strength of the fishery for low-flow years.

Impacts to the McNenny and Spearfish fish hatcheries from a 1 cfs loss of water would cause significant long-term impacts, which would be evidenced by reduced production from these hatcheries.

Coal Slurry Pipelines and Pump Stations. Assuming use of the trenching technique, a direct effect of construction of the proposed slurry pipeline across riverbeds would be the temporary loss of about 111 square yards of benthic substrate (river or stream bottom), and its complementary fish food potential, for each 10 feet of river crossed. The approximate fish food quantity, in the form of benthic invertebrates, expected to occupy that area of substrate would weigh no more than 3.5 pounds (dry weight). If a fish is assumed to be 15 percent efficient in converting its food to flesh, then approximately 0.5 pound (dry weight) of fish flesh would be lost for every 10 feet of river crossed (Table 4-21) (WCC 1981g). This impact would be expected to be localized, short-term, and of limited biological significance.

General construction activity near rivers and streams, in addition to construction activity in the riverbeds, would increase stream turbidity and siltation. Extensive literature reviews have been developed regarding the biological effects of increased turbidity and siltation. Increased turbidity reduces light penetration in water, which consequently lowers stream productivity. Most fishes actively avoid extremely turbid areas, although the direct effect is seldom lethal. Siltation causes smothering of benthic invertebrates and fish eggs and larvae. Siltation also decreases the diversity of habitat within the stream. All of these factors contribute to decreased stream productivity (Karr and Schlosser 1978; Stern and Stickle 1978; Cordone and Kelly 1961).

The discharge of untreated hydrostatic test water may increase stream turbidity, decrease dissolved oxygen, and increase iron, oil, and grease concentrations in receiving waters (WCC 1981c). In addition, the physical result of a large-volume instantaneous discharge in a small perennial stream would be "scouring" of the stream bottom and banks, which could displace affected fishes to downstream locations or, in severe cases, wash them out of the stream channel.

The biological impacts associated with increased turbidity and siltation are described above.

Decreased dissolved oxygen in receiving waters would stress affected biota and could kill some sensitive

TABLE 4-21

ESTIMATES OF MACROINVERTEBRATE AND EQUIVALENT FISH BIOMASS THAT MAY BE LOST AS A RESULT OF RIVER-CROSSING CONSTRUCTION

River Width (feet)	Macroinvertebrate Biomass (lb, dry weight)	Fish Biomass (lb, dry weight)
10	3.5	0.5
20	7.0	1.0
30	10.5	1.5
40	14.0	2.0
50	17.5	2.5
100	35.0	5.0
200	70.0	10.0
500	175.0	25.0
1000	350.0	50.0
2000	700.0	100.0
5000	1750.0	250.0

Source: WCC 1981g.

species if concentrations were reduced to 5.0 mg/l or less (EPA 1976). The total impact of these biological effects in low-volume streams or rivers could be a localized "kill" affecting most trophic levels. Recovery of the affected stream or river would be expected within two years as a result of repopulation from unaffected contiguous streams.

The effects of iron concentrations on freshwater aquatic life have been summarized and a water quality criterion of 1.0 milligram per liter (mg/l) has been established for the protection of freshwater biota (EPA 1976). Untreated hydrostatic test water may exhibit concentrations as high as approximately 14 mg/l, which would be anticipated to have various lethal and/or sublethal impacts on affected biota in streams where stream volume would not be sufficient to dilute the concentration to 1.0 mg/l or less.

While detailed criteria for concentrations of oil and grease can be established only for specific water bodies, species, and oil or grease types, it can be generally stated that even an oily sheen on the water surface may be evidence of potentially lethal impacts on affected biota (EPA 1976).

Temporary removal of river substrate as a result of trench-and-fill operations could result in the loss of 3.5 pounds (dry weight) of invertebrates for every 10 feet of river crossed (Table 4-21). While the effect of such habitat disturbance would be locally significant (assuming all removed organisms would be killed), it would be anticipated that benthic population reestablishment in the disturbed area would be complete within a few months of the termination of construction activity. This recovery phenomenon has been discussed by Hynes (1970) and recently documented by Gore and Johnson (1979).

General construction activity along riverbanks and in the affected streams would increase stream turbidity at and downstream from the pipeline crossing locations. In addition to the effects identified in Section 4.A.6, it is possible that freshwater mussels, in particular, would suffer some adverse effects. Ellis (1936) and Cairns (1968) have documented significant reductions in the feeding activity of mussels exposed to turbid water conditions, and under severe siltation conditions large numbers of macroinvertebrates have died (Casey 1959, as reported in Cordone and Kelly 1961). A recent publication by Marsh and Waters (1980), however, demonstrated that upstream drainage disturbance has a negligible impact on invertebrate populations in undisturbed downstream reaches.

The most notable fisheries impact associated with construction-induced turbidity would be a potential reduction in reproductive success. When fine sediment settles on coarse, unconsolidated substrates the permeability of those substrates is decreased. When eggs are laid in affected areas water may not flow freely over the eggs, which can result in a decrease in hatching success (Meehan and Swanston 1977; Auld and Schubel 1978). Auld and Schubel (1978) found that varying amounts of suspended sediments affected the hatching success of different fish species in different ways. Less than 1000 mg/l did not affect the hatching success of yellow perch, blueback herring, alewife, or American shad eggs, but 1000 mg/l significantly reduced the hatching success of white perch and striped bass.

It is also believed that sediment affects the flow of water through gravel, preventing the removal of metabolic waste and entrance of oxygen (Cooper 1965, Sheridan and McNeil 1968, Meehan and Swanston 1977). Shelton and Pollock (1966) found that if 15 to 30 percent of the interstices in gravel were filled with sediment, there resulted an 85 percent mortality of salmon eggs. The sediment may act as a physical barrier to the fry, even if they do hatch successfully. Sedimentation can also disrupt reproduction by covering spawning grounds (Karr and Schlosser 1978), making them unavailable for reproduction.

It is anticipated, therefore, that the total impacts associated with trench and-fill operations would be only locally significant and of short duration. Complete reestablishment of invertebrate populations would be expected within a few months of the termination of construction.

Impacts associated with the discharge of untreated hydrostatic test water would be similar in nature to those described above for affected fish populations. Biological damage, however, would be anticipated to be more severe, since invertebrates would be less mobile and therefore less capable of avoiding a discharge "plume."

Threatened and Endangered Species. The Arkansas darter is known to prefer springs and streams with dense populations of watercress or other aquatic plants, which the darter uses for spawning and foraging activity (Cross and Collins 1975). Isolated populations of the darter could occur in many streams between MP P-532 and P-649 in Kansas. Where Arkansas darter distributions coincide with stream crossing locations, it is anticipated that these darters would be affected in the same way and to the same extent that other fishes would be affected (Section 4.A.6). Additionally, however, these darters could lose a portion of their preferred aquatic vegetation habitat as a result of direct removal from the stream bed. It seems likely that the total effects of siltation and habitat removal would be significant in the stream crossing right-of way and for whatever distance downstream the suspended solids travel (WCC 1981c). Population recovery to preconstruction densities, however, would be expected within a few years of the completion of construction. In that period of time it is anticipated that aquatic vegetation would reestablish in the disturbed area and provide the habitat necessary for darter reestablishment.

If untreated hydrostatic test water were discharged in streams with Arkansas darter populations, the affected darters could experience the impacts described for fishes, above.

Dewatering Plants. It is anticipated that general construction activity associated with the proposed dewatering facilities could contribute to the suspended solids concentrations of the water bodies identified in Section 3.A.5. It is likely that these sediment contributions would occur periodically, primarily during rainstorm activity, for the duration of the one or two years scheduled for construction of each of the dewatering plants. However, no quantifiable information is available. In all cases, construction techniques that would control sediment during high flow would be used, as specified in Appendix C-1, under General Construction, Operation, and Reclamation Procedures. The impact of the increased sediment load on aquatic invertebrates would be the same as described in the preceding Coal Slurry Pipeline and Pump Stations discussion. Operation and maintenance of the dewatering facilities would contribute various nonpoint source pollutants, including petrochemicals and particulate coal fractions, to the various drainages identified in Chapter 3, Section 3.A.5. Similar pollutants would be anticipated from the operating utility stations, and it is likely that these pollutants would not be uniquely attributable to either source. The addition of these pollutants to the local drainages would cause a reduction in invertebrate density and diversity as described in the preceding Coal Slurry Pipeline and Pump Stations discussion.

Insignificant Impacts

Adandonment of surface facilities and the application of biochemicals for maintenance purposes would result in insignificant impacts. The slight reduction in aquatic organism density anticipated to be associated with abandonment procedures would be localized, short-term, and insignificant, since surface structures would be removed and the disturbed land revegetated in a short period of time. In addition, no water bodies would be directly disturbed by proposed abandonment procedures.

No significant aquatic biological impacts would be anticipated as a result of any possible application of biochemicals (e.g., herbicides, fungicides, etc.), since only state and federally approved chemicals would be used and all would be ground-applied in order to minimize aquatic habitat contamination (Appendix C-1, Use of Biochemicals).

The anticipated physical effects of any surface facility or pipeline construction include stream siltation, nonpoint source pollution, fuel spill hazards, flow regime alteration, and habitat destruction where construction would occur in a stream (Rogozen et al. 1977; Anderson et al. 1978; EPA 1976). While these various physicochemical disturbances may be expected to reduce macroinvertebrate and fish populations in perennial stream habitats, such impacts would not be expected to be significant in the intermittent streams in the potentially affected areas. There are two major reasons for anticipating this reduced impact significance. First, the indigenous biota of these temporary habitats are generally less abundant and diverse than the biota of permanent streams (Hynes 1970; Williams and Hynes 1977) and are comprised of organisms which exploit these temporarily available habitats by immigrating to them from neighboring permanent waters (Williams 1977; Larimore 1959). Recent investigations completed by Wesche and Johnson (1980) have documented both the limited aquatic biological resources and the stressful ambient water quality characteristics of many of the region's streams.

Secondly, the physicochemical effects of construction are anticipated to be limited to those periods when severe rainstorms erode soils and other contaminants into local drainages. The large volumes of runoff associated with these storms would be expected to dilute the various construction site pollutants (primarily petrochemicals) and would probably represent a minor (less than 1 percent) increase in suspended solids concentrations (WCC 1981c). Further, the intermittent and short-term nature of such effects would be expected to pre clude the possibility of chronic exposure to, or bioaccumulation of, construction site pollutants. In addition, ETSI has proposed to maintain stream flow at all crossing locations and to refuel heavy equipment outside of river channels, when possible. It is likely, therefore, that nonpoint source pollution, petrochemical spills, and flow regime alteration are construction effects that, generally, would not result in significant aquatic biological impacts.

Construction through, or within the drainage of, temporary streams with flowing water and established fish and macroinvertebrate communities would have, as stated above, siltation, petrochemical spill, flow alteration, and habitat alteration effects. The biological impacts associated with these physical effects would probably be the elimination or temporary displacement of a relatively small number of organisms (in comparison to the number of organisms anticipated to be affected in a perennial stream system). Primarily because of the limited density and diversity of temporary stream biota, it is likely that these impacts would be localized, short-term, and biologically insignificant.

If a water pipeline rupture were to occur, the severity of the anticipated impacts would depend upon the quantity and quality of Madison Formation water, in addition to its temperature (temperature-related impacts are discussed in the Water Supply System section above). The quality of the water would vary over the life of the project, but preliminary estimates (WCC 1981c) indicate that water quality criteria would not be exceeded under spill conditions.

Estimates of biological impacts related to water volume (assuming a complete pipeline rupture) can also be made. A spill of 30 cfs volume, or less, in any of the temporary streams crossed by the water supply lines would be anticipated to have no aquatic biological impact if the spill occurred during a dry streambed period.

If, however, a spill occurred during a flowing water period and represented a significant increase in stream discharge volume (e.g., a doubling of volume or greater), then the biological impacts would be similar to those caused by a local rainstorm. The effects on local fishes would be a reduction or suspension of feeding activity and displacement of some species to areas of preferred flow rates. These impacts would be expected to be localized, short-term, and insignificant.

The effects of such a water spill volume on macroinvertebrate populations would be similar to those described for fishes, but the extent of the impact would be somewhat greater because of the relative immobility of macroinvertebrates. Nevertheless, the anticipated impacts would be considered localized, short-term, and insignificant, since recovery to prespill population levels would be expected in the affected area within a few weeks of pipeline repair as a result of the "drift recolonization" phenomenon (Hynes 1970; Waters 1972; Gore and Johnson 1979).

It is anticipated that operation of the Niobrara well field, in conjunction with the Gillette water supply system and other existing water uses, could reduce the discharge of the Belle Fourche River (below Keyhole Reservoir) by approximately 1 cfs. Flow duration data indicate that the Belle Fourche River below the reservoir has been a perennial river for approximately the past 17 years. Previously the Belle Fourche had been an intermittent river with dry periods occurring primarily during late summer and fall months.

Well-field operation, in conjunction with other water uses, could reduce surface flow in the Sand Creek drainage by 2 cfs. Binns and Eiserman (1979) suggest that low-flow stream discharge can be a factor limiting productivity in Wyoming trout streams. A decrease of 2 cfs as a result of well-field operation represents an insignificant discharge decrease under low flow (critical) conditions. Data presented by Binns and Eiserman (1979) indicate that a decrease in discharge of that magnitude would not be anticipated to significantly affect the trout productivity of Sand Creek. Normal low flow discharge is approximately 100 percent of the average daily flow and, therefore, even a decrease of 2 cfs would allow for the maintenance of "completely adequate" discharge conditions.

A decrease in discharge of approximately 1 cfs would be anticipated in Crow Creek as a result of Niobrara well-field operation, in conjunction with the Gillette water supply system and other existing uses. Crow Creek Springs maintains a relatively constant discharge of 17.5 cfs. A 1 cfs decrease in discharge would represent approximately a 6 percent decline in both low-flow and average daily-flow discharge. As discussed above for Sand Creek, a decrease in discharge of 6 percent would not be anticipated to significantly affect the fisheries productivity of Crow Creek.

Surface-water drawdown could decrease the discharge of Cascade Springs (and Cascade Creek) by approximately 3 cfs. One year of record indicates that Cascade Springs maintains a discharge of approximately 24 cfs and this anticipated decrease represents a 12.5 percent reduction in water volume. Lower Cascade Creek is considered a Class III (substantial fishery resource) and maintains a warmwater sunfish fishery (Bailey and Allum 1962). It is unlikely that a decrease in discharge of this magnitude could sufficiently alter habitat or food availability to significantly affect this warmwater fishery.

Hot Springs maintains a discharge to Fall River of approximately 23 cfs. Well-field operation, in conjunction with other existing water uses, could decrease this discharge by approximately 1 cfs. Fall River is a Class III stream in South Dakota with a low-flow discharge averaging approximately 19 cfs. In the 1939 to 1979 period of record, flow duration data indicate that Fall River never experienced a discharge of less than 12 cfs. An additional decrease of 1 cfs, due to well-field operation, would not be expected to significantly affect Fall River biota, even during a "dry" year since it represents only an 8 percent additional decrease in flow.

ETSI has proposed to construct their river crossings "during periods of low flow whenever possible or be timed to eliminate conflicts with critical migration or spawning schedules of any aquatic species." As an example, ETSI has proposed to cross the Arkansas River during August and September. Striped bass migration and spawning "runs" occur during the early spring months in the Arkansas River basin, so no significant impact to striped bass in the basin would be anticipated.

The trout fisheries in the Niobrara and North Platte rivers are of special concern to the state of Nebraska. It is anticipated that river crossing construction would occur during the low-flow months of August/September. This schedule would avoid both the fall and spring spawning seasons and, thus, would minimize impacts on indigenous trout populations.

The smallmouth bass fishery in the Illinois River and Barren Fork Creek in Oklahoma is of special concern to that state. Any impacts that could reduce population levels by interfering with spawning or migrating activities would be significant. It is anticipated, however, that river crossing construction would occur during the low-flow months of August and September. This construction schedule would avoid both fall and spring spawning seasons and, as such, would minimize population-reducing impacts to smallmouth bass and other warmwater species.

At those stream and river crossing locations where construction would coincide with fish migration periods, there is a possibility that in-stream activity would interfere with pre- or post-reproductive migration. Such interference has been reported in the literature (EPA 1976), and the severity of the impact would depend upon the spawning behavior of the species involved, the suspended solids increase anticipated, and the delineation of the downstream area to be affected.

In the smaller streams and rivers where instream construction would be completed in a few days, or less, it is likely that migration would be temporarily suspended. Since most fishes migrate over a period of several days or weeks (Geen et al. 1966), migration would be expected to resume shortly after the completion of construction and the settling of suspended materials.

In wide rivers where construction would last for several weeks and possibly coincide with migration periods, spawning could be affected. Migration could be interrupted by partial blockage of the rivers and by siltation. Construction schedules would ensure that construction would not coincide with critical fish migration or spawning activities.

In summary, because construction schedules would be timed to avoid migration and spawning activities (Appendix C-1, Construction), no significant impacts to migrating fish are expected.

Threatened and Endangered Species. The distribution of the fat pocketbook mussel and its potential occurrence at MP PMB(I)-93 of the Independence lateral route were discussed in Chapter 3, Section 3.A.5. A recent mussel survey at that location in 1977, however, revealed no living specimens, fossil shells, or even suitable substrate (EPA 1978a). As a result of this survey, it is anticipated that construction of the proposed coal slurry pipeline would have no impact on the fat pocketbook. Furthermore, it would be anticipated that no Independence site project components of the proposed action or any alternative would affect the fat pocketbook, since this survey has indicated its absence from the area.

If ETSI needs to use biochemicals, such as herbicides to maintain pump station, preparation plant, or dewatering plant sites or the right-of-way area, these chemicals would have to be both state and federally approved and would be applied by acceptable ground techniques. By following these guidelines, it is likely that the potential for detectable aquatic biological impacts would be minimized.

4.A.7 CULTURAL RESOURCES AND PALEONTOLOGY

To comply with Section 106 of the National Historic Preservation Act, Executive Order 11593, and 36 CFR 800, a Memorandum of Agreement (MOA) between the Bureau of Land Management, the Advisory Council on Historic Preservation, and the appropriate State Historic Preservation Officers (SHPO) was developed (see Appendix D-3). The MOA outlines procedures and methods to be taken prior to construction to identify, evaluate, and protect cultural resources in, or eligible for inclusion in, the National Register of Historic Places (NRHP) and to mitigate any adverse impacts to these resources. Prior to construction and after consultation with the SHPO, an intensive field inventory (BLM Class III) will be undertaken for all areas to be disturbed by project construction that have been delineated as requiring an intensive inventory. The inventory would be undertaken to locate previously unknown cultural resources in delineated areas.

Avoidance of a resource by route realignment is the preferred means of mitigation of impact. Therefore, all known resources and those located during any inventory would be avoided, if avoidance is prudent and feasible (as determined in consultation with the appropriate surface management agency). Resources that are not prudently or feasibly avoidable would be mitigated, prior to construction, by the procedures in the MOA and/or other considerations (as determined in consultation with the appropriate surface management agency).

The magnitude of impact on cultural resources cannot be determined until a route is chosen and the proposed right-of-way is examined. Sites currently on the NRHP are identified in Appendix F. Significant sites and districts, as known from previous cultural resource inventories, are identified in Section 3.A.6 and the Cultural Resources Technical Report (WCC 1981h). Each site encountered requires site-specific evaluation as to impact from the project. Because avoidance is the preferred means of mitigation, most known sites that would have been in the proposed right-of way would not be directly affected.

Paleontological resources would be unavoidably destroyed or altered in some areas by construction activities. Construction activities could have a beneficial effect of uncovering valuable fossils, which would add to knowledge of the geology of the affected area.

The following discussion applies to the proposed action and the alternatives wherever ground disturbances would take place.

Construction

History and Prehistory. In the areas requiring intensive inventory, known surface and subsurface resources would be avoided, recorded, or have data recovered prior to construction if prudent and feasible. Construction activities may alter, damage, or destroy previously unknown subsurface sites and result in disturbance to or loss of horizontal and vertical subsurface cultural information. Mixing and loss of artifacts and stratigraphic data could also occur. Alteration, damage, or destruction of these subsurface resources could result specifically in the following:

- Loss of scientific and cultural information
- Loss of physical expression of the resource
- Loss of the resource for future research
- Loss of unique resources
- Loss of resources that may have important cultural affiliations
- Loss of artifact materials

Indirect beneficial impacts on cultural resources that could result from project construction are as follows:

- Cultural resources previously unknown could be located.
- Information previously unavailable could be recovered if significant sites are found during the cultural resource inventory or during construction monitoring.

Operation, Maintenance, and Abandonment

History and Prehistory. There would be no direct impacts on resources as a result of normal project operation. If emergency repairs required clearing or trenching, adverse impacts could occur, as previously discussed for construction activities. An increase in ease of conventional vehicle access may occur and, in conjunction with the decrease in project-related activity once construction is completed, may result in a greater potential for vandalism. No additional impacts on cultural resources would occur as a result of project abandonment, since no additional area would be disturbed.

4.A.8 AGRICULTURE

Impacts to agriculture would occur during project construction and operation. The main concerns related to construction of the proposed action and alternatives on agricultural lands are: (1) loss of crop production during the construction year, (2) restoration of crop production on croplands, (3) reduction of grazing until areas are restored, (4) accelerated soil erosion, (5) disturbance of topsoil and soil compaction, and (6) long-term land use change at surface facility sites. The major concern during operation is the possible loss of irrigation water and its resulting impact on agriculture. The loss could occur as a result of a decrease in spring and stream flow (Table 4-4). Acreages temporarily and permanently affected by construction, maintenance, and operation of the proposed action and alternatives are presented in Table 4-22.

Impacts on cropland production, livestock grazing, and soils along the pipeline rights-of-way would be considered generally insignificant and temporary with a successful reclamation program. Successful restoration of cropland areas and revegetation of native rangeland areas would be expected along the proposed pipeline routes with the implementation of the Erosion Control and Revegetation Plan outlined in Appendix C-1. The impacts assessed in this section are based on the assumption that the Erosion Control and Revegetation Plan will be fully implemented by ETSI. However, areas where only partial success of revegetation occurs would result in reduced density of vegetation and could have significant localized effects on grazing production and soil erosion rates within the rights-of-way. Problems could occur on areas with steep, sloping terrain, in areas of shallow or unstable soils, and in the more arid northern portion of the project area, where average annual precipitation is less than 15 inches. Controlled grazing and longer revegetation periods would be required on problem areas.

One of the significant agricultural concerns related to construction of the various project components is the loss of cropland and grazing land. Since all pipeline rights-of-way would be reclaimed (see Appendix C-1) following construction, all reductions or losses of crop production and grazing would be generally temporary (one year). Losses would be greatest at surface facility locations where lands would be taken out of production for the life of the project (Tables 3-21, 3-22, 3-31, 3-32, 3-39, 3-41, and 3-47). Since these areas would be reclaimed during the abandonment phase of the project, they would not be irreversibly converted to other uses and their viability would not be significantly diminished.

A major agricultural concern is the potential long-term (50 years) loss of crop production on prime agricultural land at surface facility sites (Tables 3-21, 3-22, 3-31, 3-32, 3-39, 3-41, and 3-47). The construction, operation, and maintenance of the 23 slurry pump stations and 9 dewatering plants associated with the proposed action would take approximately 375 acres (13 pump stations and 5 dewatering plants) of prime agricultural land out of production for approximately 50 years. The impact of this potential crop production loss would be relatively minor from a regional or state standpoint, since it would be spread over six states. The largest potential crop production loss on prime farmland at any one surface facility location would be 35 acres (pump station and dewatering plant). Since the surface facility land areas would be reclaimed during the abandonment phase of the project, these lands would not be irreversibly converted to other uses and their viability would not be significantly diminished.

During project operation the primary agricultural concern is the potential loss of volumes of water from the Madison, Minnelusa, Sundance, and Inyan Kara aquifers in parts of western South Dakota, eastern Wyoming, and northwestern Nebraska.

The present agricultural use of ground water from these aquifers in the potentially affected drawdown regions is for stock water and irrigated cropland.

TABLE 4-22

SUMMARY OF PRIME AGRICULTURAL LAND AT SURFACE FACILITIES

State	Proposed Action (acres)	Market Alternative[a] (acres)	Cypress Bend Pipeline-Barge Alternative[b] (acres)	Colorado Alternative[c] (acres)	Crook County Alternative Water Supply System (acres)	Combined Well Field Alternative Water Supply System (acres)	Oahe Alternative Water Supply System (acres)	Treated Wastewater Alternative Water Supply System (acres)
South Dakota	NA	NA	NA	NA	NA	NA	1	Unknown[d]
Wyoming	25	25	NA	0	0	0	1	Unknown[d]
Nebraska	25	0	NA	NA	NA	NA	NA	NA
Colorado	NA	NA	NA	0	NA	NA	NA	NA
Kansas	50	75	NA	25	NA	NA	NA	NA
Oklahoma	70	0	NA	NA	NA	NA	NA	NA
Arkansas	85	0	205	NA	NA	NA	NA	NA
Louisiana	120	0	NA	NA	NA	NA	NA	NA
Total	375	100	205	25	0	0	2	Unknown[d]

NA = Not applicable.

a Numbers include only surface facilities not associated with the proposed action.

b Numbers include only facilities not associated with the proposed action or market alternatives.

c Numbers include only surface facilities along main slurry pipeline between Jacobs Ranch and intersection with market alternative.

d Specific water pipeline alignments and thus specific pump station locations are not known at this time, so it is not known whether the pump stations associated with this alternative would take any prime agricultural land out of production.

Surface water originating from these aquifers is used primarily for irrigated cropland. Users of ground water from these aquifers might find it necessary to increase pumping lifts in areas of high drawdown, and surface-water users in certain areas could experience reduced flows after about 5 years of ETSI's pumping from the Madison. Section 5.A.1 in this EIS, and the Well-Field Hydrology Technical Report (WCC 1981b) discuss potential ground-water drawdown areas, with associated drawdowns and potential surface-flow reductions under six different pumping scenarios after 5, 10, 25, and 50 years of pumping.

Without an examination on a case-by-case basis, it is not possible to quantify what the specific impacts would be to agricultural users. The drawdowns for the area are a worst case prediction and without precise knowledge of the status of each spring and stream that could be affected, predictions of impacts can not be made.

The potentially affected drawdown regions of the Niobrara well field and generalized areas of Inyan Kara and Madison wells are identified on Maps 5-3, 5-4, 5-5, and 5-6 at the end of Chapter 5. Potential drawdowns and effects on surface water flows in these areas are discussed in Section 5.A.1.

The amount of irrigated cropland that could be affected outside of the drawdown area (using surface water originating from the drawdown region) is not known. Acreages of cropland irrigated by volumes of surface water are highly variable and dependent on factors such as: soil type; kind of crop and consumptive water use; climatic conditions; and type of irrigation system and its efficiency. Predictions of impacts to irrigated cropland affected outside the drawdown areas would be based on potential acreage loss estimates determined by surface flow reductions. General predictions concerning consumptive water use range from 42 (Tokach 1981) to 70 (Jones 1981) acres of irrigated cropland per cfs of surface water diverted from streams. Compensatory offerings to water users who might be affected have been made by ETSI to South Dakota and are required by Wyoming (see Appendices C-3, C-7, and C-8).

4.A.9 AIR QUALITY

Coal Slurry Preparation Plants

Construction of the coal slurry preparation plants would cause temporary increases in fugitive dust and gaseous pollutants but no significant impacts on air quality. Emission factors used in estimating impacts are presented in Appendix G-1 and fugitive dust emission estimates are presented in Appendix G-2.

Dispersion modeling of a 25.2-MMTA coal preparation plant has been done based on detailed emission estimates provided by ETSI (1980) and is discussed in Appendix G-2. For the proposed action, the largest preparation plant (Jacobs Ranch) would process 22.4 MMTA. Although modeling of the larger 25.2-MMTA plant overestimates impacts of the 22.4-MMTA plant, detailed emission estimates for the 22.4-MMTA plant are currently not available. The modeling results, which provide a conservative estimate of air quality impacts, are shown in Table 4-23.

Water Supply System

The water supply system would consist of up to 45 wells, gathering lines, access roads, and a main water pipeline. Impacts would include temporary increases in fugutive dust and gaseous pollutants and are not expected to be significant. Emission factors are presented in Appendix G-1, and emission estimates are presented in Appendix G-3.

TABLE 4-23

EXISTING AND PREDICTED AIR QUALITY VALUES ($\mu g/m^3$)

	TSP	SO_2	NO_2
Annual Average			
Existing	20	6	26
Predicted[a]	41	12	29
Federal Maximum Standard	60	80	100
Wyoming Maximum Standard	60	60	100
24-Hour Average Concentration			
Existing	20	28	b
Predicted[a]	65	39	b
Federal Maximum Standard	150	365	b
Wyoming Maximum Standard	150	260	b

[a] At plant boundaries.

[b] No standards established for this category.

TSP = total suspended particulates.

SO_2 = sulfur dioxide.

NO_2 = nitrogen dioxide.

No significant air quality impacts would be expected. Amounts of fugitive dust due to wind erosion and vehicle travel over access roads would be insignificant.

Slurry Pipelines and Pump Stations

Impacts from the construction of the slurry gathering lines, main slurry pipeline, and slurry pump stations would consist of temporary increases in fugitive dust and gaseous pollutants. In areas along the proposed pipeline route where natural, windblown dust occasionally exceeds the total suspended particulate (TSP) standards, construction activities would contribute to high levels during periods of strong wind. However, construction impacts would be temporary and insignificant. Estimates of pollutant emissions for a worst-case construction year are presented in Appendix G-4.

All pump stations would employ electric pumps; thus no significant impact on air quality would be expected.

4.A.10 RECREATION RESOURCES

Coal Slurry Preparation Plants

A consequence of the proposed action could be an increase in hunting within Campbell County and an increase in the number of people traveling outside the county for outdoor natural recreation. New project-related population could increase the demand for hunting licenses at a time when their availability has been diminishing. Based on data compiled by the Wyoming Game and Fish Commission (1979), approximately 19.1 percent of the newcomers would participate in antelope hunting for an average of 1.94 days per hunter. During 1984, the year of maximum population increase attributable to the project, roughly 512 project-related people would hunt in the county for an estimated 993 hunter days. This represents about 8.5 percent of the 1978 demand.

The use of surrounding recreation areas due to project-related population growth is expected to increase slightly but not significantly (Table 4-24). In each case these project-related increases are less than 10 percent of the non-project-related use. The projections are based on extrapolations of past use, so it should be noted that the crowding problems could worsen as a result of changes in recreational use prompted by gasoline shortages and increased travel costs.

The population increase associated with operation, maintenance, and abandonment of the coal slurry preparation plants would be less than that associated with construction. The demands associated with this population increase would add to the total needs for the area but would generate no new demands beyond those associated with construction of the plants.

Slurry Pipelines and Pump Stations

The proposed action would cross 15 rivers having either scenic or recreational value (Table 3-26). Of these, 7 have been identified in the Heritage Conservation and Recreation Service (HCRS) draft Nationwide Rivers Inventory, Phase I. (As of February 1981, this inventory program has been transferred to the National Park Service.) In accordance with a Federal Register Notice published September 8, 1980 (Volume 45, Number 175), the Bureau of Land Management (BLM) requested assistance from the Mid-Continent and South Central Regional Offices of HCRS to determine whether the ETSI proposed project could have an adverse effect on the natural, cultural, or recreation values of the inventoried river segments.

For the remaining rivers, either existing state scenic rivers or rivers potentially important to a state as future state scenic rivers, impacts to recreation experiences due to construction

TABLE 4-24

PROJECT-RELATED VISITOR USE IN PUBLIC RECREATION AREAS NEAR CAMPBELL COUNTY, WYOMING, 1980, 1985, 1990

Recreation Area	Visitor Days[a] 1980	1985	1990
Big Horn National Forest			
Without Project	909,000	1,030,000	1,150,000
With Project[b]		1,036,797	1,154,925
Black Hills National Forest			
Without Project	146,000	165,000	185,000
With Project[c]		169,538	188,288
Devils Tower National Monument			
Without Project	51,000	75,000	99,000
With Project[d]		78,796	101,750
Keyhole State Park			
Without Project	89,000	89,000	88,000
With Project[e]		95,508	92,716

Source: Oblinger-McCaleb 1980

[a] A common unit of measurement for recreation which represents 12 hours in any activity (e.g., 3 people visiting a historic area for 4 hours equals 1 visitor day).

[b] Assumes 33.1 percent of the new residents will visit for an average of 9.92 days per year.

[c] Assumes 22.1 percent of the new residents will visit for an average of 9.92 days per year.

[d] Assumes 50.1 percent of the new residents will visit for an average of 3.66 days per year.

[e] Assumes 29.8 percent of the new residents will visit for an average of 10.55 days per year.

would be short-term. At the worst, high quality recreation experiences while participating in float trips, boating, canoeing, kayaking, etc., would not be achieved. Fishing as a recreation experience could be temporarily (approximately 1 week) impaired at river crossings due to pipeline construction activity (e.g., noise intrusions, visual impacts, etc.).

The construction phase of pipeline activity would result in short-term (approximately 4-weeks) disruption to recreational resources such as historic, scenic, and recreation trails, and National Natural Landmarks which could affect the quality of the recreation experience during this time period. Because these impacts would be temporary, they are considered to be of minor significance. Major trails and National Natural Landmarks crossed by the pipeline are identified in Section 3.A.9

Though the pipeline does not cross within the boundaries of the following managed recreation areas (Harris 1980)--Ash Hollow Historic Park, Kingman County State Lake, Sam Houston State Park, Alexander State Forest, Will Rogers State Park--the quality of the recreation experience could be impaired because of alteration to the visual resources of the area. Similarly, although the pipeline would not cross the proposed Walnut Creek Recreation Area in Kansas (see Appendix C-13), temporary disruption to the visual resources of the area could affect the quality of the recreation experience.

Dewatering Plants

Actual construction of the dewatering plants would have little direct impact on recreation resources. The proposed sites are not located on or near any managed recreation areas. In addition, the placement of dewatering plants adjacent to power plants would add to the total impact but is unlikely to substantially alter recreational experiences. Increased use of existing areas because of the presence of construction workers and their families is expected to be less than 10 percent of current use and therefore is considered insignificant.

Ancillary Facilities

In accordance with the September 8, 1980, Federal Register (Vol. 45, No. 175), BLM requested the assistance of HCRS in determining whether the proposed microwave towers in the vicinity of Big Piney Creek and the Saline River could have an adverse effect on the natural, cultural, or recreational values of rivers identified in the Nationwide Rivers Inventory Phase I program. This consultation has confirmed that the proposed microwave towers along these rivers would not have a significant adverse effect which could foreclose the possibility of the Big Piney Creek and Saline River from any consideration as a National Wild and Scenic River. In fact, these towers would each receive a point rating of 35 on HCRS's intrusion classification table. An average intrusion level of 100 points or more per river segment would constitute a significant and "lasting adverse effect" on these rivers' potential for future study as a National Wild and Scenic river (Schmitt 1981).

An additional microwave tower would be located at the southern boundary of the Oologah Reservoir. Although this proposed tower would be visible from the reservoir, this would not be considered a significant intrusion on achieving a high quality recreational experience.

4.A.11 TRANSPORTATION NETWORKS

No significant impacts on existing roadways are expected from the operation, maintenance, and abandonment of any project components. Because of the placement of pipeline components and the means of laying the pipe, it is anticipated that there would be no significant impacts on the railroad system, despite numerous rail crossings. Each crossing must be approved by the railroad involved, and it is assumed that in gaining such permission there would be agreement on the timing of the pipeline construction activity to assure no disruption in rail traffic.

Coal Slurry Preparation Plants

Construction activities would increase the volumes of commuter and truck traffic on State Highway 59 between the preparation plant sites and the nearby town of Gillette. However, because of the recent reconstruction of the highway between Douglas and Gillette and the additional construction planned for the next three years, it is not anticipated that any major traffic disruptions would result from project-related activities. In addition, Interstate 90 connecting Gillette and Moorcroft is now complete; so workers commuting to Gillette would cause no significant impacts.

Slurry Pipelines and Pump Stations

Impacts on the existing surface transportation network would result from activities during construction of the proposed pipeline. These impacts are of three primary types:

1. Increased traffic caused by construction workers traveling to the construction work site
2. Increased movement of heavy equipment and materials to the construction site
3. Disruption of roads while the pipeline is placed under existing roadbeds.

In most places these impacts would be minimal because they would last only a few days and the surrounding area is rural, so there would be little traffic movement along the affected roadways. Near large urban centers, commuters on interstates might experience some temporary disruption but would not experience any appreciable delay in travel time. Congestion might occur outside Pine Bluff where the pipeline would cross three access roads to the city: U.S. 270, U.S. 65, and U.S. 79. Scheduling of construction activities could reduce the potential for these impacts. Traffic might be affected for a short period of time where the highways pass through scenic countryside or provide access to high-use recreation areas (Table 4-25). Such short-term disruption of traffic is not considered significant.

Dewatering Facilities

Most of the dewatering facilities would be located near urban areas that have well-established transportation networks. In general, project-related activities should have no significant impact on the major highways, except where the activities are quite close to cities such as Oologah, Muskogee, New Roads, and Lake Charles. At these sites there is a greater amount of regular commuter traffic, which could experience some slowing during rush hours if large equipment were being moved at that time. Assuming that such equipment movements can be scheduled around the prime commute hours and that the disruption would be temporary, the impacts at these sites should also be insignificant. Without such scheduling, more traffic disruption and congestion could occur.

It should be noted that the Lake Charles lateral would cross Interstate 49, the proposed North-South Expressway. This project has been approved and, depending upon the coincidence of its construction and construction of the lateral, there could be disruptions in traffic flow that cannot be determined at this time.

4.A.12 VISUAL RESOURCES

Impacts to visual resources are defined to be changes in the form, line,

TABLE 4-25

AREAS OF POTENTIAL TOURIST TRAFFIC DISRUPTION
DUE TO CONSTRUCTION: PROPOSED ACTION

State	Highway	Milepost	Note
Kansas	U.S. 36	P-394	Oberlin State Park
	U.S. 24	P-414	Sheridan County State Park and Prairie Dog State Park
	U.S. 56/156	P-530	Arkansas River Crossing
Oklahoma	State 51	P-830	Scenic Roadway
	State 266	P-863	Arkansas River and Recreation Area
Arkansas	U.S. 71	P-918	Scenic
	State 23	PMB-939	Scenic
	State 7	PMB-985	Scenic

color, and/or texture of an area. Impacts to "visually sensitive" areas are of most concern. Criteria used to identify visually sensitive areas include proximity to areas used by humans (major roadways, scenic highways, parks and recreation areas, historic and cultural sites, urban developments, waterways and natural or scenic rivers) and proximity to areas already designated as having high scenic quality.

To determine the significance of impacts to visually sensitive areas, changes to these areas were classified according to the extent of disturbance, visibility from public areas, and duration of impacts. Standard procedures included in the project description, such as reclamation of disturbed areas and facility design (Appendix C-1), were considered in determining the extent of disturbance that would be caused by construction, operation, maintenance, and abandonment of the project.

Changes directly related to vegetation that would be mitigated through revegetation within one or two growing seasons were considered temporary and, thus, insignificant. Where landform changes would result (e.g., rocky areas) or where revegetation would be difficult (e.g., steep slopes), visual contrasts are likely to remain for a longer time. Modifications that would be noticeable for two to five years were considered short-term; those that would be noticeable for five years to a lifetime were considered long-term.

Visual impacts were considered significant if they occurred in highly sensitive areas and would be extensive or long-term. Significant visual impact areas are summarized in Table 4-26.

Among the most significant impact areas are those where natural, scenic, or recreational waterways are crossed, creating even short-term visual contrasts that could affect the recreation experience and scenic quality of the landscape. Fourteen rivers crossed by the proposed route are either identified for consideration as natural and scenic rivers or are already protected under state legislation (Section 3.A.9, Table 3-26). Of these, only six are of concern because of their proximity to human use areas or the extent of disruption to the natural features in the landscape. These include the Arkansas River, Chikaskia River, Mulberry River, Bayou Bartholomew, Little River, and Illinois Bayou.

Because of the importance of water as a high quality visual resource (Litton et al. 1971), several other river crossings--not identified for protected status--and recreational lakes/reservoirs are also considered to be significant impact areas; among these are the South Platte River, the Republican River, the Verdigris River, Oologah Lake, Kingman State Lake, Smokey Hill River, Neosho River, Catahoula Lake, Greers Ferry Reservoir, and the White River.

Visual impacts are also considered to be significant at recreation areas. Visual contrasts in color, line, form, and texture that could be seen from parks, hiking trails, national forests, and camping areas are identified in Table 4-26. For the proposed action pipeline construction activities could affect the visual part of the recreation experience at 11 locations.

The final category of areas of significant impacts is directly related to proximity to major roadways. Though the motorist has different expectations than the recreationist for quality visual experiences, many states are attempting to protect and improve the landscapes within the "seen-area" of transportation corridors. The proposed action crosses or parallels 13 major roadways where significant visual contrasts would be

TABLE 4-26

SUMMARY OF SIGNIFICANT IMPACTS ON VISUAL RESOURCES: PROPOSED ACTION

Facility and/or Milepost	Sensitivity[a]	Duration of Impact[b]	Notes
Water-Well Field	Low to medium	Long	Some contrast reduced in long term as revegetation takes place. Structures visible over long term.
<u>Pipeline</u>			
MP PMB-91	Medium	Short	Crosses U.S. 20 and Niobrara River. Recreational.
Pump Station P-3 and Micro-wave Tower, MP PMB-91.9	Medium	Long	Highly visible.
MP PMB-265	High	Short to long	Crossing of U.S. 30, South Platte River, I-80. Recreational use. Dense canopy of mature trees.
MP PMB-360	Medium to high[c]	Short	Intersects U.S. 6/34 and Republican River. Recreation use.
MP P-434 - P-436	High[c]	Short to long	Intersects U.S. 24 (scenic) Pacific R.R., and South Fork of Solomon River.
P P-445	Low to medium	Short to long	U.S. 283, Saline River crossing.
MP P-486	Medium	Short	Smokey Hill River crossing.
MP P-496	Medium	Short	U.S. 183 and Big Timber Creek crossing, 7 miles from town of LaCross.

TABLE 4-26 Continued

Facility and/or Milepost	Sensitivity[a]	Duration of Impact[b]	Notes
MP P-508 - P-515	Medium to high[c]	Short	State Highway 4, Walnut Creek crossing, proposed state recreation area, State 96 intersection.
MP P-530	High[c]	Short to long	U.S. 56 (scenic) and Arkansas River crossing, (identified for study by HCRS and the State), with dense vegetation, 9 miles from Great Bend.
Pump Station P-7 MP P-560	Medium to High	Long	Contrast in scale with low-profile foreground.
MP P-591	High[c]	Short	Kingman State Lake and camping area, Ninnescah River (identified for study by HCRS and the State).
MP P-610	High[c]	Short to long	Crosses Chikaskia (identified for study by HCRS) River near State Highway 14.
Microwave Tower MP P-677	Medium	Long	Near State 11.
Microwave Tower MP P-726	Medium	Long	Near Arkansas River and State 20.
MP P-761	Medium	Long	Osage Indian Reservation, oak wooded area and rock outcropping.
MP P-770 - P-779	High[c]	Short	Verdigris River crossing; dense vegetation, Oologah Lake to northern borders of Will Rogers State Park.
MP P-808	High[c]	Long	Rock ledge river bank, densely wooded riparian zone, Neosho River.

TABLE 4-26 Continued

Facility and/or Milepost	Sensitivity[a]	Duration of Impact[b]	Notes
MP P-838	High	Short	Crosses Neosho River, 1 mile from seen area of Highway 2, crosses Arkansas River at MP P-843.
MP P-850 - P-866	High	Short	Parallels Arkansas River, crosses Spaniard Creek, adjacent to Webbers Flat lock and dam and across river from Penkiller State Park.
MP P-850 P-866	High	Short	Parallels Arkansas River, crosses Spaniard Creek, adjacent to Webbers Flat lock and dam and across river from Tenkiller State Park.
MP PMB-929	Medium	Short	Crosses Mulberry River near Highway 64; Ozark Nat'l Forest to north.
Microwave Tower MP PMB-946	High[c]	Long	Near national forest.
MP PMB-960 - PMB-999	High[c]	Short to long	Crosses Spadra and Piney creeks (both candidates for scenic status), the Illinois Bayou; heavily vegetated. Ozark National Forest to north and Dardanelle Lake to south; parallels I-40 (scenic).
Microwave Tower PMB(I)-30	Medium	Long	Near Republican River and State 25.

TABLE 4-26 Continued

Facility and/or Milepost	Sensitivity[a]	Duration of Impact[b]	Notes
PMB(I)-36-60	High[c]	Short to long	Crosses Cadron Creek, southern portion of Greers Ferry reservoir and Little Red River. Popular recreation and scenic area of state.
MP PMB-1013	Medium to high	Short to long	Crosses Arkansas River between two parks and within sight of State Highway 154.
MP PMB-1021 - PMB-1030	Medium to high	Short to long	Crosses Fourche LaFave River and parallels border of scenic Ouachita Nat'l Forest, northwest of Little Rock.
Microwave Tower MP PM-1118	High	Long	Near Saline River and State 35.
MP PM-1199	High[c]	Short to long	Pipeline crosses state scenic Bayou Bartholomew, disruption to vegetation long-term if mature trees (oak, hickory, willow) are included.
Microwave Tower MP PM-1275	Medium	Long	Near U.S. 84.
MP PM-1288	High[c]	Short to long	Crosses state scenic Little River adjacent to Kisatchie National Forest and Catahoula Lake.
Microwave Tower MP PM-1301	Medium	Long	Near State 28.
MP PM-1316-PM-1320	High[c]	Long	Crosses Bayou Boeuf and Cocodrie diversion channel adjacent to Kisatchie National Forest.

TABLE 4-26 Concluded

Facility and/or Milepost	Sensitivity[a]	Duration of Impact[b]	Notes
Microwave Tower MP PM-NW1	Medium	Long	North of Alexander State Forest.
Dewatering Plant			
Independence	Medium to high[c]	Long	Located along White River, heavy vegetation affected.

Note: Each site listed would have a significant degree of modification as a result of the proposed action. Facility locations are shown in Appendix A.

[a]Sensitivity denotes the priority to human use areas, with high sensitivity attributed areas used for recreation, sightseeing and water-related outdoor experiences.

[b]Duration of impact indicates time period that visual changes are likely to be most obvious, short implies 2-5 years, and long is 5 years and over.

[c]Denotes potentially controversial consequences.

noticed by motorists. Impacts at 10 of these crossings are contrasts resulting from alteration of vegetation and landform, and 3 are related to pump stations visible from the roadway.

Visual impacts directly related to the addition of physical structures to the landscape were considered significant only if they contrasted dramatically with the natural setting (e.g., preparation plants were determined to add additional impacts, only, to the existing mining activities and structures, as were the dewatering facilities located next to power plants). The dewatering plants having significant visual impacts because of their interaction with existing or planned power plants are: Independence, Wilton, and Boyce. Two of the pump stations and 9 of the microwave towers would have significant impacts along the proposed route (Table 4-26). The visual contrasts resulting from cleared vegetation and the scale and design configuration of these facilities would make them highly visible and would detract from the natural setting. Of minor significance were the remaining dewatering plants; the well field and pipelines; the New Roads and Wilton extensions; and the microwave towers not identified above.

4.B **MARKET ALTERNATIVE**

Impacts for this alternative are described below only for those portions of the market alternative that differ from the proposed action. For water resources, slurry pipeline ruptures and spills, vegetation, aquatic biology, agriculture, cultural resources, transportation, visual resources, and air quality, the impacts for the market alternative were found to be essentially the same as for the proposed action (see Sections 4.A.1, 4.A.3, 4.A.4, 4.A.6, 4.A.7, 4.A.9, 4.A.11, and 4.A.12), even where the routes vary. Specific impacts for this alternative for socioeconomics, wildlife, recreation, and agriculture were found to vary from the proposed action and are discussed below.

4.B.1 SOCIOECONOMIC CONSIDERATIONS

Coal Preparation Plants and Water Supply System

Under the market alternative, the capacity of the North Rawhide preparation plant would be increased to 13.1 million tons annually (MMTA) and the capacity of the Jacobs Ranch preparation plant would be reduced to 14.3 MMTA. The result would be a redistribution of the construction work force nearer to Gillette (less than 10 miles from the North Rawhide plant). There are two possible effects. The shift of employment to the North Rawhide plant would lower the commuting distance traveled by the construction workers who would live in Gillette, and in addition there would be a marginal increase in demand for housing and services in Gillette. However, overall social and economic effects in the Wyoming area under the market alternative would not be significantly different from those caused by the proposed action.

Slurry Pipelines and Pump Stations

This section discusses impacts to areas with pipeline and pump stations only, as shown in Table 4-27. Segments of pipeline and pump stations near dewatering plants are discussed in the Dewatering Plants section.

Construction. The social and economic consequences of construction would generally be of the same type and magnitude as those identified for the proposed action. As for the proposed action, the level of adverse effects of pipeline construction on the affected area would not represent an adverse impact of significant proportions.

Operation, Maintenance, and Abandonment. The pipeline operation work force

TABLE 4-27

EFFECTS OF CONSTRUCTION ON AREAS WITH PIPELINE AND PUMP STATIONS ONLY: MARKET ALTERNATIVE

Area	County/ Parish	1975 Pop.	Project Component[a]	Peak Fixed-Site Employment[b]			Peak Pipeline Employment			Estimated Peak Pop. In-Migration		Estimated Peak Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
North Kansas	Decatur	5,100												
	Norton	6,700												
	Phillips	8,000												
	Rooks	7,100	PL, PS	4/83	49	25	3&4/83	748	374	insignificant	486	insignificant	226	195 Russell
	Osborne	6,200		4/83	49	25				insignificant		insignificant		741 Hays
	Russell	9,000												
	Ellsworth	6,200												
	Rice	12,000												
	McPherson	25,400												
South Kansas	Harvey	28,900												
	Sedgewick	345,200												
	Butler	39,700	PL, PS	4/83	49	25	1&2/84	748	374	insignificant	486	insignificant	226	4975 Wichita
	Cowley	33,800												
	Chatauqua	4,700												

Source: Population data are from U.S. Bureau of the Census 1978.

[a]PL = pipeline
PS = pump station

[b]Fixed-site employment includes construction and service sector employment.

[c]Assumes maximum (rough terrain) spread size as a worst case.

would be concentrated at maintenance bases at Jacobs Ranch and at the Pryor, White Bluff, and New Roads dewatering plant sites. Pump stations would be automated. Consequently, no significant employment and population effects would be associated with operational work force requirements in counties with pipeline and pump stations only (Table 4-28).

Host counties would derive property tax revenue benefits for the economic life of the pipeline system (Table 4-28). The degree of effect on each county would depend not only on the value of the system in the county (a function of pipeline length and diameter and pump station location), but also on the size of the existing tax base and local decisions on how to incorporate the new source of revenues into the county tax structure.

Upon abandonment, employment and population effects would be nil and property tax revenues would decline.

Dewatering Plants

This section discusses impacts of dewatering plants and their associated pipelines and pump stations as shown in Table 4-29.

Construction. Under the market alternative, there would be a different set of dewatering plants. Construction and operation of the Independence, White Bluff, Boyce, Lake Charles, New Roads, and Wilton dewatering plants would be the same as for the proposed action. In Oklahoma, the Ponca City and Muskogee dewatering plants would not be constructed. However, the Pryor dewatering plant would be increased in capacity from 3 to 5.3 MMTA, and a dewatering plant would be built at Oologah, Oklahoma, about 30 miles from Pryor. In Louisiana, the Baton Rouge dewatering plant would be constructed.

Employment and population effects would be insignificant in all the dewatering plant areas (Table 4-29). Even where the Pryor and Oologah plants would be constructed within 30 miles of each other, the aggregate peak work force demand of 483 would be met from the Tulsa area and no in-migration of nonlocal construction workers would occur.

Operation, Maintenance, and Abandonment. Employment and population effects from the dewatering plant and pipeline operation and maintenance would be insignificant (Table 4-30). New property tax revenues would benefit those counties or parishes in which dewatering plants were located. The degree of benefit would depend upon the value of the system in the county, the existing tax base, and local decisions on how to incorporate the new source of revenues into the county tax structure.

Upon abandonment, direct employment would be eliminated and property tax revenues would decline.

4.B.2 WILDLIFE

Insignificant impacts resulting from pipeline construction are summarized in Section 4.A.5. These impacts would be expected to occur similarly if the market alternative route were chosen. Wildlife species of special concern that could be affected by the market alternative are listed by component in Table 4-20.

Wildlife species of special interest that could occur along the market alternative route in Kansas and Oklahoma include the black-footed ferret, bald eagle, interior least tern, and greater prairie chicken (Table 4-20). In addition, loss of riparian vegetation at stream crossings along the market alternative route in Kansas and Oklahoma could be locally significant, since

TABLE 4-28

EFFECTS OF OPERATION ON AREAS WITH PIPELINE AND PUMP STATIONS ONLY: MARKET ALTERNATIVE

Area	County/ Parish[a]	Project Component[b]	Annual County Property Tax Revenues: 1976-77 Property Tax Revenues (x $1000)	Estimated[c] ETSI Property Tax Revenues (1980 dollars) (x $1000)	Percentage of 1976-77 Property Tax Revenues
North Kansas	Decatur	PL	2,192	530	24
	Norton	PL,PS	2,452	540	22
	Phillips	PL	3,108	90	3
	Rooks	PL	2,854	610	21
	Osborne	PL	1,730	150	9
	Russell	PL	4,456	770	17
	Ellsworth	PL,PS	2,962	760	26
	Rice	PL	4,515	340	4
	McPherson	PL	8,720	390	4
South Kansas	Harvey	PL	9,556	670	7
	Sedgewick	PL	90,077	330	0.3
	Butler	PL,PS	11,866	870	7
	Cowley	PL	8,986	630	7
	Chatauqua	PL	1,366	440	32

Note: There would be no direct or secondary permanent employment and no population in-migration.

[a] Only counties in which components are to be located are listed.

[b] PL = pipeline
PS = pump station

[c] Estimated property taxes by county were estimated by ETSI for the EIS by extrapolating previously developed unit cost estimates for components and should in no way be construed as representing the cost estimate for the components. Values shown on this table were derived by ETSI as follows:

Sum of estimated cost of components in county (1980 dollars) x Statewide ratio of assessed value to market value x Percentage tax rate assumed for county = Estimated ETSI property tax revenues in 1980 dollars

TABLE 4-29

EFFECTS OF CONSTRUCTION ON AREAS WITH DEWATERING PLANTS: MARKET ALTERNATIVE

Area	County/ Parish	Project Components[a]	Existing Construction Labor Pool	Peak Fixed-Site Employment[b]			Peak Pipeline Employment			Estimated Peak Pop. In-Migration		Estimated Peak Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
Oologah-Pryor, OK	Osage, Washington, Rogers, Mayes, Tulsa, Wagoner, Cherokee, Adair	PL, DP, MB, PS	11,990 in Tulsa SMSA & N.E. Okla. regions	1/84	483	0	3/83 3/84	670 670	335 335	0	435 435	0	200 200	150/Pryor; 400/Bartlesville; Tulsa not inventoried
Baton Rouge, LA	W. Baton Rouge, E. Baton Rouge	PL, DP	24,675 in Baton Rouge labor mkt. in 1978	4/85	259	0	3/84	260	130	0	169	0	80	3500 units in Baton Rouge

Source: Labor pool data are from WCC 1981d.

[a]PL = pipeline
DP = dewatering plant
MB = maintenance base
PS = pump station

[b]Fixed-site employment includes construction and service sector employment.

[c]Assumes maximum (rough terrain) spread size as a worst case.

TABLE 4-30

EFFECTS OF OPERATION ON AREAS WITH DEWATERING PLANTS: MARKET ALTERNATIVE

Area	County/ Parish[a]	Project Component[b]	Annual County Property Tax Revenues: 1976-77 Property Tax Revenues (x $1000)	Annual County Property Tax Revenues: Estimated ETSI Property Tax Revenues (1980 dollars) (x $1000)[c]	Annual County Property Tax Revenues: Percentage of 1976-77 Property Tax Revenues	Permanent Employment: Direct	Permanent Employment: Secondary	Estimated Population In-Migration
Oologah-Pryor, OK	Osage	PL	3,208	440	14	107	118	508
	Washington	PL	5,945	300	5			
	Rogers	PL,DP,PS	4,362	1031	24			
	Mayes	PL,DP,MB,PS	2,126	1084	51			
	Cherokee	PL	1,366	380	28			
	Adair	PL	916	210	23			
Baton Rouge, LA	W. Baton Rouge	PL	2,562	127	5	40	44	189
	E. Baton Rouge	PL,DP	36,694	369	1			

[a] Only counties in which components are to be located are listed.

[b] PL = pipeline
DP = dewatering plant
MB = maintenance base
PS = pump station

[c] Estimated property taxes by county were estimated by ETSI for the EIS by extrapolating previously developed unit cost estimates for components and should in no way be construed as representing the cost estimate for the components. Values shown on this table were derived by ETSI as follows:

Sum of estimated cost of components in county (1980 dollars) x Statewide ratio of assessed value to market value x Percentage tax rate assumed for county = Estimated ETSI property tax revenues in 1980 dollars

wildlife species are concentrated in these areas.

Generally, potential impacts to the black-footed ferret and bald eagle would be the same as described for the proposed action in Section 4.A.5.

Interior Least Tern

Breeding records exist for this state protected species from Rooks County, Kansas. The market alternative would traverse the South Fork Solomon River at MP MB-80. Construction in this portion of Kansas is scheduled for early March 1984. Interior least terns probably nest in the area in June and July. The interior least tern would not be affected in Kansas.

Greater Prairie Chicken

In Oklahoma, the range of the greater prairie chicken might be encountered between about MP MB-324 to MB-337 of the market alternative, and at about MP MB-442 of the market alternative.

Construction is scheduled in this portion of Oklahoma in October. Since the greater prairie chicken strutting season is in April and May, construction would not interfere with breeding birds. Some strutting grounds could be temporarily altered by construction; however, such temporary impacts would be localized and insignificant (Short 1980).

4.B.3 RECREATION RESOURCES

Slurry Pipeline and Pump Stations

Most recreational impacts resulting from construction of the market alternative would be temporary (less than 2 visitor seasons), similar to those discussed for the proposed action. Of significant recreational concern would be: the 7 managed recreational areas within 5 miles of the pipeline (including 2 state parks--Prairie Dog and Rooks County in Kansas that are both within 3 miles of the pipeline); the 6 waterways crossed by the pipeline and having recreational or scenic value (the Illinois River in Oklahoma and the Caney River in Kansas are both considered prime water and scenic recreation resources by their respective states); the 11 major recreation/historic trails crossed by the pipeline (including 2 recommended for the National Trails System--the Santa Fe and the Old Cattle); the proximity of both the pipeline and dewatering plant to the Will Rogers State Park and Oologah Lake recreation area; and one microwave tower (near MP MB-485) located within view of the Ozark National Forest boundary.

Similar to the impacts discussed in Section 4.A.10, the nature of the recreation impacts is directly related to modifications to the visual resources in the area, noise from construction activities, and the prominence of existing man-made intrusions (e.g., access roads, towers, stacks) in the natural environment which would degrade the quality of the recreation experience. Though some of these impacts are of short duration (1-2 months), they would be significant if they occurred at any time coinciding with peak visitor use. Water-related impacts such as at river crossings are particularly sensitive during seasonal use of waterways.

4.B.4 AGRICULTURE

The construction, operation, and maintenance of the eight market alternative slurry pump stations and two dewatering plants (not associated with the proposed action) would take approximately 100 acres (four pump stations, Table 4-22) of prime agricultural land out of production for approximately 50 years. The impact of this potential crop production loss would be relatively minor from a regional or state standpoint. Since the surface facility land areas would be reclaimed during the abandonment phase of the project, these lands would not be irreversibly converted to other uses and their viability would not be significantly diminished. The impact of operation of this alternative using any of the well-field water sources is discussed in Section 4.A.8.

4.B.5 VISUAL RESOURCES

Similar to the proposed action, the visual impacts for the market alternative are primarily concentrated around landscapes where water- or recreation-related activities predominate and where alteration of the natural vegetation would result in noticeable contrasts in color, line, texture, and form. Significant impacts are summarized in Table 4-31.

Several river crossings are identified as significant: these include four that are proposed for study by the former National Heritage Conservation and Recreation Service; three that are protected wild and scenic state rivers; and one that has been identified for state protection (see Table 3-34). In addition, five rivers would be crossed that have not been proposed for state or national protection but have been identi fied as having significant visual qualities. Other bodies of water where visual impacts would result from pipeline activity include the lakes and reservoirs where recreation or scenic experiences may be affected; these include Wilson Reservoir, Norton Reservoir, and Tenkiller Reservoir. Removal of vegetation along the pipeline right-of-way, or the addition of pump stations, access roads, and microwave towers in these areas, would result in visual contrasts in color, line, texture, and form to the natural landscape. In many instances, even temporary visual consequences would be sensitive in these environments.

Other sites where the market alternative construction activities could affect the scenic recreation experience include the eight parks, hiking trails, campgrounds, and forest lands within the "seen area" of the pipeline.

Additional visual consequences would occur where pipeline and pump station activities are visible to motorists at the eight mileposts near major roadways.

4.C **CYPRESS BEND PIPELINE-BARGE ALTERNATIVE**

Impacts to water resources, socioeconomics, aquatic biology, agriculture, air quality, and recreation are discussed below for only that portion of the Cypress Bend pipeline-barge alternative that is not in common with the market alternative (MP PMB-1092 to B-81). Since the analysis identified no major impacts, the following topics are not discussed: vegetation, wildlife, cultural resources, transportation networks, visual resources, and ruptures and spills.

4.C.1 WATER RESOURCES

<u>Surface Water</u>

Impacts would be similar to those for the proposed action, with the exception that under this alternative, temporary turbidity effects in bayou/wetland areas of Louisiana would not occur.

4.C.2 SOCIOECONOMIC CONSIDERATIONS

<u>Coal Preparation Plants and Water Supply System</u>

Under the pipeline-barge alternative, the capacity of the North Rawhide preparation plant would be 18.9 MMTA and the capacity of the Jacobs Ranch preparation plant would be 8.5 MMTA. The result would be a redistribution of the construction work force nearer to Gillette

TABLE 4-31

SUMMARY OF IMPACTS ON VISUAL RESOURCES:
MARKET ALTERNATIVE

Facility and/or Milepost	Sensitivity[a]	Duration of Impact[c]	Notes
MP MB-36-42	High[b]	Short	Crosses Prairie Dog Creek at edge of state park, 2 miles from Norton.
MP MB-60-83	High[b]	Short	Intersects U.S. 24 west of Stockton; crosses South Fork of Solomon River and near Rooks County State Park; south of Webster State Park.
MP MB-115-137	Medium to high[b]	Short	Rolling terrain with numerous creeks and heavy vegetation, Wilson Reservoir and Saline River (identified for study by HCRS) sport-recreation areas.
MP MB-172	Medium	Long	Microwave tower near State 4.
MP MB-324-330	Medium to high[b]	Long	This area is considered picturesque; Rock Creek close to wilderness trail, good riparian vegetation.
MP MB-347-366	Medium	Short to long	Close to Osage State Park, Bartlesville, crosses Caney River (identified for state study), rock outcropping and steep slopes.

TABLE 4-31 Concluded

Facility and/or Milepost	Sensitivity	Duration of Impact[c]	Notes
MP MB-373.5 Pump Station	Medium to high	Long	Contrast in scale, between pump station facilities and low-profile foreground.
MP MB-417-427	Medium to high	Short to long	Camping-recreation area, steep slopes, scenic.
MP MB-440-446	High[b]	Short to long	Pipeline crosses two state scenic rivers (Barren Fork and Illinois) through well vegetated mountainous region.
MP MB-482.5 Pump Station	High	Long	Contrasts with forested mountain setting in scale and texture.
MP MB-825 Pump Station	High	Long	Microwave tower near Ozark National Forest.
Dewatering Plant (Total Impacts)			
Oologah	High[b]	Long	Borders Will Rogers State Park and south end of Oologah Lake.

Note: Impacts caused by dewatering plants would be the same as those described for the proposed action (Table 4-26).

[a]Sensitivity denotes the proximity to human use areas, with high sensitivity attributed to areas used for recreation, sightseeing, and water-related outdoor experiences.

[b]Denotes potentially controversial consequences.

[c]Duration of impact indicated time period that visual changes are likely to be most obvious; short implies 2-5 years; long is 5 years and over.

(less than 10 miles from the North Rawhide plant). There are two possible effects. The shift of employment to the North Rawhide plant would lower the commuting distance traveled by the construction workers who would live in Gillette, and in addition there would be a marginal increase in demand for housing and services in Gillette. However, overall social and economic effects in the Wyoming area under the Cypress Bend pipeline-barge alternative would not be significantly different from those caused by the proposed action.

Slurry Pipelines and Pump Stations

The social and economic consequences of construction, operation, maintenance, and abandonment would generally be of the same type and magnitude as those identified for the proposed action or market alternative. Those unique to the Cypress Bend lateral are shown in Tables 4-32 and 4-33.

Dewatering Plants

Construction. The pipeline-barge alternative dewatering plants would be identical to the market alternative as far as White Bluff; one additional plant would be located at Cypress Bend.

Employment and Population. Construction of the Cypress Bend dewatering plant and barge loading facility would generate employment, population, and housing effects on local communities because of the generally rural character of southeast Arkansas and the distance from major labor pools (Table 4-32). The nearest cities are Greenville, Mississippi (57 miles), and Pine Bluff, Arkansas (77 miles). The site is relatively remote, and a large proportion of construction workers would have to move into the area during construction.

Assuming the composition, source, and behavior of the construction work force for the ETSI project facilities at Cypress Bend would be similar to those of the work force that constructed the Potlatch paper mill, completed in Desha County in 1977, the ratio of local to nonlocal workers at Cypress Bend would be 15 percent local to 85 percent nonlocal. The paper mill is located less than 10 miles from the Cypress Bend site and had a peak force of 1000 workers, about 300 more than projected for ETSI-Cypress Bend facilities (Wilson 1980). Sixty percent of the total work force would be nonlocals who relocate temporarily to residences within 40 miles of the job site, and 25 percent of the total work force would commute on a daily basis from farther than 40 miles away (i.e., from places such as Pine Bluff and Little Rock and from Greenville, Mississippi, and Monroe, Louisiana) (Wilson 1980).

Of an estimated peak construction work force of 715 in the first quarter of 1984, approximately 608 would be nonlocal. Of these, approximately 429 would relocate to the local area during construction and 179 would commute from 60 to 100 miles away. About 107 local workers would be employed at the peak.

Secondary employment that would be generated as a result of construction of the Cypress Bend site is estimated to be about 365 new service jobs, which would be spread throughout the local area (i.e., communities within 40 miles of the site, such as Arkansas City, McGehee, Dermott, and Dumas). Most of the estimated 365 new secondary jobs would be filled by present residents of local communities that host the nonlocal construction workers.

The pipeline spread construction work force for the Cypress Bend lateral would be 390. It is assumed that half would be nonlocal and half would reside within a 100-mile radius (which includes the Little Rock and Pine Bluff areas).

TABLE 4-32

EFFECTS OF CONSTRUCTION: CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

Area	County/ Parish	Project Components[a]	Existing Construction Labor Pool	Peak Fixed-Site Employment[b]			Peak Pipeline Employment			Estimated Peak Pop. In-Migration		Estimated Peak Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
Cypress Bend, AR	Lincoln, Desha, Drew, Chicot, Ashley	PL, DP, BL	964 in 5 counties in 1977	1/84	715	608	3/84	390	195	1593	254	547	165	223 units in 4 communities

Source: Labor pool data are from WCC 1981d.

[a]PL = pipeline
DP = dewatering plant
BL = barge-loading facility

[b]Fixed-site employment includes construction and service sector employment.

[c]Assumes maximum (rough terrain) spread size as a worst case.

TABLE 4-33

EFFECTS OF OPERATION: CYPRESS BEND PIPELINE-BARGE ALTERNATIVE

Area	County/ Parish[a]	Project Component[b]	Annual County Property Tax Revenues: 1976-77 Property Tax Revenues (x $1000)	Annual County Property Tax Revenues: Estimated ETSI Property Tax Revenues (1980 dollars) (x $1000)[d]	Annual County Property Tax Revenues: Percentage of 1976-77 Property Tax Revenues	Permanent Employment: Direct	Permanent Employment: Secondary	Estimated Population In-Migration
Cypress Bend, AR	Lincoln	PL	964	203	21	167	184	780
	Desha	PL,DP	2,233	162[c]	7			

[a] Only counties in which components are to be located are listed.

[b] PL = pipeline
DP = dewatering plant
MB = maintenance base

[c] Pipeline only, does not include value of dewatering plant, plus terminal facilities.

[d] Estimated property taxes by county were estimated by ETSI for the EIS by extrapolating previously developed unit cost estimates for components and should in no way be construed as representing <u>the</u> cost estimate for the components. Values shown on this table were derived by ETSI as follows:

Sum of estimated cost of components in county (1980 dollars) x Statewide ratio of assessed value to market value x Percentage tax rate assumed for county = Estimated ETSI property tax revenues in 1980 dollars

There would be no significant secondary employment generated as a result of pipeline construction.

The population increase that would be attributable to the ETSI fixed-site construction at Cypress Bend is estimated to be a maximum of around 1593 persons. This in-migrant population would be distributed among communities within 40 miles of the site, and principally in Arkansas City, McGehee, Dermott, and Dumas. During pipeline construction in the third quarter of 1984, 275 nonlocal pipeline workers would be in the area. Total mobile pipeline population would be about 300 (Table 4-32).

Housing. The total estimated peak demand for housing units in the area would be a maximum of about 547 in the first quarter of 1984. Because rental housing of any kind is in very short supply, mobile homes would be the principal solution to the demand for housing by the in-migrant population.

Pipeline construction workers would demand an estimated 165 housing units in the area in the third quarter of 1984. This is over 75 percent of the 223 hotel and motel units in the four local communities, so some nonlocal pipeline workers would possibly have to commute daily from farther away (i.e., Pine Bluff, Monroe, Little Rock).

According to several local leaders, there would be no great problem in providing housing for the construction workers and their families that move to the area to construct the dewatering plant and barge facilities. During construction of the Potlatch paper mill, which employed 1000 at peak, local mobile home parks expanded their facilities and additional mobile homes were brought in. According to Mr. Merle Peterson of the Dumas Chamber of Commerce, there are 100 or more vacant mobile home spaces available in Dumas and the surrounding area. Mr. Peterson states that the communities had no serious problems accommodating the influx of people during the Potlatch mill construction, that the local citizens would welcome the growth opportunity, and that the area should be able to handle the ETSI construction period with no major problems (Peterson 1980).

Public Services. No significant stress on local public facilities and services is expected as a result of increased demands during construction of the dewatering plant and barge loading facility. With the exception of Dermott, which needs an additional 300,000-gallon water storage tank, the local communities have excess capacity in both water and sewage disposal systems.

School districts in Arkansas City, McGehee, Dermott, and Dumas are expanding and upgrading facilities and could accommodate increases in enrollment during construction of the Cypress Bend facilities.

The Potlatch paper mill is contributing considerable property tax revenues to Desha County, and the local public services are fiscally healthy. For example, the Arkansas City School District receives some $600,000 per year from property taxes on the Potlatch paper mill and plans to construct a new high school.

Operation, Maintenance, and Abandonment. As shown in Table 4-33, significant employment, population, and tax revenue effects would result from operations at the Cypress Bend dewatering plant and barge loading facility, where 167 direct jobs, an estimated 184 secondary jobs, and an estimated population increase of 780 persons are expected. New property tax revenues would benefit Desha County. The degree of benefit would depend upon the existing tax base and local decisions on how much to use the new source of revenues. Upon abandonment, direct jobs would be eliminated and property tax revenues, already reduced by depreciation, would decline further.

Employment and Population. In the Cypress Bend area, the estimated in-migrant population of 780 is expected to locate throughout the area, principally in the communities of Arkansas City, McGehee, Dermott, and Dumas.

Housing. An estimated 280 housing units would be required. Though permanent workers are expected to prefer single-family homes, at operation start-up mobile homes would probably be the dominant housing type for permanent personnel.

Public Services. Local public services would have to meet new demands created by the in-migrant permanent population. With one exception, the water and sewer services in the four communities surveyed have now or will soon have excess capacity available to meet increased demands. The exception is the Arkansas City water system, which serves 300 customers now and would have to be expanded to accommodate a significant increase in demand.

Public schools in Arkansas City, McGehee, Dermott, and Dumas currently have capacity for additional students. All four school districts are in good fiscal condition and have ongoing capital improvement programs. No problems are expected from increased enrollments.

Local fiscal conditions in Desha County and the Arkansas City School District have been improved considerably by the revenues from the new Potlatch paper mill. Arkansas City has just built a new fire station, and the school district is planning to build a new high school. Estimated ETSI assessed values and property tax revenues that would accrue to Lincoln and Desha counties are compared with 1976-77 property tax revenues in Table 4-33.

4.C.3 AQUATIC BIOLOGY

Significant Impacts

River bottom habitats and their invertebrate communities would be destroyed or displaced where piles for the barge loading facility would be driven. This would be a locally significant (limited to the construction area), short-term biological impact. It is anticipated that a positive impact associated with the barge facility support columns would be their colonization by communities of aquatic invertebrates shortly after their placement in the river.

Insignificant Impacts

The Cypress Bend dewatering plant would discharge its clariflocculator overflow to the Mississippi River. Since this effluent would be required to meet National Pollutant Discharge Elimination System (NPDES) water quality standards, it is anticipated that there would be no detectable aquatic biological impact associated with the Cypress Bend dewatering plant discharge.

Construction of the barge loading facility would progress in stages and would extend over a period of 7 years (1982-1989). No dredging would be required, and the riverward dock face would be approximately 3000 feet long. It is anticipated that indigenous adult and juvenile fishes (Section 3.C.4.) would avoid the construction area, at least during construction activity. This displacement impact would be localized, intermittent (recurring during periods of construction activity), and biologically insignificant, since affected fishes would quickly reestablish in disturbed areas.

The primary physical effect of in-river construction activity, which would be anticipated to affect fish eggs and larvae, would be increased turbidity. The general biological impact of increased turbidity and siltation on fish eggs and larvae is described in Section 4.A.6 and is expected to be similar for the Mississippi fish fauna. ETSI's proposal to avoid construction dredging would be expected to minimize egg and larval mortality as a result of substrate in-filling and smothering. Nevertheless, some mortality would be expected, but the impact would probably be localized and biologically insignificant on a population level.

The potential for petrochemical spills exists on all construction sites. It is anticipated that low-volume spills originating from construction activities and equipment would have a limited, generally insignificant impact. Contamination of the Mississippi River by spilled materials would occur primarily during rainstorms, when they would be washed into the river through natural drainage channels. Since aromatics are generally the most lethal portion of these petroleum products, spills on land would lose their most volatile (i.e., toxic) components to evaporation before reaching the river.

According to the ETSI barge consultant, Meece Marine Enterprises, Inc., there would be no need for maintenance dredging at the barge loading facility. It is notable that maintenance dredging is considered to be the most significant impact associated with barge facilities and, as such, its elimination from the maintenance routine for ETSI's facility suggests that there would be no significant aquatic biological impacts associated with the routine operation and maintenance of the facility.

Two towboats per day would be used for coal transport; this would represent an increase in 9-foot-draw towboat traffic of approximately 17 percent in the lower Mississippi River (COE 1977).

Based on recent research results (Sparks 1975; Ragland 1974; COE 1976; Johnson 1976), increases in turbidity from ETSI tow traffic in the lower Mississippi River would probably be insignificant due to the naturally elevated ambient turbidity conditions and the low number of daily tows (one to two ETSI tows per day).

Wave wash as a result of barge river towboat traffic has received some attention by various state and federal biologists. As a towboat passes a point, there is a slight increase in the water level followed quickly by a rapid decrease in water level of approximately 1.5 feet at the shoreline. If there is a shallow slope on shore, a considerable portion of the river bottom is exposed. As the stern passes, the water rushes back in a series of waves. Narrow points with sloping shorelines would have a more pronounced wave action. A towboat could alter the rate and direction of flow inside channels.

The drawdown would expose benthic organisms along the shoreline. Mollusks will withdraw into their shells when exposed, with a resultant disruption of feeding and respiration. The other possibility is that the mollusks burrow deeper into the mud or retreat to deeper waters. These effects would normally be short-term and be of limited impact.

Fishes would probably not be affected by wave wash, as they would be able to leave the affected area and are normally subjected to wave action (Sparks 1975).

The proposed barge route is confined to the lower Mississippi River. Since the effects from waves are more significant in shallow and narrow rivers, wave wash in the deeper portions of the lower Mississippi River would be expected to be biologically insignificant.

4.C.4 AGRICULTURE

The construction, operation, maintenance, and abandonment of the Cypress Bend dewatering plant and barge loading facility (only facilities not associated with proposed action or market alternative) would take approximately 205 acres of potential prime agricultural land out of production for approximately 50 years (Table 4-22). The impact of this crop production loss would be relatively minor from a regional or state standpoint. Since this land area would be reclaimed during the abandonment phase of the project, this land would not be irreversibly converted to other uses and the viability of the land resource would not be significantly diminished.

4.C.5 AIR QUALITY

Coal Slurry Preparation Plants

For this alternative, the North Rawhide plant would process 18.9 MMTA of coal. This capacity represents about 85 percent of the 22.4-MMTA capacity of the Jacobs Ranch plant described for the proposed action (Section 4.A.9). Although air pollutant emissions are not directly proportional to processing capacity, the North Rawhide plant would probably result in pollutant concentration increases equal to about 80 to 90 percent of those discussed for the Jacobs Ranch plant in the proposed action. Processing capacities, and thus air quality impacts, of the other plants for this alternative would be much less. No violations of the ambient air quality standards would be expected.

Dewatering Plants

Impacts from operation of a coal-fired dewatering boiler would include emissions of particulates and gaseous pollutants. These emissions, and the pollutant concentration increases associated with them, are discussed in Appendix G-5. Dispersion modeling results indicate that ambient air quality standards would not be violated because of operation of the boiler.

Barge Loading Facility

Construction impacts would include temporary increases in fugitive dust and gaseous pollutant concentrations due to construction activities and equipment. These impacts are not expected to be significant. Noise impacts would be similar to those discussed for the coal slurry preparation plants.

The barge loading facilities would be sources of fugitive particulate emissions from the open coal stockpiles and the barge loading operations. The coal on the barges would also be a source of windblown particulates. These emissions would be strongly dependent on meteorological conditions at the site, and under certain conditions could cause localized high particulate concentrations near the facilities for short periods. Impacts on regional and/or long-term air quality would be expected to be insignificant. Emission estimates for stockpile wind erosion are presented in Appendix G-6.

Tugboats used to tow the barges would be sources of gaseous pollutants during operation. Estimates of these emissions are also presented in Appendix G-6. No significant impact is expected from these emissions.

4.C.6 RECREATION RESOURCES

Slurry Pipelines and Pump Stations

The only segments of pipeline where minor recreation consequences may result are the crossings at Bayou Bartholomew (B-37 and B-45), a river inventoried by the state of Arkansas for consideration as a protected waterway. The noise, increased sedimentation, and possible disruption to sport fishing, boating, and other recreational use of the waterway would occur only during construction and are considered insignificant impacts because of their short duration.

Dewatering Plants and Barge Loading Facility

The site of the Cypress Bend dewatering plant is a relatively rural area where, unlike the locations of other dewatering plants, there is no existing power plant. The area is easily accessible and is desirable for casual recreation use. While the use of the site for the dewatering plant and barge loading facility would permanently remove the land as a recreation resource, the impact is not considered significant because there is substantial area still available nearby.

4.D COLORADO ALTERNATIVE

The Colorado alternative is an alternative northern pipeline segment that could be used in conjunction with the proposed action, market alternative, or Cypress Bend pipeline-barge alternative. Only impacts associated with the Colorado alternative segment (MP C-1 to C-602) are discussed here. The impacts to cultural resources, air quality, or transportation would be similar to those described for the proposed action (see Sections 4.A.3, 4.A.7, 4.A.9, 4.A.11, and 4.A.13).

4.D.1 WATER RESOURCES

Surface Water

Impacts would be similar to those for the proposed action, with the exception that the largest single hydrostatic test water discharge is estimated to be 49 acre-feet. This would correspond to a continuous discharge over 24 hours of approximately 25 cubic feet per second and would exceed the background flow at most crossings, except for major rivers. The effects of this impact are discussed in Section 4.A.1 under Surface Water.

4.D.2 SOCIOECONOMIC CONSIDERATIONS

Under the Colorado alternative pipeline route, the main slurry pipeline would follow a route nearly due south from Jacobs Ranch across the northeastern corner of Colorado (as opposed to crossing Nebraska) and east-southeast across Kansas to Rice County, where the Colorado route would rejoin the market alternative route. As a result, a different set of counties and communities would be in the affected area (Tables 4-34 and 4-35). The social and economic impacts of construction, operation, maintenance, and abandonment would generally be of the same type and magnitude as those identified for the proposed action. Several of the Wyoming communities would experience significant impacts (such as dramatic increases in population and housing and some strain on local public finances); most of the communities outside Wyoming would not experience long-term socioeconomic impacts.

4.D.3 SLURRY PIPELINE RUPTURES AND SPILLS

A spill between MP C-315 and C-325 of the Colorado alternative could result in some loss of greater prairie chicken strutting habitat. According to the Colorado Division of Wildlife, any loss of strutting habitat would result in a decrease in production and the possible abandonment of the ground by this state-protected species. In addition, a spill at Deception Creek (MP C-558), also of the Colorado alternative, could have an impact on the Cheyenne Bottoms State

TABLE 4-34

EFFECTS OF CONSTRUCTION ON AREAS WITH PIPELINE AND PUMP STATIONS ONLY: COLORADO ALTERNATIVE PIPELINE ROUTE

Area	County/ Parish	1975 Pop.	Project Components[a]	Peak Fixed-Site Employment[b]			Peak Pipeline Employment			Estimated Peak Pop. In-Migration		Estimated Peak Housing Unit Demand		Hotel/Motel Units in Selected Communities
				Qtr/Yr	Total	Non-local	Qtr/Yr	Total[c]	Non-local[c]	Fixed-Site	Pipeline[c]	Fixed-Site	Pipeline[c]	
Southeast Wyoming	Goshen	12,000	PL				3/84	748	562		731		337	1700 Cheyenne
	Laramie	63,000												500 Scottsbluff
	Platte	7,300												
	Scotts Bluff, NB	36,200												
Northeast Colorado	Weld	107,400	PS, PS				2/84	748	562		731		337	400 Sterling
	Logan	19,500												
	Washington	5,500		4/83	49	38				insignificant		insignificant		
	Yuma	8,900		4/83	49	38				insignificant		insignificant		
	Morgan	21,800												
West Kansas	Cheyenne	4,100	PL, PS	4/83	49	24	3&4/83	748	374	insignificant	486	insignificant	226	309 Colby
	Sherman	8,200												741 Hays
	Thomas	8,100												
	Sheridan	4,000												
	Gove	4,000												
	Trego	4,500												
	Ellis	25,500												
	Rush	5,000												
	Barton	30,900												
	Ellsworth	6,200												
	Rice	12,000												

Source: Population data are from U.S. Bureau of the Census 1978.

[a]PL = pipeline
PS = pump station

[b]Fixed-site employment includes construction and service sector employment.

[c]Assumes maximum (rough terrain) spread size as a worst case.

TABLE 4-35

EFFECTS OF OPERATION ON AREAS WITH PIPELINE AND PUMP STATIONS ONLY: COLORADO ALTERNATIVE PIPELINE ROUTE

			Annual County Property Tax Revenues		
Area	County/ Parish[a]	Project Component[b]	1976-77 Property Tax Revenues (x $1000)	Estimated[c] ETSI Property Tax Revenues (1980 dollars) (x $1000)	Percentage of 1976-77 Property Tax Revenues
Southeast Wyoming	Goshen	PL	2,628	1,286	49
	Laramie	PL	14,620	721	5
Northeast Colorado	Weld	PL, PS	39,950	860	2
	Logan	PL	7,074	550	8
	Washington	PL	2,686	400	15
	Yuma	PL, PS	3,467	1,250	36
West Kansas	Cheyenne	PL	1,112	540	49
	Sherman	PL	3,118	150	5
	Thomas	PL	4,472	620	14
	Sheridan	PL	1,710	160	9
	Gove	PL	2,947	340	17
	Trego	PL	1,608	430	27
	Ellis	PL, PS	6,002	600	9
	Rush	PL	2,500	370	14
	Barton	PL	9,368	370	4
	Ellsworth	PL	2,062	760	3
	Rice	PL	4,515	340	8

Note: There would be no direct or secondary permanent employment and no population in-migration.

a Only counties in which components are to be located are listed.

b PL = pipeline
PS = pump station

c Estimated property taxes by county were estimated by ETSI for the EIS by extrapolating previously developed unit cost estimates for components and should in no way be construed as representing the cost estimate for the components. Values shown on this table were derived by ETSI as follows:

Sum of estimated cost of components in county (1980 dollars) x Statewide ratio of assessed value to market value x Percentage tax rate assumed for county = Estimated ETSI property tax revenues in 1980 dollars

Waterfowl Refuge located 10 miles downstream from the stream crossing. The refuge is a critical staging area for whooping cranes and a nesting area for the state-protected (Kansas) interior least tern. Any loss of habitat in Cheyenne Bottoms as a result of sedimentation would be considered a long-term significant impact.

4.D.4 VEGETATION

The Colorado butterfly-weed is currently under review for potential listing on the federal threatened and endangered species list by the Fish and Wildlife Service. This species may occur on the Colorado alternative route. Once the exact location of this plant is identified, the possible impacts and mitigation measures can be determined.

4.D.5 WILDLIFE

Wildlife species of special concern that could be affected by the Colorado alternative in Wyoming, Colorado, and Kansas include the sage grouse, black-footed ferret, bald eagle, golden eagle, greater prairie chicken, and whooping crane.

Sage Grouse

No sage grouse strutting grounds are expected to be directly crossed by the Colorado alternative in Wyoming. However, between about MP C-60 and C-75 several strutting grounds could occur as close as a half-mile from the pipeline right-of-way. Construction is scheduled in this area during September 1984. Since the sage grouse breeds in May and June, no impact to breeding birds would be expected. The chance does exist that a strutting ground could be traversed, although the resulting impact would be local and insignificant.

Greater Prairie Chicken

In Colorado, the greater prairie chicken is listed as endangered by state level endangered species legislation. Between about MP C-315 and C-325 of the Colorado alternative (northwest of Wray), there is concern for a remnant population of greater prairie chickens. According to the Colorado Division of Wildlife (1980), if the alignment passes through greater prairie chicken strutting grounds, these areas could be permanently abandoned. Loss of strutting habitat would result in a reduction in the already depleted greater prairie chicken population in Colorado. The impact would be long-term and significant.

Whooping Crane

In Kansas the whooping crane occurs only as a transient visitor during March, April, and October (Platt et al. 1974). Cheyenne Bottoms State Waterfowl Refuge in Barton County, Kansas, is designated as critical habitat for migrating whooping cranes. The Colorado alternative would run approximately 5 miles north of the refuge. Queal and Wood (1980) indicated that at this distance, the whooping cranes would not be disturbed by pipeline construction. However, concern exists that a slurry spill in Deception Creek would severely affect Cheyenne Bottoms and consequently the whooping crane's critical habitat (Queal and Wood 1980). The Colorado alternative would cross Deception Creek at MP C-558 in Barton County, Kansas. A major rupture in Deception Creek could cause a reduction in suitable whooping crane habitat in Cheyenne Bottoms. The effects of a potential spill in Deception Creek are described in more detail in the Threatened and Endangered Species Technical Report (WCC 1981f) and in the Ruptures and Spills section of this environmental impact statement (Section 4.D.3).

Golden Eagle

The most probable area for the occurrence of golden eagle nests would be between about MP C-210 and C-240 in the Pawnee Buttes area northeast of Greeley, Colorado (L. Carlson 1980). If golden eagles were nesting along or near any of this alignment, construction of this alignment could result in the loss or abandonment of the nest site. Construction in this area is scheduled for early April. The golden eagle nests as early as late February in this area. Consequently, the potential exists for construction disturbing golden eagles during nesting in Colorado. Until field surveys can determine the precise proximity of nest sites to the actual construction corridor, impacts to the golden eagle will not be fully known.

Other Species

Potential impacts to the black-footed ferret and bald eagle would be the same as those described for the proposed action in Section 4.A.5.

4.D.6 AQUATIC BIOLOGY

Significant and insignificant impacts associated with construction, operation, maintenance, and abandonment of the Colorado alternative coal slurry pipelines and pump stations, would be similar in nature and extent to impacts discussed in Section 4.A.6, except for potential impact to the two "threatened" fishes discussed below.

Threatened and Endangered Species

Construction of the Colorado alternative slurry pipeline would be anticipated to occur during the low-flow months of August and September, which would avoid probable spawning periods (April through June) for the Plains orangethroat darter (in Colorado) and the Topeka shiner (in Kansas). Since construction would not coincide with spawning periods, no significant impact is anticipated (see discussion in Section 4.A.6).

If untreated hydrostatic test water were discharged into the Topeka shiner or Plains orangethroater darter's streams, some individuals may be affected as described in Section 4.A.6, or they may be killed.

4.D.7 AGRICULTURE

The construction, operation, and maintenance of the five Colorado alternative slurry pump stations (not associated with the proposed action or market alternative) would take 25 acres (pump station C-6 in Kansas, Table 4-22) of prime agricultural land out of production for approximately 50 years. The impact of this potential crop production loss would be relatively minor from a regional or state standpoint. During the abandonment phase of the project, all surface facility land areas would be reclaimed; therefore these land areas would not be irreversibly converted to other uses and their viability would not be significantly diminished. The impact of operation of this alternative with any of the well-field sources is discussed in Section 4.A.8.

4.D.8 RECREATION RESOURCES

Recreational consequences resulting from the Colorado alternative would occur at the Fort Laramie National Historic site in Wyoming, at the pipeline crossing of the Arikaree River in Colorado (inventoried by the former Heritage Conservation and Recreation Service under the Nationwide Rivers Inventory, Phase I), and the potential Pawnee Buttes National Natural Landmark in Colorado. The impacts are directly related to the changes in visual quality resulting from construction activities and are considered of short duration (1-2 growing seasons). The effect of these changes on the quality of the recreation experience would be significant only during peak visitor months.

The microwave tower located near Cedar Bluff State Park could affect the quality of the recreation experience through visual intrusions.

4.D.9 VISUAL RESOURCES

Significant visual contrasts with the existing landscape character would occur along the following milepost sections:

MP C-220 to C-228

The pipeline pump station (C-4), transmission line, and microwave tower (Map A-45) would result in significant visual contrast to this high-quality visual resource and potential National Natural Landmark. The unique and highly valued natural formation has both scenic and historic value, and any disturbance to its natural features would be significant. Even if the pipeline right-of-way is reclaimed satisfactorily, the pump station, microwave tower, and transmission line and towers would be visible from the Butte area and escarpment, detracting from the natural character of the scenic formation.

MP C-345 to C-350

The pump station (C-5) and connecting transmission line and towers (Map A-47) would contrast significantly with the natural lines of this high-quality visual resource area and could affect the potential classification of the Arikaree River as a wild and scenic river. Reclamation along the steep river banks would be difficult to achieve without leaving visible evidence of construction activities, resulting in noticeable contrasts to the natural character of the foreground area of the landscape.

4.E COAL CLEANING OPERATION ALTERNATIVE

The coal cleaning alternative would involve an additional processing function at the coal preparation plants and would be located within the preparation plant boundaries. This alternative would not result in any additional impacts besides those already discussed for the proposed action at the preparation plants for water resources (Section 4.A.1), vegetation (Section 4.A.4), wildlife (Section 4.A.5), cultural resources (Section 4.A.7), agriculture (Section 4.A.8), air quality (Section 4.A.9), transportation networks (Section 4.A.11), and visual resources (Section 4.A.12). This alternative would result in additional environmental impacts only for socioeconomic considerations, aquatic biology, and recreation resources, as discussed below. The additional requirement of 300 acre-feet of water per year for the coal cleaning alternative was included in the hydrologic impact analysis of the proposed action to provide a worst-case analysis.

4.E.1 SOCIOECONOMIC CONSIDERATIONS

Construction

Population and Employment. Construction of the three coal cleaning plants as part of the preparation plants would require 25 percent more workers (about 550) than under the proposed action, market alternative, or pipeline-barge alternative. The resultant increment in in-migrant population would place additional demands on Gillette and the other Wyoming communities, particularly Niobrara County and the town of Lusk. This increment would add marginally to the impacts created by the proposed action, market alternative, or pipeline-barge alternative.

The demand for housing during construction would be increased, and more temporary housing units would be necessary.

Public Services. Construction-period stress on public services and facilities would be marginally increased, but there is excess capacity so there would be no problem providing additional school, water, or sewer services.

Operation, Maintenance, and Abandonment
Population and Employment. Operation of the three coal cleaning plants would be integrated within the three preparation plants and would require about 25 percent more permanent ETSI-related workers (Table 1-21). Secondary employment would be increased by 25 percent over projected ETSI-related employment in response to the greater number of jobs.

Housing. Although the increment in long-term demand for housing in the Gillette area would be greater than without the coal cleaning plants, the net increase in total housing would be under 2 percent.

Public Services. As with housing, the net increase in demand for public services in Gillette would not be significant, since there would be excess capacity for water and sewer facilities and for schools (Table 4-20 in WCC 1981d).

4.E.2 RECREATION RESOURCES

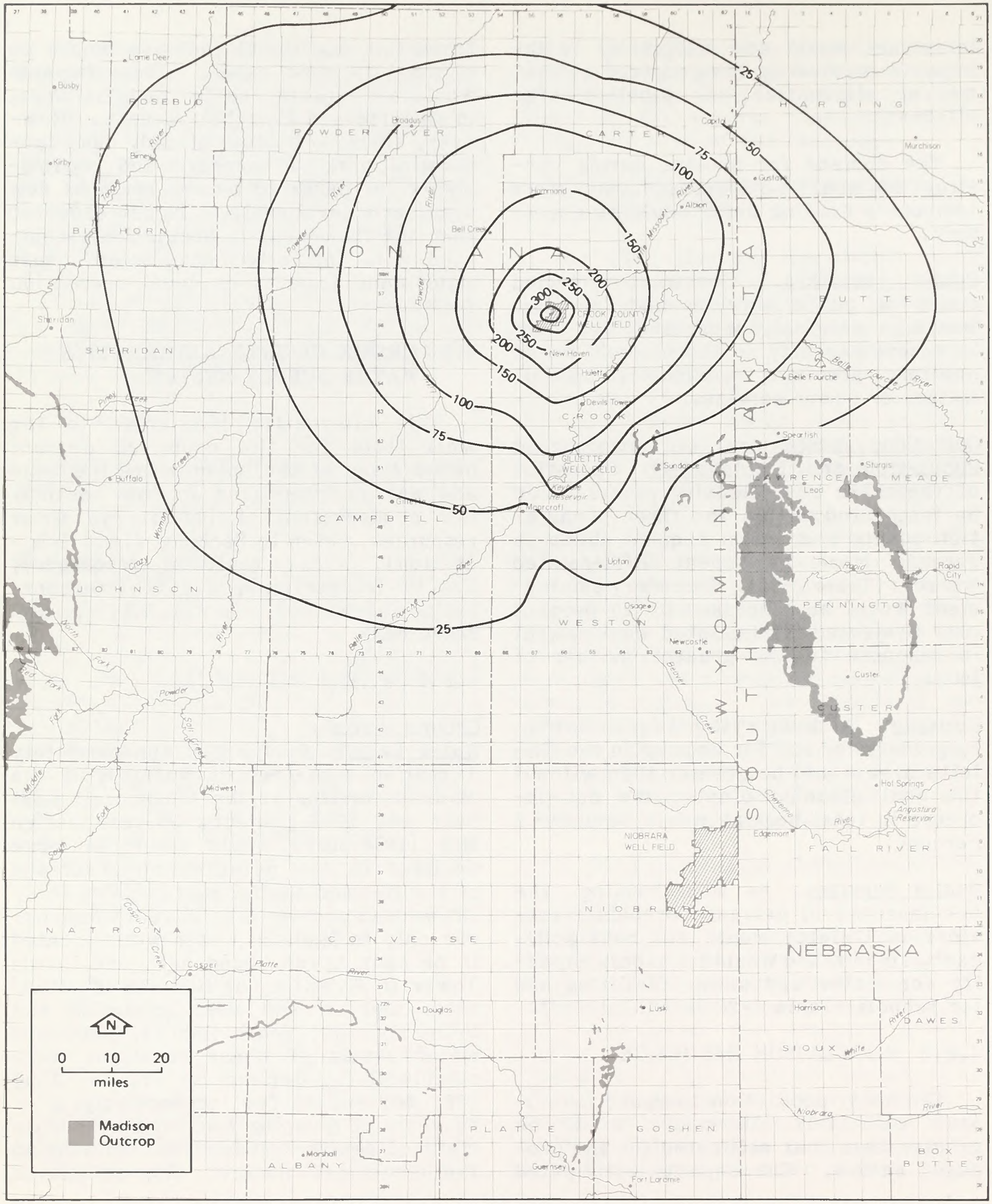
The total population increase associated with this alternative would be greater than that estimated for the proposed action. The impacts anticipated from this additional increase would be minimal in most cases. These impacts would be experienced in the park areas in Gillette and Campbell County. However, since both areas already have substantial parkland acreage and requirements for parks to be set aside as new areas are developed, it is not expected that the increment in population associated with this alternative would cause significant impacts on local recreation facilities.

4.F CROOK COUNTY ALTERNATIVE WATER SUPPLY SYSTEM

This alternative is similar to the well field for the proposed action; hence many of the impacts are the same and are not repeated in this section. For a discussion of impacts to these resources, refer to Sections 4.A.4 (vegetation), 4.A.7 (cultural resources), 4.A.10 (recreation), 4.A.11 (transportation networks), and 4.A.12 (visual resources).

4.F.1 WATER RESOURCES

Ground Water
Water Levels. Pumping of approximately 1 million acre-feet of water from the Madison aquifer at the Crook well field over the ETSI project's 50-year design life (1985-2035) would result in large declines in the potentiometric surface of the Madison aquifer system (Map 4-3). Drawdowns greater than 25 feet would occur only in Madison water wells located in or near Upton, Sundance, and Devils Tower in Wyoming; at Bell Creek, Montana; and in and near Spearfish and Belle Fourche, South Dakota. Madison water levels at these locations were calculated to decline by 37, 30, 130, 150, 26, and 44 feet respectively after 50 years of pumping when the best estimate of aquifer parameters was used in the numerical model. The calculated



Map 4-3. CALCULATED WATER-LEVEL DECLINES IN THE MADISON AQUIFER POTENTIOMETRIC SURFACE AFTER 50 YEARS (1985-2035) OF PUMPING FROM CROOK COUNTY WELL FIELD ONLY (PLAN 3)

probability distribution of drawdowns at Devils Tower shows that there is a 98 percent chance that drawdowns would be greater than 60 feet, a 50 percent chance that drawdowns would be greater than 110 feet, and a 2 percent chance that drawdowns would be greater than 200 feet. The calculated probability distribution showed that there is a 50 percent chance that drawdowns would be greater than 44 feet at Belle Fourche, a 50 percent chance that drawdowns would be greater than 34 feet at Upton, and a 50 percent chance that drawdowns would be greater than 120 feet at Bell Creek. The details concerning these probability distributions are presented in Chapter 7 of the Well-Field Hydrology Technical Report (WCC 1981b).

The declines in the potentiometric surface in the upper part of the Minnelusa Formation would be only a few feet less than those in the Madison aquifer after 50 years of pumping (Map 4-3). Relatively few Minnelusa water wells exist in the area where drawdowns are calculated to be more than 25 feet (Map 3-10). Minnelusa water users in whose wells water levels would decline by more than 25 feet include the town of Hulett, Wyoming, and irrigation users along Red Water Creek and the Belle Fourche River in South Dakota. Water levels were calculated to decline by 120 feet at the Hulett municipal well and by less than 40 feet in the area where Minnelusa waters are used for irrigation in South Dakota.

Many small oil field wells that produce from stratigraphic traps in the upper Minnelusa exist within the region in which declines in the potentiometric surface of the upper Minnelusa would be greater than 25 feet. Reservoir pressures have the potential to decrease in those fields as a result of the pumping at the Crook County well field. Because of the complexities of the geology associated with the oil fields, further refinements concerning impacts cannot be made at this time. The impacts, however, would be equal to or less than those predicted for the corresponding rock units at equivalent distances from the well field. A list of oil fields in the area around the Crook County well field is provided in Table G-2, Appendix G, Well-Field Hydrology Technical Report (WCC 1981b).

Once pumping has ceased, water levels would recover rapidly during the first few years and would continue to rise gradually thereafter (Figure 4-5). Water levels at Bell Creek oil field Madison wells would recover 92 feet from the 150-foot decline after the 50-year period of pumping (Table 4-5). The water level in the Madison water well at Devils Tower National Monument would recover approximately 120 feet after 50 years of recovery.

Water Quality. The concentration of total dissolved solids (TDS) in the well field would increase gradually over the life of the project, from 900 milligrams per liter (mg/l) to 910 mg/l. Changes in TDS concentrations at Madison water wells currently in use would be less than 1 percent.

Spring and Stream Flow. Ground-water discharge to the streams and springs in the vicinity of the Crook County well field would decrease as a result of pumping from the Madison aquifer (Table 4-4). The base flow of Sand Creek in eastern Crook County would decrease by 4 cfs. The base flow of Spearfish Creek was calculated to decrease by 1 cubic foot per second (cfs). The total discharge of Crow Creek Springs, near the McNenny Fish Hatchery in Lawrence

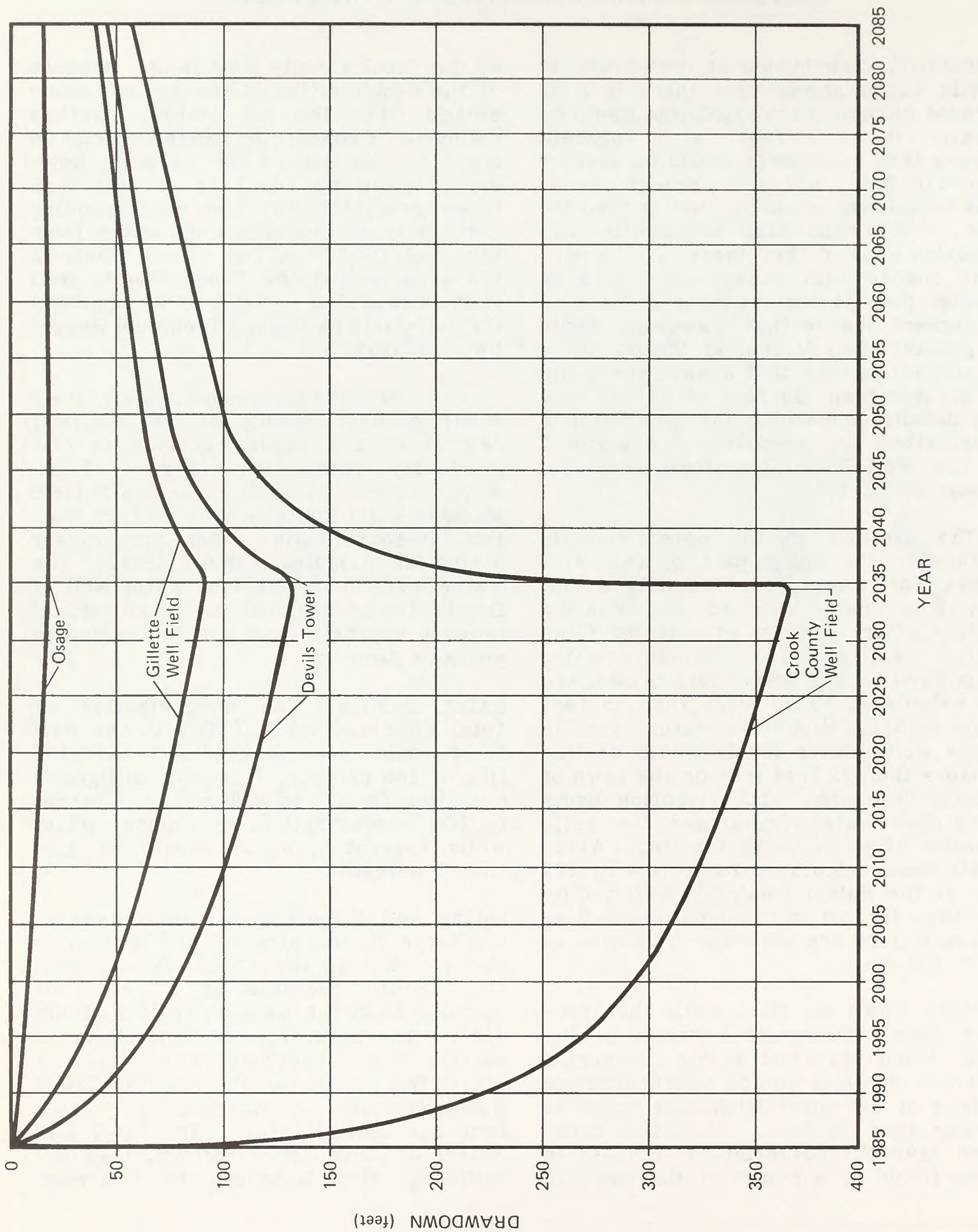


Figure 4-5. TIME-DRAWDOWN PLOT WITH PUMPING FROM CROOK COUNTY WELL FIELD ONLY (PLAN 3)

County, South Dakota, would decrease by 2 cfs. The base flow of the Belle Fourche River between Keyhole Reservoir and the Wyoming-South Dakota state line would decrease by 4 cfs. The base flow of the Little Missouri River south of the state line in Wyoming would decrease by approximately 1 cfs. These reductions in stream flow would result in impacts to the aquatic biota of these streams, as discussed in Section 4.F.4. Additional data concerning the flow characteristics of these streams is contained in Appendix I of the Well-Field Hydrology Technical Report (WCC 1981b) and the Aquatic Biology Technical Report (WCC 1981g).

Crook County Alternative with Gillette Supplemental Water

Water Levels. Pumping 1 million acre-feet of ground water from the Madison aquifer system during the period 1985-2035 would cause large drawdowns in the potentiometric surface of the Madison aquifer (Map 4-4). The cone of depression in the Madison aquifer system and the calculated spring flow and stream flow reductions are similar to those calculated for pumping from the proposed Crook County well field alone, except that the cone of depression is more asymmetrical. The pronounced asymmetry is the result of the low-transmissivity zone along the Black Hills monocline, which is located west of the Gillette well field.

With both the Crook County and Gillette well fields pumping simultaneously, drawdowns would be somewhat greater than those calculated for Plan 3 at Osage, Upton, Sundance, and Devils Tower. Drawdowns of 35 feet, 80 feet, 52 feet, and 170 feet would occur at Osage, Upton, Sundance, and Devils Tower, respectively, after 50 years of pumping (Table 4-2, Figure 4-6). Drawdowns at the Bell Creek, Montana, wells would be 120 feet. Drawdowns in the Belle Fourche and Spearfish areas of South Dakota would be 44 and 26 feet.

Water Quality Changes. The TDS concentrations of the ground water would increase gradually from 900 to less than 910 mg/l at the Crook County well field over the life of the project, and TDS concentrations would increase gradually from 600 to 620 mg/l at the city of Gillette well field over the life of the project. This would not significantly change Gillette's water quality treatment requirements.

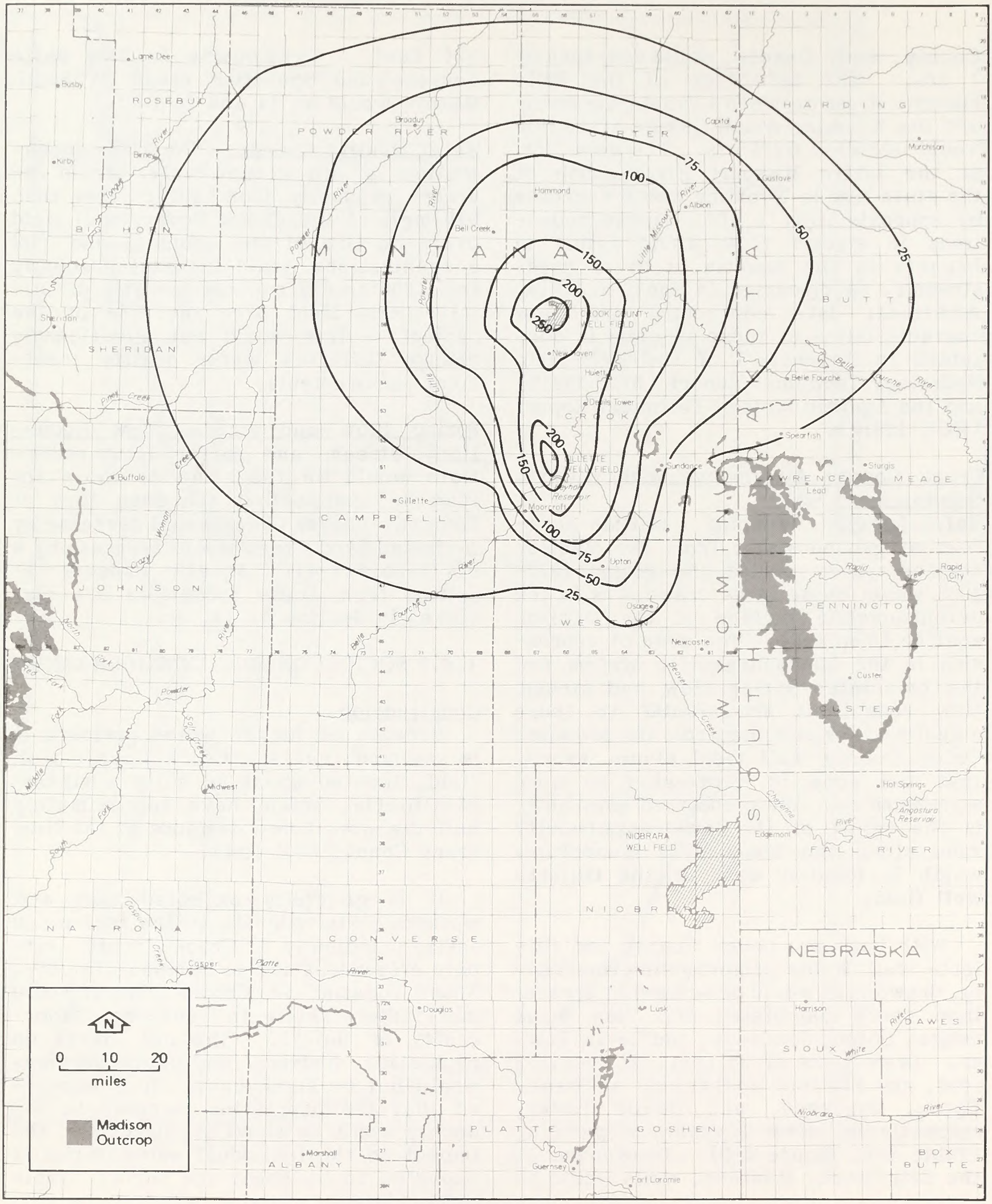
Spring Flow and Stream Flow Reduction. Stream and spring flow reductions would be the same as those for Plan 3, except that the base flow of Stockade-Beaver Creek would decrease by 1 cfs and Sand Creek would decrease by 4 cfs (Table 4-4). Aquatic impacts resulting from these reductions are discussed in Section 4.F.4.

4.F.2 SOCIOECONOMIC CONSIDERATIONS

Construction

Because of higher water pressure it is assumed that the Crook County well field, located about 40 miles northeast of Gillette, would have approximately half the work force demands of the Niobrara County well field.

It is generally expected that new workers would migrate to the region and settle principally in Crook County, with only a few locating in Campbell County. Those locating in Crook County would most likely settle in Sundance, Moorcroft, or Hulett. The net effect on population, housing, and public services would not be significant. It is expected that the population increase in the county would be about 2.7 percent. The impact to the individual communities is expected to be about the same. Table



Map 4-4. CALCULATED WATER-LEVEL DECLINES IN THE MADISON AQUIFER POTENTIOMETRIC SURFACE AFTER 50 YEARS (1985-2035) OF PUMPING FROM CROOK COUNTY AND GILLETTE WELL FIELDS (PLAN 4)

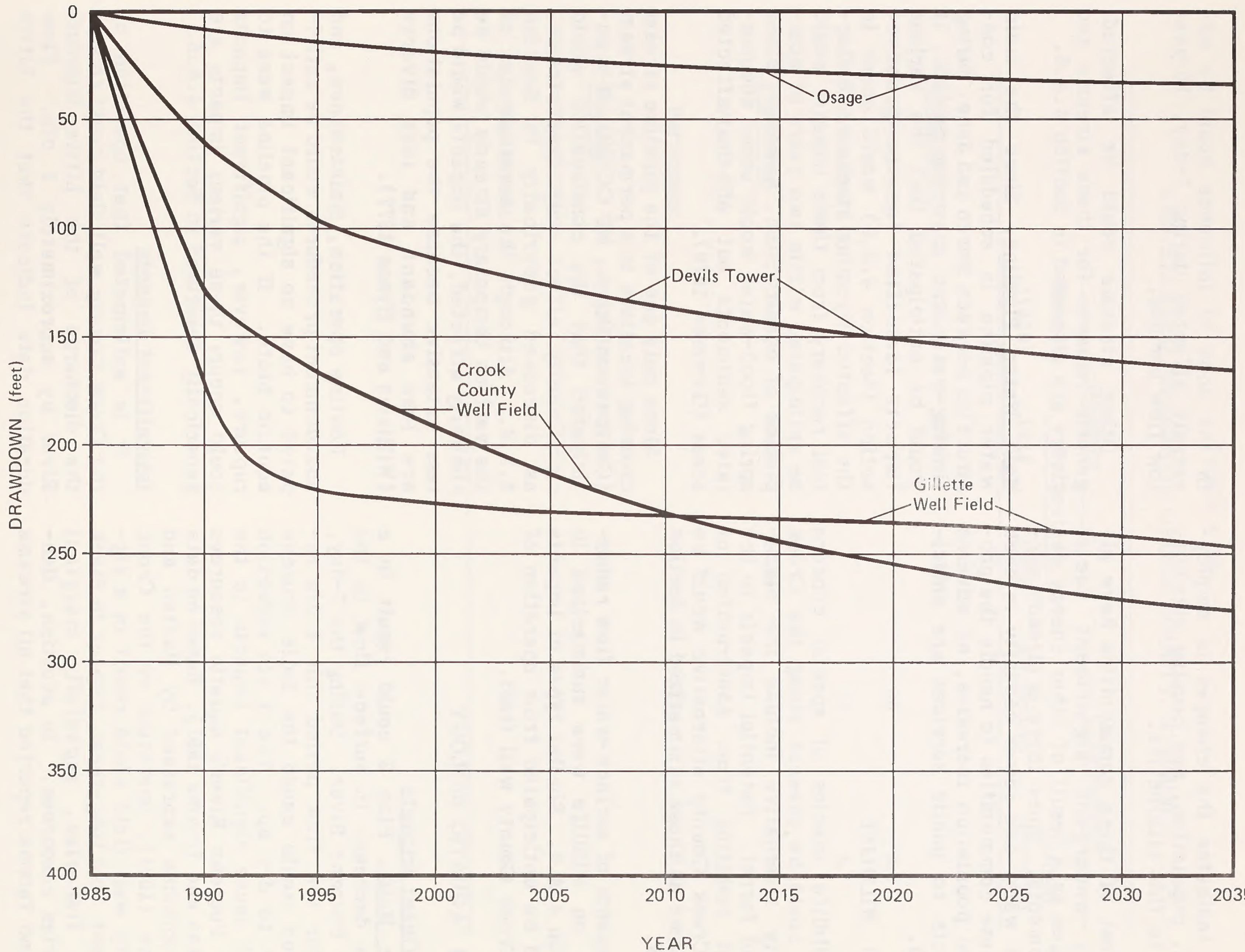


Figure 4-6. TIME-DRAWDOWN PLOT WITH PUMPING FROM CROOK COUNTY AND GILLETTE WELL FIELDS (PLAN 4)

4-36 indicates the changes in employment, population, and housing attributable to this alternative.

Most of these communities have already undergone significant social changes as a result of other energy developments. Since there is already adequate water and sewer capacity in each of these communities to handle the projected population increases, no adverse impacts to public services are anticipated.

4.F.3 WILDLIFE

Wildlife species of special concern that could be present along the Crook County alternative include the black-footed ferret. Potential impacts to the ferret resulting from construction of the Crook County alternative would be the same as those summarized in Section 4.A.5.

Impacts of surface-water flow reductions on wildlife were summarized in Section 4.A.5. Similar types of impacts would be anticipated from operation of the Crook County well field.

4.F.4 AQUATIC BIOLOGY

Significant Impacts

Water Wells. Plan 3 could result in a 4 cfs decrease in surface flow in the Belle Fourche River. During the 7-day, 10-year low flow period this 4 cfs reduction would cause the Belle Fourche River to dry up. The 4 cfs reduction would cause significant impacts to the Belle Fourche River's aquatic resources (Hanten and Talsma 1981). Based on data and opinions expressed by Hanten and Talsma (1981), operation of the Crook County well field could result in a significant, and long-term, impact to Black Hills fisheries, especially marginal fisheries resources. In addition, Hanten and Talsma reported that all streams in the zone of influence could be adversely affected during 7-day, 10-year low flow periods.

Other streams could be affected; generic impacts for these streams and rivers are discussed in Section 4.A.6.

Main Water Pipeline. Since the main water pipeline is scheduled for construction between March and June, during flowing-water and spawning periods, it would be anticipated that the various impacts identified for the proposed action (Section 4.A.6) would occur in the affected Wyoming streams. Biological recovery from these impacts would be anticipated within two years of completion of construction, however, since spring flood-water would scour accumulated sediments out of the affected areas (Gammon 1970).

Since only one of the pipeline stream crossing locations is a permanent stream (Cottonwood Creek, MP CC-29), it is anticipated that the construction would significantly affect only that stream, as discussed generically in Section 4.A.6. Although the invertebrates of the various temporary streams would be similarly affected, the impacts would be less extensive because the populations are less abundant and less diverse (Williams and Hynes 1977).

Routine operation, maintenance, and abandonment procedures would be anticipated to have no significant impact on aquatic biota. If the pipeline were to rupture, however, significant impacts could occur; these various impacts are generically described in Section 4.A.6.

Insignificant Impacts

It is anticipated that operation of the Crook County well field could reduce the discharge of the Little Missouri River by approximately 1 cfs. Flow duration data indicate that the Little

TABLE 4-36

ETSI-RELATED IMPACTS ON CROOK COUNTY, WYOMING

	Baseline			ETSI-Related	
	Existing	Projected			Percent
	(1979)	1984	1990	Employers	Increase
Employment	2339	2500	2750		
Fixed-Site				80	3.2
Permanent				13	4.7
Population	5661	6000	6700		
Fixed-Site				161	2.7
Permanent				25	0.4
Housing	2000	2100	2400		
Fixed-Site				69	3.3
Permanent				10	0.4

Missouri River experiences 0 discharge during "dry" years and maintains low flows during the late summer and fall months during most years. A 1-cfs decrease in discharge would not be expected to significantly affect aquatic biota during "normal" rainfall years, since the Little Missouri fauna are adapted to natural low flow and even intermittent conditions. During "dry" years, however, a 1-cfs discharge decrease could significantly lengthen the period of time that the streambed would be dry. The anticipated biological impact would be the temporary displacement of affected biota to downstream or tributary areas with sufficient water to maintain life. It is anticipated that the streambed would be recolonized from these temporary refuges when flow would resume in the Little Missouri channel. This impact would be considered short-term and insignificant primarily because intermittent flow is a natural condition in the Little Missouri River.

Well-field operation could reduce flow in the Belle Fourche River by approximately 4 cfs. The impacts of a 2-cfs reduction in flow are discussed in Section 4.A.6 and would be similar for a 4-cfs reduction, except for a limited (unquantifiable) reduction in Keyhole Reservoir fishery production.

Sand Creek would experience a decrease in discharge of approximately 4 cfs as a result of well-field operation. A 4-cfs reduction in flow would not be anticipated to result in significant biological impacts for the reasons cited in Section 4.A.6.

Crow Creek Springs (and Crow Creek) could experience a reduction in discharge of approximately 2 cfs as a result of well-field operation. A 2-cfs decrease would represent a decrease of approximately 11 percent in both low flow and average daily flow discharge (approximately 17.5 cfs). As discussed in Section 4.A.6, such a decrease in Crow Creek would not be anticipated to significantly affect the fisheries productivity of Crow Creek.

4.F.5 AGRICULTURE

The construction, operation, and maintenance of the surface facilities associated with the Crook County alternative water supply system would not take any prime agricultural land out of production.

The primary agricultural concern during project operation of the Crook County well field is the potential loss of water from the Madison, Minnelusa, Sundance, and Inyan Kara aquifers in parts of western South Dakota and eastern Wyoming.

The potentially affected drawdown region of the Crook County well field and generalized areas of Inyan Kara and Madison wells are identified on Maps 5-11, 5-12, 5-13, and 5-14 at the end of Chapter 5. Potential drawdowns and effects on surface flows in these areas are discussed in Sections 4.A.1 and 4.F.1.

See Section 4.A.8 for a discussion of the potential effects of well-field operation on agriculture.

4.F.6 AIR QUALITY AND NOISE

Construction

Impacts at water wells, pipelines, and access roads would include temporary increases in fugitive dust and gaseous pollutants. These impacts are not expected to be significant. Estimates of fugitive dust emissions, calculated using emission factors presented in Appendix G-1, are provided in Appendix G-7.

4.G COMBINED WELL-FIELD ALTERNATIVE WATER SUPPLY SYSTEM

Construction and operation of this alternative would result in many of the same type and magnitude of impacts already discussed for the Niobrara and Crook County well fields (Sections 4.A and 4.F) since the same type of surface facilities and pipeline routes would be used. The only difference in impacts would be those associated with the reduced pumping rate (10,100 acre-feet per year) from each well field and the corresponding reduction in the number of wells that would have to be constructed (Crook, 9 instead of 24; Niobrara, 22 instead of 45). This would affect the impacts to water resources (both groundwater hydrology and surface water), socioeconomics, aquatic biology, and agriculture, as discussed below.

4.G.1 WATER RESOURCES

Ground Water

The hydrology impacts from the combined well field alternative due to ETSI's pumping would be similar to the cumulative hydrology impacts (Plans 1 through 5) discussed in detail in Chapter 5. The only significant difference would occur in the vicinity of Gillette and Osage, where impacts to hydrology shown in Plan 5 in Chapter 5 at these locations would be a result of pumping of Madison water by other users, not ETSI.

Surface Water

Under this alternative, impacts to surface waters resulting from stream crossings, hydrostatic test water discharge flooding, dewatering plant drainage, and spills and ruptures would be similar to those discussed in Sections 4.A.1 and 4.A.3 for the proposed action. The estimated stream flow reductions for this alternative (Table 5-3) could result in a potential increase in temperature, and associated decrease in dissolved oxygen, and a reduction in waste assimilative capacity of affected surface waters. During the first 10 years, stream flow reductions would be generally similar in location and amount to those estimated for Plan 3 (Crook County well field), while after 50 years the estimated reductions under this alternative would be similar to Plan 2 (Niobrara plus Gillette well field). Under this alternative, the waste assimilative capacity of the Fall River (city of Hot Springs, South Dakota) would not be directly affected during the first 25 years, as it would under Plans 1, 2, and 6 (Table 4-6). Over the 50-year project life, the estimated stream flow reductions under this alternative would reduce the waste assimilative capacity of the Fall River during both summer and winter seasons, and could indirectly affect ammonia treatment requirements for the city of Hot Springs, depending upon future treatment capacity and effluent limitations. Under this alternative, the waste assimilative capacity of the Belle Fourche River would be reduced within the first 25 years, and over the project's 50-year lifetime. Additional treatment facilities could be required at the town of Hulett, Wyoming, to reduce the levels of residual chlorine to meet established effluent limits. This could directly affect the existing effluent limits (i.e., within the first 25 years) and indirectly affect future limits (i.e., over the 50-year project life).

4.G.2 SOCIOECONOMIC CONSIDERATIONS

The construction work force for this alternative would be about the same in number as that for the Niobrara and Crook County well fields. However, since there are fewer wells, the construction time period would be only about half as long. The resulting socioeconomic impacts to the Lusk and Gillette areas would be very similar to those discussed for each well field in

Sections 4.A.2 and 4.F.2, since the peak number of workers is similar. These impacts would be more temporary (about 12 months) to correspond to the shorter construction period.

4.G.3 AQUATIC BIOLOGY

This alternative would result in stream and spring flow reductions (see Section 5.A.1) to the Little Missouri River, Belle Fourche River, Sand Creek, Crow Creek Springs, Spearfish Creek, Cheyenne River, Cascade Springs, and Hot Springs. Reductions would range from about half as much to about the same as that calculated for full pumping at the Niobrara and Crook County well fields. These reductions would reduce the quality of the aquatic habitat in the affected streams and could cause a reduction in the fish populations as described in Section 4.F.4. These impacts would generally occur only after longer periods of pumping and would not exceed in magnitude the impacts discussed in Section 4.F.4, but would be somewhat less in most streams because of lower stream flow reductions (see Table 5-15).

4.G.4 AGRICULTURE

Construction, operation, and maintenance of the surface facilities associated with this alternative water supply system would not take any prime agricultural land out of production.

Operation of the well fields (Niobrara and Crook County) associated with this alternative would result in an overall reduction of impacts to agricultural water users compared to the proposed action (Niobrara well field only) or Crook County alternative (Crook County well field only).

The potentially affected drawdown region for this alternative and generalized areas of Inyan Kara and Madison wells are identified on Maps 5-19, 5-20, 5-21, and 5-22 at the end of Chapter 5. This alternative would impact a smaller portion of the near surface Inyan Kara aquifer and near surface groundwater drawdowns and surface flow reductions would be lessened. Refer to Section 5.A.1 for a discussion and comparison of the estimated cumulative groundwater drawdowns and surface flow reductions associated with this alternative, the proposed action, and the Crook County alternative water supply system. Section 4.A.8 includes a discussion of the potential effects of well-field operation on agriculture.

4.H **OAHE ALTERNATIVE WATER SUPPLY SYSTEM**

This alternative would replace the Niobrara County well field as a source of water for the proposed action. Since this alternative consists of only a pipeline and pump stations, there would be no impact to ground water and in particular to the Madison Formation and its users. For other resources, such as vegetation, cultural resources, air quality, transportation networks, and visual resources, the types of impacts would be the same as those discussed for the proposed action in Sections 4.A.4, 4.A.7, 4.A.9, 4.A.11, and 4.A.12, respectively.

Purchase of water from either the state of South Dakota or directly from the Water and Power Resources Service would not alter impacts to environmental resources along the right-of-way, since the same route would be used. The potential prime agricultural land at pump station sites that would be affected would differ depending on who water was purchased from, since pump stations are at different sites (see Agriculture section, below).

4.H.1 WATER PURCHASE FROM SOUTH DAKOTA

Water Resources

Surface Water. The total Missouri River inflow into the Oahe Reservoir averages approximately 21,000,000 acre-feet per year (L. Carlson 1980). Studies conducted by the U.S. Army Corps of Engineers (L. Carlson 1980) on withdrawals of 2 million to 6 million acre-feet per year showed negligible effects upon the reservoir for all conditions except major droughts, which resulted in only minor drawdowns. The proposed withdrawal of 30,200 acre-feet (less than 0.15 percent of annual inflow) is not, therefore, expected to generate a measurable change in reservoir levels.

Socioeconomic Considerations

Construction.

Population and Employment. No major socioeconomic effects would be likely in South Dakota during construction of the 280-mile water pipeline through western South Dakota and Wyoming from the Oahe Reservoir to the preparation plants.

Approximately 75 percent of the construction work force would be nonlocal. The other 25 percent would be available from the Pierre and Rapid City labor markets. Only the Wyoming segment of the water line may require as much as 100 percent of the construction work force to be imported from outside the region. Construction of the Oahe water supply system would not cause any socioeconomic effects in Wyoming significantly different from those of the proposed action.

Housing. There would be no significant effect on local housing as a result of construction of the Oahe alternative water supply system. Nonlocal construction workers on the Oahe pipeline would require temporary housing in communities along the route. The pipeline alignment is roughly parallel to U.S. Interstate 90, a heavily traveled east-west route, and there are numerous and adequate motel accommodations available in Pierre, Wall, Rapid City, Spearfish, and other smaller communities in South Dakota. The contractor would most likely establish temporary spread headquarters in Pierre, Rapid City, and Gillette, and mobile construction workers would look there first for accommodations.

In Wyoming, temporary quarters for mobile pipeline construction workers may be more difficult to find. The socioeconomic impacts on Gillette and other Wyoming communities would not be significantly different under the Oahe alternative from what they would be under the proposed action.

Operation, Maintenance, and Abandonment. The operation of the Oahe alternative with the state of South Dakota would also provide a beneficial impact--supplying water to several communities in South Dakota (see Section 1.H).

Population and Employment. Operation of the Oahe water pipeline would employ about 12 persons. Pump stations would be automated and would require no permanent operations personnel. No significant secondary employment would be created in the communities along the route.

Wildlife

Wildlife species of special concern that could occur along the Oahe alternative water supply system include the mule deer, black-footed ferret, northern swift fox, bald eagle, whooping crane, golden eagle, and interior least tern. In addition, concern has been expressed for potential impacts to sharptailed grouse dancing grounds (courtship areas), but no details of where they would occur along the Oahe alternative route in South Dakota have been identified (L. Carlson 1980).

Mule Deer. Between approximately MP 0-195 and 0-220, an important winter range area of mule deer in Wyoming would be traversed by the Oahe alternative (Nimick 1980). One concern (Nimick 1980) is that if construction occurred through this area in winter when the deer were present in large numbers, a significant impact to the regional population could occur. If the alignment were constructed through this area in a season other than winter, no significant impact to mule deer would occur (Nimick 1980). The current assumed schedule does not allow identification of when construction would occur in this area. Operation, maintenance, and abandonment of this route in Wyoming would not affect the mule deer.

Northern Swift Fox. The northern swift fox could occur in prairie dog towns along the entire Oahe route through South Dakota (Sharps 1980). Although the chances of destroying individuals during construction is probably negligible, construction near dens could displace some individuals. If dens are not destroyed by construction, the swift fox may return after construction in the area ceases. Others may be permanently displaced. If construction occurs in areas containing females and whelps, the females may be forced to abandon the young. Some individuals may be lost if construction occurs in the spring. A loss of individual swift foxes would be considered a significant impact in South Dakota.

Black-Footed Ferret. The black-footed ferret could possibly occur along most of the Oahe alternative pipeline corridor in Wyoming and South Dakota. Potential impacts to the ferret would be the same as previously described in Section 4.A.5.

Bald Eagle. Since no nests are known in the affected areas and roost trees would not be destroyed during construction, no significant impacts to the bald eagle are expected.

Whooping Crane. Since there are no known staging areas currently being used by whooping cranes along the Oahe alternative, no impacts would be expected.

Interior Least Tern. Recent nesting records of the interior least tern in portions of South Dakota that would contain Oahe alternative components do not exist (South Dakota Ornithologists Union 1978). Consequently, no impacts are anticipated.

Aquatic Biology

Significant Impacts. Construction of the intake structure in the Oahe Reservoir would disturb or eliminate some substrate and aquatic vegetation. The impact of such a habitat modification would be limited to the construction area and would be considered of limited, short-term significance to the affected invertebrate population. Repopulation of the substrate would be anticipated within one year of the completion of construction, since at least one new generation of invertebrates would be available to colonize the disturbed area.

The nature and extent of aquatic biological impacts anticipated to be associated with pipeline construction through rivers and streams are discussed for the proposed action in Section 4.A.6. They would be expected to be similar for South Dakota and Wyoming stream crossing locations, except for four protected fishes in South Dakota.

Threatened and Endangered Species. Several state-protected fishes--the finescale dace, longnose sucker, northern redbelly dace, and sturgeon chub--would be affected by pipeline construction through the streams in which they occur in the same way, and to the same extent, that other fishes would be affected as identified in Section 4.A.6. Since construction would be anticipated to occur during low flow conditions (late summer-early fall), peak spawning periods for these species would not coincide with construction activity. It is anticipated, therefore, that no significant impacts on these species would occur.

Routine operation, maintenance, and abandonment procedures would be anticipated to have no significant impact on aquatic biota. If the pipeline were to rupture, however, significant impacts could occur; these various impacts were generically described in Section 4.A.6. The four protected South Dakota fishes mentioned in the preceding paragraph would be similarly affected if a rupture were to occur in the streams in which they occur.

Insignificant Impacts. Although construction of an intake structure in the reservoir would disturb some shoreline vegetation, it is anticipated that the reservoir fishery would not be significantly affected, since affected fishes would simply leave the area of disturbance during construction periods.

The water intake would draw a maximum of 30,200 acre-feet per year (approximately 42 cubic feet per second) from the Oahe Reservoir, of which 20,200 acre feet would be used by ETSI. Depending on the intake design and location, it may entrain (draw into the intake) eggs and newly hatched fish, including yellow perch, buffalofish, and shiners, and may impinge (draw against the intake structure) adult and juvenile fish. Generally, however, an intake pumping such a small volume of water, located below the water surface and away from a shoreline area, and pumping at a velocity of less than 0.5 foot per second would be expected to have limited biological impact (Nelson and Beckman 1979).

Agriculture

Construction, operation, and maintenance of the eight pump stations associated with the Oahe alternative water pipeline would take approximately 2 acres (two pump stations, Table 4-22) of potential prime agricultural land out of production for approximately 50 years. The impact of this potential crop production loss would be relatively minor from a regional standpoint. Since all surface facility land areas would be reclaimed during the abandonment phase of the project, these land areas would not be irreversibly converted to other uses and their viability would not be diminished.

Recreation Resources

No significant recreation impacts are anticipated as a result of construction, operation, maintenance, and abandonment of the Oahe alternative water supply system. However, the visual quality of the Oahe Reservoir and recreation area could be reduced until revegetation takes place. Water-related recreation activities are unlikely to be affected in the long term. The pipeline passes two other recreation areas, the Bear Butte State Park (pump station located here also) and Black Hills National Forest, where temporary impacts could occur if landscape disruption takes place during visitor seasons. The crossing of the Cheyenne River (identified in the Nationwide Rivers Inventory, Phase I, by the former Heritage Conservation and Recreation Service 1981a) would not have any lasting adverse effects that could eliminate the inventoried river segment from possible future consideration as a National Wild and Scenic River. Human access is not accommodated at that point. The Western Black Hills Volcanic Intrusion in Wyoming would have temporary direct impacts due to noise from construction activity and visual intrusions affecting the quality of recreation experiences in this area.

4.H.2 WATER PURCHASE FROM WATER AND POWER RESOURCES SERVICE

The environmental impacts for this option would be very similar to those discussed in Section 4.H.1, since both options would use the same route. Only the impacts to agriculture would differ, since pump stations would be at different locations. This option would not provide the capability for water supply to South Dakota communities along the route.

Agriculture

Two pump stations (O-4A and O-5A) would take about 2 acres of potential prime agricultural land out of production for approximately 50 years.

4.I TREATED WASTEWATER ALTERNATIVE WATER SUPPLY SYSTEM

The treated wastewater alternative consists primarily of a pipeline from South Dakota to the preparation plants in Wyoming. In this respect, many of the impacts (including socioeconomics, vegetation, wildlife, cultural, air quality, recreation, transportation, and wilderness) resulting from this alternative would be similar in type and magnitude to impacts described for the Oahe alternative (Section 4.H). The wastewater alternative route is the same as the Oahe route for much of the distance, as shown on Maps A-62 through A-64 of the Appendix A Addendum. Impacts to water resources, aquatic biology, and agriculture would differ from those discussed for the Oahe alternative and are presented below.

4.I.1 WATER RESOURCES

It is the position of the South Dakota Department of Natural Resources that transport and use of treated wastewater from this proposed system would not infringe on downstream water rights; if conflicts should appear, other remedies, including return flows with additional stored water and monetary compensation,may be available (Neufeld 1981).

Under this alternative, the flow in four South Dakota streams and rivers would be reduced by the amounts shown in Table 4-37, as a result of diverting the wastewater to the pipeline.

Table 4-38 presents the expected water quality of the proposed wastewater effluent sources now discharged from treatment facilities, based upon data presently available. Based upon the estimated 1985 flows, a weighted average value is also shown for several constituents.

The elimination of wastewater discharge to these streams and rivers would result in a corresponding change in receiving-water quality. This would include a reduction in biochemical oxygen demand (BOD_5), which could result in an increase in the level of dissolved oxygen in the receiving streams. Depending upon the time of year, temperature levels could be lower without the wastewater discharges. The levels of total dissolved solids, chlorides, ammonia, and chlorine would also be expected to be less in receiving waters under this alternative.

The specific magnitude of water quality effects in the receiving water would

TABLE 4-37

FLOW REDUCTIONS RESULTING FROM TREATED WASTEWATER ALTERNATIVE

Stream or River	Reduction in Flow: Acre-Feet per Year (ac-ft/yr)	Reduction in Flow: Cubic Feet per Second (cfs)
Rapid Creek	8971	12.4
Box Elder Creek	1893	2.6
Whitewood Creek	6710	9.3
Belle Fourche River	975	1.3

TABLE 4-38

WATER QUALITY CHARACTERISTICS OF WASTEWATER SOURCES

Wastewater Source	BOD_5 (mg/l)[a]	SS (mg/l)[a]	pH[a]	NH_3 (mg/l)[a]	TDS (mg/l)[b]	SO_4 (mg/l)[b]	Cl (mg/l)[b]	Cl_2 (mg/l)[a]	Fecal Coliform (no./ml)[a]
Rapid City	25.8	35.7	7.7	5.8	944	255	233	0.25	87.9
Ellsworth Air Force Base	22.7	21.4	7.5	4.9	554	157	56	0.28	112.8
Box Elder	6.1	22.7	8.5	1.2	826	348	89	0.0	36.6
Rapid Valley	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead/Deadwood	8.9	8.7	7.0	0.05	355	27	55	0.07	87.6
Homestake	NA	12.7	8.1	NA	1276	645	81	NA	NA
Whitewood	37.4	57.1	7.2	4.0	NA	NA	NA	NA	6,030
Spearfish[c]	--	--	--	--	--	--	--	--	--
Spearfish Area[c]	--	--	--	--	--	--	--	--	--
Belle Fourche	60.1	64.0	7.9	21.6	906	272	187	NA	51,030
Flow Weighted Average[d]	24.2	26.9	--	5.6	898	305	153	0.21	3,660

	Trace Metals (μg/l)[a]				
	Lead	Arsenic	Zinc	Cyanide	Copper
Homestake					
Outfall 001	49.8	70.8	99.9	3080	912
Outfall 002	NA	27.1	18.8	NA	21.6
Outfall 003	NA	NA	65.0	477	140

[a]Based upon the geometric mean of effluent sampling results recorded by the South Dakota Department of Water and Natural Resources, 1975-1980, from NPDES Discharge Monitoring Reports (Pirner 1981).

[b]Based upon a single effluent sample, taken by the South Dakota Department of Water and Natural Resources on April 16, 1981, at each wastewater discharge location (Strub 1981).

[c]Data are not reported for Spearfish area discharges because the wastewater treatment facility at Spearfish is defective and effluent discharge (seepage) may be contaminated by groundwater formation.

[d]This flow weighted average is based upon the reported concentrations and the projected flows given in Table 1-23. It does not account for potential changes in effluent quality resulting from future facility upgradings or changes during pipeline transport or storage.

depend upon the background water quality and flow. Sufficient gaging records immediately adjacent to proposed dischargers are not available to quantify specific effects. Table 4-39 presents an estimation of water quality changes due to wastewater discharge at Rapid City (the largest single discharger), based on measurements made immediately up- and downstream from the existing discharge. As shown, without the Rapid City discharge, instream concentrations of dissolved minerals, principally chlorides, as well as ammonia, would be significantly reduced in Rapid City.

Effects resulting from a spill or rupture of the slurry pipeline under this alternative would probably be similar to those discussed in Section 4.A.3. It is likely, however, that higher levels of oxygen-demanding organic material, ammonia, and chlorides would be present if wastewater is used as the carrier water, which would result in slightly greater oxygen stress effects compared with the proposed action alternative. Simulation tests would be required to determine whether significant levels of toxic pollutants would be present.

The wastewater used under this alternative would have to be treated to an acceptable secondary level by each South Dakota discharger, which includes future plant upgradings in some cases and includes disinfection where necessary. A spill or rupture of the wastewater collection pipeline could result in a release of the treated wastewater into surface waters along the route from Box Elder, South Dakota, to Gillette, Wyoming. The impacts resulting from a wastewater pipeline spill would include temporary oxygen and temperature stress and temporarily elevated levels of dissolved constituents and ammonia. Because the wastewater would be treated, significant public health effects are not anticipated from a wastewater pipeline spill.

4.I.2 AQUATIC BIOLOGY

Since all treatment facilities presently discharge into streams, removal of water for the wastewater supply system would cause reduced flows in the receiving waters. In fact, the Rapid City treatment facility contributes a significant portion of the stream flow below Pactola Reservoir. On 18 September 1979 flow above the sewage discharge in Rapid Creek was 5.5 cfs while below the outfall 18.4 cfs was reported (Table 4-39). Using these figures, removal of the 12.4 cfs for the wastewater alternative would reduce flows below the outfall by 67 percent. Rapid Creek, below Rapid City was rated as a substantial fishery resource (Class III waters) by the U.S. Fish and Wildlife Service and the South Dakota Department of Game, Fish and Parks (1978). Glover (1979) suggested 15 cfs as the minimum flow recommendation for maintenance of fish and wildlife resources in Rapid Creek below Pactola Reservoir, however, the stretch for which the recommendation was made ends above the sewage outfall. Consequently, no minimum flow recommendations exist downstream of the outfall. The proposed wastewater removal would severely reduce flows in Rapid Creek below the outfall, particularly during drier months. Such large reductions would cause significant impacts to aquatic resources in Rapid Creek downstream of the sewage outfall. Impacts which result from reduced stream flows in Black Hills streams were previously described in Section 4.A.6.

Not all effects from removal of the wastewater discharge are expected to be adverse; significant, although localized, improvements in receiving water quality could result. Although specific data are lacking, a decrease in chlorine, ammonia, oxygen-demanding organic

TABLE 4-39

ESTIMATED EFFECT UPON RECEIVING-WATER QUALITY DUE TO WASTEWATER DISCHARGE AT RAPID CITY

Parameter	Immediately Upstream of Wastewater Discharge	Immediately Downstream of Wastewater Discharge
Flow (cfs)	5.5	18.4
Temperature (°C)	18	19
pH	8.7	8.2
Total Alkalinity (mg/l)	196	186
Specific Conductance (μmho at 25°C)	800	1275
Dissolved Oxygen (mg/l)	9.15	10.4
Ammonia, NH_3-N (mg/l)	< 0.1	4.4
NO_3-N (mg/l)	2.2	6.6
Suspended Solids (mg/l)	26	17
COD (mg/l)	42	65
BOD_5 (mg/l)	< 2	9.5
SO_4 (mg/l)	275	298
Cl (mg/l)	7	225
Ca (mg/l as $CaCO_3$)	250	348
Mg (mg/l as $CaCO_3$)	118	78

Source: Sampling performed September 18, 1979 (Strub 1981).

materials, and water temperature could be reasonably expected for some distance below the outfall. Such improvements may provide habitat for species previously unable to survive any adverse effects of existing water quality.

The wastewater alternative would remove 1.3 cfs from the Belle Fourche River at the town of Belle Fourche, South Dakota. This stretch was rated as a high-priority fishery resource by the U.S. Fish and Wildlife Service and the South Dakota Department of Game, Fish and Parks (1978). Removal of 1.3 cfs from the Belle Fourche River would violate minimum stream flow recommendations (Glover 1979) for each month from September through March. During each of these months the recommended flows adequate to maintain existing fish and wildlife resources is 100 percent of the available discharge. According to Hanten and Talsma (1981), reductions in flows in the Belle Fourche River even as low as 1.3 cfs would cause significant, adverse impacts to existing aquatic resources. The impacts would be the same as those described for the Belle Fourche River in Section 4.A.6 from well field related drawdowns.

Specific data are lacking from Whitewood and Box Elder creeks. However, the large reductions in flow below the sewage outfalls (9.3 and 2.6 cfs, respectively) suggest potentially significant adverse impacts to aquatic biota. Beneficial water quality could be reasonably expected in these streams. These impacts would probably be similar to those described for Rapid Creek above.

The effects of a wastewater spill on aquatic resources would depend primarily on the location and the time of the spill. Spills in dry streambeds would have little or no effect on aquatic resources. The significance of biological impacts in permanent waters or in intermittent streams with flow depends primarily on the volume of water in the affected water body. In general, the smaller the stream in which a spill occurs, the greater the physical effects to be anticipated.

If a wastewater line spill represented a significant increase in stream volume (e.g., doubling the volume, or greater), then the physical impacts would be similar to the effects that result from local rainstorms. The impacts on aquatic organisms would be downstream or out-of-stream displacement and scouring of the streambed.

Water released from the Rapid City wastewater treatment facilities during April 1981 was 7 to 8.5°C, which would exceed ambient stream temperatures at some pipeline crossings in the area of the facilities by at least 4.0°C. A sudden increase in water temperature above 3.0°C could result in localized fish and invertebrate kill as a result of heat shock (Talmage and Coutant 1978). It should be noted that stream temperature changes would be short-term (less than 24 hours) and that only stream crossings in the immediate vicinity of collection facilities would be susceptible to thermal stress.

TDS and sulfate levels in the wastewater average around 900 and 300 mg/l, respectively, which are below levels that would cause significant effects on aquatic biota (EPA 1976).

The EPA (1976) has established a free chlorine maximum concentration criterion of 0.02 mg/l for salmonids and 0.1 mg/l for other freshwater aquatic organisms. A flow weighted average of free chlorine in the wastewater supply system is estimated to be 0.21 mg/l (Table 4-38), which is nearly 4 times the criterion established for salmonids. It is reasonable to suspect that a rupture in the water supply line would cause significant, long-term impacts to aquatic organisms as a result of the toxic characteristics of the chlorine constituents.

The wastewater is also estimated to contain 5.6 mg/l of ammonia. The EPA (1976) recommends a maximum criterion of 0.02 mg/l of ammonia for freshwater aquatic life. Consequently, significant impacts to aquatic biota would be expected from the toxic characteristics of ammonia as a result of a wastewater pipeline rupture.

4.I.3 AGRICULTURE

Construction, operation, and maintenance of the nine pump stations associated with this alternative could potentially take a small amount of prime agricultural land out of production for 50 years. Since the exact pump station locations are not known at this time, it was not possible to determine whether any prime agricultural land would be taken out of production by this alternative. If this alternative is selected, it will be necessary to evaluate each pump station location to determine if it is prime agricultural land.

Operation of this alternative would cause surface flow reductions in three creeks (Rapid Creek, Box Elder Creek, and Whitewood Creek) and one river (Belle Fourche River) in South Dakota and Wyoming. The combined total flow reduction to these watercourses would amount to approximately 25.6 cfs per year. Surface flow reductions which would occur in each of these watercourses are listed in Section 4.J.1. According to the South Dakota Department of Water and Natural Resources (Neufeld 1981), "Use of treated wastewater would not infringe on downstream water rights. Only the effluent from Ellsworth Air Force Base is specifically appropriated for irrigation. However, the water right for this use is conditioned upon the availability of the Ellsworth effluent and in no way requires Ellsworth to continue its present discharge."

4.J SLURRY PIPELINE WATER DISCHARGE ALTERNATIVE

Because this alternative would only affect water quality of the receiving streams, other resource topics are not discussed here. There would be no significant impacts to aquatic biology, since the water to be discharged would have to meet requirements of a National Pollutant Discharge Elimination System (NPDES) permit.

Under this alternative, one of the three alternative water sources (Madison ground water, Oahe Reservoir surface water, or reclaimed wastewater) would be removed from the slurry at the dewatering plant and discharged. To date, detailed water quality investigations have been performed for Madison ground water and Oahe Reservoir surface water. Investigations have not been completed for a reclaimed wastewater source.

4.J.1 WATER RESOURCES

Surface Water: Proposed Action and Oahe Alternative Water Sources

The estimated rates of discharge of the slurry pipeline water (dewatering plant effluent) are presented in Table 4-40.

Characteristics of Dewatering Plant Effluent. The water quality characteristics of the dewatering plant effluent would depend on a number of factors; principally, the characteristics of the source coal and water, the degree of processing or treatment during dewatering, and to some extent the detention time, or travel time, in the pipeline.

Simulation studies (simulated coal slurry transport of proposed coal and

TABLE 4-40

SLURRY EFFLUENT DISCHARGE RATES

Discharge Location	Discharge (cfs) Proposed Action (cleaned)	Proposed Action (uncleaned)	Market Alternative	Pipeline-Barge Alternative
Ponca City	5.4	5.4	-	-
Pryor	2.4	2.4	4.3	4.3
Oologah	-	-	2.8	2.8
Muskogee	4.1	4.1	-	-
Independence	4.1	4.1	4.1	4.1
White Bluff	4.1	4.1	4.1	4.1
Cypress Bend	-	-	-	15.1
New Roads	1.6	1.6	1.6	-
Baton Rouge	-	-	4.7	-
Lake Charles	3.3	3.3	3.3	-
Boyce	1.5	1.5	1.5	-
Wilton	4.1	4.1	4.1	-

Note: These rates represent the maximum instantaneous discharge at each of the sites, and not a continuous annual discharge rate.

water sources) indicate that the level of total dissolved solids (TDS) and sulfate (SO_4) could significantly increase in the slurry carrier water (Plummer and Associates 1980). Levels up to 1900 milligrams per liter (mg/l) TDS and 1100 mg/l SO_4 could occur in the dewatering plant effluent under worst-case conditions (i.e., highest concentrations in the source water combined with the greatest amount of leaching of constituents from the coal during transport). In addition, a biochemical oxygen demand (BOD_5) of 125 to 175 mg/l would be exerted in the slurry dewatering plant effluent.

Chemical analyses for 129 potentially toxic constituents, classified by the EPA as "priority pollutants," have been performed on two simulated slurry filtrates. Among the priority pollutants are 114 potentially toxic organic constituents. The results of simulation tests indicate that all but 2 of these 114 organic constituents were below the detection limits. Methylene chloride was detected at low levels and was probably the result of unavoidable standard sampling and analytical contamination, as indicated in the EPA approved test procedure guidelines (EPA 1979c, 1981b) which were used. Bis-(2-ethyl-hexyl) phthalate was detected at trace levels far below EPA criteria to protect human health (EPA 1980b), which may also be due to unavoidable sampling contamination (EPA 1981b).

Simulation studies for radioactivity indicated that significant levels would not occur in the dewatering plant effluent and that treatment would not be required to meet applicable state standards (Plummer and Associates 1981).

Several trace metals were measured in the simulated slurry filtrate. The Surface Water Quality Technical Report (WCC 1981g) presents a summary of these simulation test results.

Applicable State and Federal Standards. In compliance with the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500, 86 Stat. 816, 33 USC 1151), Oklahoma, Arkansas, and Louisiana have established water quality standards for surface waters within each state. These standards are designed to enhance the present, future, and potential beneficial uses of particular waterways and include both numerical and nonnumerical criteria for maintenance of the physical and chemical quality of surface waters. Table 4-41 presents a summary of the designated beneficial uses, and applicable standards, for the specific reaches of rivers proposed as alternative discharge sites.

To date, national standards of performance for the control of slurry effluent discharge reflecting best available technology have not been established.

Relationship of Discharge to Existing Standards. Based upon simulation studies completed to date, and the estimated water quality of the Madison aquifer source water over the 50-year project lifetime, the range in quality characteristics of the slurry dewatering plant effluent is presented in Table 4-42.

The estimated allowable discharge quality at each of the proposed sites (Table 4-43) is based upon existing stream standards and design low flow (Table 3-48) and the proposed discharge rates (Table 4-40). A comparison of the estimated worst-case effluent quality with the allowable discharge quality enables an estimation of the level of treatment required for each of the three standard-specific minerals. These treatment levels are presented in Tables 4-44, 4-45, and 4-46.

The potential variations among the three principal water sources (Niobrara

TABLE 4-41

BENEFICIAL USES AND STATE STANDARDS AT EFFLUENT DISCHARGE LOCATIONS

		Receiving-Water Standards							
Delivery Terminal	Receiving-Water Beneficial Uses	TDS (mg/l)	SO_4 (mg/l)	Cl (mg/l)	DO (mg/l)	96-hr TLM[a] (percent)	Radium (picocuries/liter)	pH	Turbidity (JTU)
Ponca City (Oklahoma)	B, C, D, F, G, H, J	2076[d]	257[d]	657[d]	5	5	5[b]	6.5-8.5	50
Pryor (Oklahoma)	A, C, D, E, F, G, H, J	261[d]	61[d]	17[d]	5	5	5[b]	6.5-8.5	50
Oologah (Oklahoma)	A, C, D, E, F, G, H, I, J	649[d]	272[d]	112[d]	5	5	5[b]	6.5-8.5	50
Muskogee (Oklahoma)	B, C, D, E, F, G, H, I, J	1876[d]	172[d]	860[d]	5	5	5[b]	6.5-8.5	50
Independence (Arkansas)	A, C, H	430	60	20	5	1	3[c]	6.0-9.0	50
White Bluff (Arkansas)	A, C, H	750	100	250	5	1	3[c]	6.0-9.0	50
Cypress Bend (Arkansas)	A, C, H	425	150	60	5	1	3[c]	6.0-9.0	50
New Roads (Louisiana)	A, C, H	400	120	75	5	10	-	6.5-9.0	-
Baton Rouge (Louisiana)	A, C, H	400	120	75	5	10	-	6.5-9.0	-
Lake Charles (Louisiana)	C, G, H	225	35	62	4	10	-	6.0-8.5	-

TABLE 4-41 Concluded

Delivery Terminal	Receiving-Water Beneficial Uses	Receiving-Water Standards							
		TDS (mg/l)	SO_4 (mg/l)	Cl (mg/l)	DO (mg/l)	96-hr TLM[a] (percent)	Radium (picocuries/ liter)	pH	Turbidity (JTU)
Boyce (Louisiana)	A, C, H	780	112	184	5	10	-	6.0-8.5	-
Wilton (Louisiana)	A, C, H	400	120	75	5	10	-	6.5-9.0	-

Note: In Oklahoma the criteria apply to all flow conditions greater than the 7-day, 2-year flow. In Arkansas, the criteria apply to all stream flows greater than the 7-day, 10-year low flow. In Louisiana, the criteria apply to all flow conditions.

[a] Refers to the 96-hour TLM (median tolerance limit) for persistent toxicants; permissible concentrations in the receiving water after mixing are given as a percent of the 96 hour TLM concentration.

[b] Refers to the permissible level of radium 226 plus radium 228.

[c] Refers to the permissible level of radium 226.

[d] Refers to the sample standard

Abbreviations:

A = public and private water supply
B = emergency water supply
C = fish and wildlife propagation
D = agriculture
E = hydroelectric power generation
F = industrial and municipal cooling water
G = primary body contact recreation (e.g., swimming)
H = secondary body contact recreation (e.g., boating)
I = navigation
J = aesthetics
K = smallmouth bass fisheries
L = trout fisheries
mg/l = milligrams per liter
TDS = total dissolved solids
SO_4 = sulfate
Cl = chloride
DO = dissolved oxygen
TLM = mean tolerance limit
JTU = Jackson turbidity unit

TABLE 4-42

ESTIMATED WATER QUALITY OF DEWATERING PLANT EFFLUENT UNDER VARYING PROJECT CONDITIONS

Conditions	Constituent	Initial Concentration[a] (mg/l)	Concentration After 50 Years (mg/l)
Typical	TDS	900 - 1300	960 - 1310
	SO_4	425 - 750	467 - 757
	BOD_5	125 - 175	125 - 175
	Cl	50 - 70	50 - 70
Extreme[b]	TDS	1500 - 1900	1560 - 1910
	SO_4	750 - 1075	792 - 1082
	Cl	50 - 70	50 - 70
	BOD_5	125 - 175	125 - 175

Source: Plummer and Associates 1981.

Notes:

mg/l = milligrams per liter

TDS = total dissolved solids

SO_4 = sulfate

BOD_5 = biochemical oxygen demand

Cl = chloride

[a] A function of well-field water quality, quantity of leached constituents, and coal processing procedures.

[b] Worst-case estimates, occurring a minimum percentage of the time.

TABLE 4-43

ESTIMATED ALLOWABLE DISCHARGE QUALITY

Site	Dewatering Discharge (cfs)*	Alternative	Allowable Discharge Quality (mg/l)		
			TDS	Cl	SO_4
Ponca City	5.4	PA	a	a	9052
Pryor	4.3	MA, BA	1454	199	576
Pryor	2.4	PA	2455	338	993
Oologah	2.8	MA, BA	596	105	231
Muskogee	4.1	PA	a	a	a
Independence	4.1	PA, MA, BA	a	793	3022
White Bluff	4.1	PA, MA, BA	a	1713	4490
Cypress Bend	15.1	BA	a	a	a
New Roads	1.6	PA, MA	a	a	a
Baton Rouge	4.7	MA	a	a	a
Lake Charles	3.3	PA, MA	225	62	35
Boyce	1.5	PA, MA	a	184	112
Wilton	4.1	PA, MA	a	a	a

Source: Plummer and Associates 1981.

Notes:

cfs = cubic feet per second
mg/l = milligrams per liter
TDS = total dissolved solids
Cl = chloride
SO_4 = sulfate
PA = proposed action
MA = market alternative
BA = pipeline-barge alternative
a = The allowable discharge quality level is greater than 10,000 mg/l, which is much greater than the level of the slurry quality; the allowable water quality level would not be exceeded.
* = These rates represent the maximum instantaneous discharge at each of the sites and not a continuous annual discharge rate.

TABLE 4-44

PRELIMINARY ASSESSMENT OF TREATMENT REQUIREMENTS (Percent TDS Removal)

Carrier Water[a]	Oahe Reservoir / Niobrara County Well Field		Crook County Well Field	
	Concentration in Dewatering Plant Effluent (mg/l)			
	800	1000	1200	1500
Discharge Site				
Ponca City	None	None	None	None
Pryor[b]	None	None	None	3%
Oologah	26%	40%	50%	60%
Muskogee	None	None	None	None
Independence	None	None	None	None
White Bluff	None	None	None	None
Cypress Bend	None	None	None	None
New Roads	None	None	None	None
Baton Rouge	None	None	None	None
Lake Charles[c]	72%	78%	81%	85%
Lake Charles[d]	None	None	None	None
Boyce	None	None	None	None
Wilton	None	None	None	None

Source: Plummer and Associates 1981.

[a]The concentration in each of the carrier waters is estimated to range in value due to variable source water quality and variable leaching characteristics. This range is indicated by the "Concentration in Dewatering Plant Effluent" headings beneath each of the bars.

[b]Applies to highest proposed discharge of 4.3 cfs.

[c]Above salt water barrier.

[d]Below salt water barrier.

TABLE 4-45

PRELIMINARY ASSESSMENT OF TREATMENT REQUIREMENTS (percent SO_4 Removal)

Carrier Water[a]	Oahe Reservoir / Niobrara County Well Field		Crook County Well Field	
	Concentration in Dewatering Plant Effluent (mg/l)			
	400	500	1000	1200
Discharge Site				
Ponca City	None	None	None	None
Pryor[b]	None	None	42%	52%
Pryor[c]	None	None	None	17%
Oologah	42%	54%	77%	81%
Muskogee	None	None	None	None
Independence	None	None	None	None
White Bluff	None	None	None	None
Cypress Bend	None	None	None	None
New Roads	None	None	None	None
Baton Rouge	None	None	None	None
Lake Charles[d]	91%	94%	97%	97%
Lake Charles[e]	None	None	None	None
Boyce	72%	78%	89%	91%
Wilton	None	None	None	None

Source: Plummer and Associates 1981.

[a]The concentration in each of the carrier waters is estimated to range in value due to variable leaching characteristics. This range is indicated by the "Concentration in Dewatering Plant Effluent" headings beneath each of the bars.

[b]Applies to highest proposed discharge of 4.3 cfs.

[c]Applies to lowest proposed discharge of 2.4 cfs.

[d]Above salt water barrier.

[e]Below salt water barrier.

TABLE 4-46

PRELIMINARY ASSESSMENT OF TREATMENT REQUIREMENTS (percent chloride removal)

Carrier Water[a]

- Oahe Reservoir (bar spans 40 to 70)
- Niobrara County Well Field (bar spans 50 to 100)
- Crook County Well Field (bar spans 50 to 70)

Discharge Site	Concentration in Dewatering Plant Effluent (mg/l) 40	50	60	70	100
Ponca City	None	None	None	None	None
Pryor[b]	None	None	None	None	None
Oologah	None	None	None	None	None
Muskogee	None	None	None	None	None
Independence	None	None	None	None	None
White Bluff	None	None	None	None	None
Cypress Bend	None	None	None	None	None
New Roads	None	None	None	None	None
Baton Rouge	None	None	None	None	None
Lake Charles[c]	None	None	None	11%	38%
Lake Charles[d]	None	None	None	None	None
Boyce	None	None	None	None	None
Wilton	None	None	None	None	None

Source: Plummer and Associates 1981.

[a] The concentration in each of the carrier waters is estimated to range in value due to variable source water quality and variable leaching characteristics. This range is indicated by the "Concentration in Dewatering Plant Effluent" headings beneath each of the bars.

[b] Applies to proposed discharge of 4.3 or 2.4 cfs.

[c] Above salt water barrier.

[d] Below salt water barrier.

and Crook County well fields and Oahe Reservoir) are also indicated.

Biological treatment would also be required at several discharge sites in order to reduce discharge levels to an equivalent secondary level of treatment. At this time, investigations are underway to determine specific requirements for each site.

The two candidate biological treatment processes are aeration lagoons and activated sludge. In either of these processes, microbiological organisms would reduce the organic content in the dewatering plant effluent, thereby reducing the biochemical oxygen demand (BOD_5) to acceptable levels. The biological treatment process, which would be included at all discharge sites, would also serve to reduce the levels of trace metals. Table 4-47 presents the levels of the metals that were detected in simulation tests and also shows the projected levels following biological treatment. The projected levels after aeration lagoon treatment would be less than all U.S. EPA Primary Drinking Water Standards. Dilution of the dewatering plant effluent in the receiving stream or river would further reduce the project-related increase below these projected levels. For activated sludge, the projected levels would be less than all Primary Drinking Water Standards except mercury and selenium, which have standards of 2 and 10 $\mu g/l$, respectively.

At four sites (Pryor, Oologah, Lake Charles, and Boyce) treatment to remove TDS, SO_4, or Cl would be required. Candidate treatment facilities under investigation at this time are reverse osmosis, electrodialysis, and ion exchange. One of these processes would be selected as the process to follow the biological treatment stage at these four sites.

<u>Surface Water: Treated Wastewater Alternative</u>

Table 4-38 indicates a preliminary estimation of the water quality characteristics of the wastewater as it would be delivered to Gillette. Simulation studies have not been completed using an actual wastewater sample (or composite) slurried with a proposed coal sample. If this alternative is selected, additional studies, including laboratory simulation investigations, would be required in order to apply for the necessary NPDES permit at each discharge site. These studies would determine the characteristics of a wastewater dewatering plant effluent, and would identify and evaluate the treatment facilities that might be necessary. At a minimum, the simulation studies would need to evaluate the levels of dissolved inorganic constituents, all U.S. EPA priority pollutants, BOD_5, and possibly fecal coliform.

One area of potential concern (Peavy et al. 1979) is the interaction of the organic constituents derived from the coal (e.g., humic and fulvic acids) with chlorine, which could potentially result in chlorinated hydrocarbons in the dewatering plant effluent. Residual chlorine, present in the wastewater prior to transport, could require pretreatment (dechlorination) if detectable levels of organic priority pollutants were identified during simulation studies.

4.K FORT SMITH, ARKANSAS, ROUTE VARIATION ALTERNATIVE

The pipeline right-of-way for this route variation would be located in the same general area as that for the proposed action, but it has been shifted to avoid a proposed water impoundment on Lee Creek. The impacts of constructing a coal slurry pipeline along this route variation do not measurably change the impacts already described for the

TABLE 4-47

PRIORITY POLLUTANTS MEASURED
DURING ETSI SIMULATION STUDIES AND PROJECTED REDUCTIONS

Parameter	Observed Range[a] (μg/l)	Values Outside Range[b] (μg/l)	Average Removal[c] (%)		Maximum Projected Concentrations After Treatment	
			Aerated Pond	Activated Sludge	Aerated Lagoon (μg/l)	Activated Sludge (μg/l)
Arsenic (As)	<2 - <12		--	<43	--	7
Beryllium (Be)	1 - 2		>50	--	1	--
Cadmium (Cd)	<4 - <10		97	31	<1	7
Chromium (Cr)	<3 - 27		63	45	10	15
Copper (Cu)	20 - 90		49	52	46	43
Cyanide (Cn)	<20		45	18	11	16
Gold (Au)	<2		--	--	--	--
Lead (Pb)	<1 - 17	130	86	49	2	9
Mercury (Hg)	2 - <6	27, 28	>99	30	<1	4
Molybdenum (Mo)	14		--	--	--	--
Nickel (Ni)	<2 - 25	110	17	29	21	18
Selenium (Se)	<1 - <20		50	0	10	20
Silver (Ag)	<3 - <10		--	31	--	7
Thallium (Th)	<1 - 5		44	38	3	3
Tin (Sn)	<8 - <10		--	--	--	--
Zinc (Zn)	10 - 50	160	55	35	22	33
Bis(2-Ethylhexyl) phthalate	<5	40, 12	70	37	<2	3
Methylene Chloride	<5	17	65	21	<2	4

Source: Plummer 1981.

[a]Shows range of concentrations measured in ETSI coal slurry simulation tests using several coal and water sources.

[b]Concentrations measured in ETSI coal slurry simulation tests which have been shown statistically to lie outside the expected range of concentrations.

[c]Average removal percentages based on EPA EPA (1980c).

proposed action route near Fort Smith, Arkansas (about MP P-892 to P-920) (see Section 4.A). No surface facilities would be located along the right-of-way for this route variation, so the disturbance to soil, wildlife, and other resources would be negligible after reclamation.

4.L NO-ACTION ALTERNATIVE

The no-action alternative (both the all-rail and rail-barge routes) would have impacts only on socioeconomic conditions, wildlife, aquatic biology, and air quality and noise, as discussed below. No major impacts on other resources as a result of the no-action alternative have been identified, primarily because no new rights-of-way would be required for the no-action alternative. Thus no discussion is presented for water resources, vegetation, cultural resources, agriculture, recreation, transportation, or visual resources for the no-action alternative.

4.L.1 SOCIOECONOMIC CONSIDERATIONS

All-Rail Alternative

At least 600 communities would experience some impacts that could be attributed to the increased rail traffic associated with the movement of 37.4 million tons annually (MMTA) of coal. Some of these impacts would be minor, in part depending on the location of the town with respect to the train tracks; others would be more significant. Further, these impacts would be both positive and negative. Specifically, the impacts would be increases in employment, rail accidents, and community disruption.

Employment. Total employment related to the movement of 37.4 MMTA of coal would be approximately 5800 persons, based on Burlington Northern's (BN) planning factor of 8 million ton-miles of coal per year per employee (Boyce 1980) and an estimated 46,270 annual ton-miles. The employment related to rail operation alone is estimated to be approximately 2466. Whether this results in the same number of new jobs is a function of overemployment at some of the railroads as well as expected future gains in productivity. If, in the extreme, this employment results in both new jobs and new-to-the-area people, location-specific socioeconomic impacts would not be significant. New workers would be distributed along the 3623 miles of unduplicated track and among the 600 communities with population in excess of 2.5 million.

Employment related to rail maintenance and support staff could be an additional 2300 people. These would be located in such cities as Alliance, Nebraska, Kansas City, Missouri, and other cities identified as maintenance or inspection stops (Table 3-52). Again, because of the number of towns where these people could be expected to settle, the only town identified as likely to be significantly affected is Alliance, Nebraska.

A majority of Alliance's population is dependent upon BN for employment and so tends to be supportive of further rail-related growth. While local officials voice no concern over the future, it seems likely that at some point needed retail services and recreational opportunities as well as certain public facilities would have to be provided.

Rail Accidents. Based on the safety records of all U.S. railroads between 1977 and 1979, it was estimated that the transport of 37.4 MMTA of coal would result in 48 grade crossing accidents per year, in which there would be 51 nonfatal casualties and 12 fatal casualties

(DOT 1978, 1979b, 1980a). Railroad employees and passengers account for an additional 2 nonfatal casualties and 0.1 fatal casualty. In light of the superior safety record of coal trains, however, these figures represent an upper bound. During 1977 and 1978 BN coal trains experienced an accident rate one-third that of all other BN trains (Boyce 1981). Hence, it could be expected that the actual number of casualties and deaths would be 17 and 4, respectively.

Community Disruption. Community disruption is due largely to the presence of at-grade crossings, which when occupied by a train result in passenger vehicle delay, and possibly emergency vehicle delay. At least 600 communities are potentially so affected. Delays due to train traffic would depend on the speed of the train, which is a function of track conditions, grade, equipment, and traffic control systems. To provide a general time-delay range, Table 4-48 estimates daily grade crossing delays based on unit coal train traffic, where one unit coal train is 1 mile in length. The actual number of trains per day due to the shipment of 37.4 MMTA of coal ranges from approximately 20 trains per day along routes from the Wyoming mines to Kansas City, to 1 train per day as the route branches out nearer to its termini.

Precise estimates of the impacts due to the 37.4-MMTA-related traffic are further complicated by the fact that the railroads have been working extensively with individual towns to relieve perceived or anticipated problems. While it could be expected that related impacts would be the most severe in towns in Nebraska, it is impossible to predict the magnitude due to other projected increases in rail traffic and the changes that these may induce. Changes such as rerouting tracks around a city that is now bisected by the railroad (such as Broken Bow), would mean that there would be no impacts.

Solutions to grade-crossing problems must be considered on a site-specific basis. The movement of 37.4 MMTA alone would not cause significant community disruption. Considered with other rail traffic and expectations for growth in this traffic, however, overall growth could lead to significant disruption. While this disruption cannot be identified by town or quantified for the whole of the route, it can be noted that there are increasing local attempts to correct current rail-related problems. If it is assumed that a community's willingness to spend funds for a rerouting or other rail modification effort is an adequate indication of a significant rail-related disruption, then in towns such as Lincoln the current impacts are significant and it can be expected that in the future such impacts in other towns will also be significant.

Rail-Barge Alternative

Socioeconomic impacts associated with this alternative would be minor and would be the following:

1. Employment for 300 people during a 2-year construction period and for 40 people to operate a new or expanded transshipment facility in or near St. Louis that would handle approximately 18.3 MMTA. This would not drastically affect local employment (Mankus 1980; Collins 1981). The cost of this facility has been estimated to be at least $19 million (Rieber and Soo 1977a, p. 4-73).

   Employment for 729 people as crew on the barges. Even if these workers were all new to the area, the impact when distributed over towns

TABLE 4-48

GRADE CROSSING DELAY (minutes per day)

No. of Trains per Day	Train Speed 10 mph	20 mph	30 mph	40 mph	50 mph
1	6.0 min	3.0 min	2.0 min	1.5 min	1.2 min
5	30.0	15.0	10.0	7.5	6.0
10	60.0	30.0	20.0	15.0	12.0
15	90.0	45.0	30.0	22.5	18.0
20	120.0	60.0	40.0	30.0	24.0
30	180.0	90.0	60.0	45.0	36.0

along the 800 miles of the barge route would be insignificant.

2. An increase of about 2 to 3 tows per day on the Mississippi River. No significant impact is anticipated from this increase, as the open channel of the lower Mississippi is assumed to have virtually unlimited capacity and has been judged capable of handling an increase of 70 MMTA with ease (Rieber and Soo 1977b, p. 1-17).

3. Recreational use of the Mississippi River would be unaffected. Most of the recreational boat use of the river is north of St. Louis, where the water quality is better. South of St. Louis, few pleasure craft use the river (Mankus 1980). Further movement of 18.3 MMTA would not affect recreation in such areas as Memphis, Vicksburg, or New Orleans (Hill 1980).

4. At present, traffic on the Mississippi is at the rate of one tow per hour. Two or three additional tows per day would therefore not significantly increase traffic, congestion, or accidents (Feld 1980).

4.L.2 WILDLIFE

All-Rail Alternative

The all-rail alternative would not result in additional losses of wildlife habitat, since construction of new railroad corridors would not be necessary. However, there are several, often severe, impacts to wildlife that could result from increased railroad traffic. The major impacts of railroad operation on terrestrial fauna would be harassment and train-animal collisions. Migration of big game animals that might cross rail lines should not be interrupted significantly by the predicted increase in rail traffic.

The main harassment factor of the all rail alternative would be noise associated with passing trains and human presence. Wildlife presently occupying the vicinity of the railroad corridors are accustomed to existing noise levels, so the increase in noise associated with the increased traffic is not anticipated to have any adverse effects. Increased railroad traffic could cause displacement of wildlife from the immediate vicinity of the railroad corridor. Some species, such as raptors and sage grouse, might not be able to adjust to increased disturbance during critical nesting or courtship periods, and abandonment of strutting grounds and traditional nesting areas could occur.

Increased railroad traffic could also cause an increase in train-animal collisions. This increase would most likely be linear. Deer and antelope deaths are the most visible result of train-animal collisions, although many small animals are similarly lost. Increased railroad traffic also increase the probability of fires resulting from railroad operation.

Rail-Barge Alternative

The impacts of the rail part of this alternative would be the same as for the all-rail alternative. No impacts on wildlife would be expected from the barge transportation.

4.L.3 AQUATIC BIOLOGY

All-Rail Alternative

The potential for hopper car spills into water bodies exists, and it is anticipated that such spills could have localized, short-term significant impacts. A single-car (100-ton) spill would be expected to smother and kill stream-bottom invertebrates in at least a 100-square-yard area. This would represent a loss of approximately 3 pounds (dry weight) of invertebrates and 0.5 pound (dry weight) of fish flesh that would have been produced from foraging on the affected invertebrate population (Table 4-21). In addition, damage would occur during the retrieval of derailed cars from or near streambeds. This would include disturbance of established vegetation, with resultant erosion and downstream siltation, and potential disturbance of streambed contours by heavy equipment.

Rail-Barge Alternative

Generally, aquatic impacts from a barge spill would be similar to those for a slurry pipeline rupture in a large river (Section 4.B.4 of the Ruptures and Spills Technical Report [WCC 1981j]). The most severe impacts to aquatic resources would result from habitat loss in the spill area and downstream turbidity and siltation. A barge spill could be reasonably expected to cause a direct loss of all benthic invertebrates and a few fish in the spill area. Downstream, additional invertebrates and possibly some fish eggs and larvae would be similarly smothered. Most adult fish would be displaced from the spill area. A barge spill, although locally significant, would have little effect on the river's overall aquatic biota. Cleanup of such a spill would cause additional sedimentation and turbidity effects.

4.L.4 AIR QUALITY AND NOISE

All-Rail Alternative

Impacts from operation of coal unit trains would include coal dust blown from hopper cars and pollutant emissions from locomotive engines. Emissions data relating to coal-dust blow-off are scarce; estimates range from 0.05 percent to 1.0 percent of total tonnage hauled (EPA 1978b). These figures are in agreement with the "rough approximation" of 0.1 percent presented by the Office of Technology Assessment (1977). The actual amount of coal lost would vary with train speed, meteorological conditions, and coal composition, but it appears that losses from a 100-car train hauling 100 tons per car could range from 5 to 100 tons. These emissions would be spread over the entire route, and violations of the standard for total suspended particulates (TSP) would not be expected.

Emissions of pollutants from locomotive engines depend on the type of engine and the terrain along the route, and are directly proportional to the amount of fuel consumed. Emission factors have been published by the EPA and summarized by the OTA (1977). These composite average factors (expressed as pounds per thousand gallons of fuel consumed) are as follows: carbon monoxide, 174; hydrocarbons, 78; nitrogen oxides, 430; particulates, 25; sulfur oxides, 57.

A study done for the Federal Railroad Administration (Peat, Marwick, Mitchell and Co. 1979) presents a fuel consumption figure of 16,360 gallons for a unit train round trip between between Arco Junction and Kansas City. This route is expected to be similar to the railroad route for proposed action markets. Applying the above factors would yield the following pollutant emissions (in tons per trip): carbon monoxide, 1.4; hydrocarbons, 0.6; nitrogen oxides, 3.5; particulates, 0.2; sulfur oxides, 0.5.

These emissions would occur during every round trip and would lead to increases in ambient pollutant concentrations. Site-specific meteorological data would be necessary to quantify these increases; however, a report done for the OTA (1977) indicates that short-term ambient concentrations would be below the federal ambient air quality standards.

Noise levels resulting from railroad operations depend on train speed, the number and type of locomotives, train weight, and track type. Maximum sound levels at distances of 50 feet may range from 50 to 100 decibels, A-weighted scale (OTA 1977; Peat, Marwick, Mitchell and Co. 1979). The EPA (1974b) has suggested an ambient noise level of 55 decibels as adequate to protect public health and welfare. The distance to the 55 dBA contour is expected to range from about 400 to 800 feet. The increases in rail traffic under the no-action alternative would extend this distance to about 1000 to 1500 feet. This assumes no attenuation by terrain or buildings, which would decrease the distance. At these distances, substantial portions of small towns along the rail route would be significantly affected by increased noise levels.

Rail-Barge Alternative

Air quality and noise impacts resulting from the rail portion of the rail-barge alternative would be the same as those discussed for the all-rail alternative above. Impacts to air quality and noise for the barge portion of this alternative would be the same as those discussed for the Cypress Bend pipeline-barge alternative in Section 4.C.5.

MITIGATION MEASURES

The measures presented in this section are in addition to the general construction, operating, and reclamation procedures described in Appendix C-1 committed to by the applicant (ETSI); the Bureau of Land Management (BLM) general measures in Appendix D-2, which will be included in the BLM right-of-way grant if one is issued; the Forest Service general measures in Appendix D-5, which will be included in any Forest Service right-of-way grant; and Corps of Engineers general measures in Appendix D 7, which would be part of any authorized Section 404 or Section 10 permits.

BLM and the Forest Service can require and enforce mitigation measures only on federally administered land, not on private land-- except in cases where a law such as the Endangered Species Act provides specific authority. Measures may also be required and enforced by BLM and the Forest Service if the measure is designed to mitigate an impact that could affect federally administered land. Measures applicable to private land have been recommended to ETSI. This section contains those measures that ETSI has committed to implement in writing. The letters of commitment from ETSI that relate to these measures are included in Appendix C-13.

Federal field compliance officers would conduct field inspections to ensure that all stipulation requirements are met by the grantee (ETSI) and its contractors on federal land. During key construction periods, the compliance officer may be at a specific site until construction is completed. If the grantee violates the terms and conditions of the right-of-way grant, the federal agency may issue immediate orders to suspend operations on federal land in order to protect public health and safety and the environment.

These measures apply to the proposed action, except where noted that they apply to a specific alternative.

Applicant-Committed Measures

1. Measure: Where higher volumes of test water would be discharged into streams during low flow periods, route hydrostatic test water through settling or detention basins or through straw or hay bales in order to decrease the levels of iron and suspended solids in the discharge water.

   Effectiveness: Field experience by Butler (1980), McCabe (1980), and Bennett (1980) indicates that these measures can reduce the levels of iron and suspended solids in the discharge water to meet applicable local requirements. Such measures would therefore be effective in eliminating any water quality impacts.

2. Measure: To control erosion and excess levels of stream turbidity, hydrostatic test water will be routed directly into a flowing stream at reduced levels of velocity. By careful routing of discharge water into the drainage and controlling velocities, erosion and excess levels of turbidity will be avoided.

   Effectiveness: This measure would reduce the potentially high velocity of flow of the discharge and would be effective in controlling erosion and excess levels of stream turbidity.

3. Measure: In order to avoid affecting wetland habitat, site-specific visits will be made to detail the location of these wetlands: in Kansas, at the crossing of Rattlesnake Creek (MP PMB-551); North Fork Ninnescah River (MP PMB-567); South Fork Ninnescah River (MP PMB-593); and in Arkansas (MP PMB-1010). When mapped in more detail in relationship to the proposed action route, these areas will be avoided to the extent possible.

   Effectiveness: These actions would be anticipated to be successful in eliminating significant effects on wildlife associated with these wetlands.

4. Measure: When strutting grounds of the greater prairie chicken along the Colorado alternative route between MP C-310 and C-330 are defined by the appropriate state agency prior to right-of-way acquisition, these areas will be avoided. During strutting periods of the greater prairie chicken, steps will be taken to avoid disturbing the birds as required.

   Effectiveness: These actions would be anticipated to reduce any potential effects on the greater prairie chicken in Colorado.

5. Measure: In order to avoid affecting the northern swift fox along the Oahe pipeline in South Dakota, a more detailed identification of denning sites in relationship to the Oahe alternative pipeline route between MP O-35 and O-65 will be made by an appropriate state agency prior to right-of-way acquisition.

   Effectiveness: This action would be anticipated to be successful in eliminating the possibility of destruction of denning sites between MP O-35 and O-65.

6. Measure: In order to avoid affecting an important winter range area for mule deer, construction will be avoided along the Oahe water pipeline in Wyoming between MP O-195 and O-225 from December through March, or as recommended by the appropriate state agency.

   Effectiveness: This scheduling adjustment would be anticipated to be entirely successful in eliminating significant effects on wintering mule deer between MP O-195 and O-225 of the Oahe alternative.

7. Measure: To provide housing consistent with Gillette, Newcastle, Upton, and Wright planning efforts, ETSI will work with representatives

of these cities to assess this potential problem.

Effectiveness: If additional housing is supplied by ETSI as a result of this consultation, this measure would avoid housing shortage, add to stable employment, and stimulate tax benefits in excess of cost of services in the area.

8. Measure: Reduce bank erosion and improve aesthetics of bank zones disturbed on stream and river crossings by replanting vegetation recommended by local land use managers and appropriate state and fed eral agencies.

   Effectiveness: These actions would eliminate the disturbance of banks that might otherwise constitute more than temporary adverse impacts on streams and rivers.

9. Measure: To provide maximum protection for any rivers of special interest that are crossed (Table 4-49), install pipeline valves on both sides of the rivers or use best possible pipeline rupture technology.

   Effectiveness: This measure would reduce potential impact on highly scenic and recreational rivers or jeopardize their natural and relatively undisturbed water quality enjoyed by recreationists.

10. Measure: Avoid the proposed Walnut Creek Recreation Area site in Kansas.

    Effectiveness: By avoiding this area, the recreation use at the proposed recreation area will not be disrupted.

<u>BLM-Required Measures</u>

1. Measure: If the Colorado alternative is used, ETSI will be required to install pipeline valves on both sides of Deception Creek in Kansas at MP C-558 or use best possible pipeline rupture technology for maximum protection.

   Effectiveness: This measure would minimize the possible impact on critical habitat of the whooping crane (<u>Grus americana</u>) in the Cheyenne Bottoms Wildlife Refuge in Kansas.

MONITORING PROGRAMS

As has been shown in this chapter, ETSI's pumping has the potential to affect other ground-water users as well as spring and stream flow. Because of these potential impacts, a hydrologic monitoring program was recommended in the Draft EIS. In addition to the program required by Wyoming state law, ETSI is committed to the monitoring program described below. This monitoring program would meet three objectives:

1. To identify and distinguish between the impacts on the Madison aquifer system caused by ETSI's ground-water development and the effects of other water users and/or climatic events on the aquifer system, and to document these impacts and effects

2. Provide additional data that might be used for subsequent refinement or reevaluation of ETSI's impact

3. Provide a warning that impacts are exceeding prior estimates, and thus provide the lead time necessary for designing and implementing additional mitigating and monitoring measures

This hydrogeologic monitoring network was designed to complement federal, state, and university programs now being

TABLE 4-49

WATERWAYS APPLICABLE TO MITIGATION MEASURE 9

Route	Waterway
Proposed Action	Arkansas River, KS[a] North Fork Ninnescah River, KS[a] Chikaskia River, KS[a] Mulberry River, AR[a,b] Spadra Creek, AR[a] Big Piney Creek, AR[b] Illinois Bayou, AR[a,b] Saline River, AR[a,b] Cadron Creek, AR[b] Bayou Bartholomew, AR[a] Big Creek, AR[b] Lower Little Red River, AR[b] Bayou Bartholomew, LA[c] Little River, LA[c] Spring Creek, LA[b,c]
Market Alternative	Saline River, KS[b] Grouse Creek, KS[b] Caney River, KS[a,b] Illinois River, OK[b,c] Barren Fork River, OK[c] Lee Creek, OK[b,c]
Cypress Bend Pipeline-Barge Alternative	All rivers listed for the market alternative Bayou Bartholomew, AR[a]
Colorado Alternative	Arikaree River, CO[b]
Oahe Alternative Water Supply System	Cheyenne River, SD[b]

[a] Identified for study and possible inclusion in a state rivers program.

[b] Identified for possible future study as a potential National Wild and Scenic River (HCRS 1981a, 1981b).

[c] Under an existing state rivers protection program.

conducted. It is anticipated that the monitoring program conducted by ETSI will be coordinated with hydrologic monitoring programs of future projects in the affected area. Stream gages presently being maintained by the U.S. Geological Survey in the western Black Hills Region are listed in Table 6-2 and mapped on Figure 6-1 of the Well-Field Hydrology Technical Report (WCC 1981b). The stream gaging stations that would be maintained and the observation wells that would be installed and maintained by ETSI are listed on Table 4-50 and shown on Map 4-5. Hydrologic data would also be collected from other existing water wells in the vicinity of the ETSI well fields, as described below. The data that would be collected and the procedures the monitoring program would follow are described in greater detail in Chapter 6 of the Well-Field Hydrology Technical Report (WCC 1981b).

Plan 1: Niobrara County Well Field Only

- All Madison wells in the vicinity of the well field will be monitored, if owner permission is granted. These will include the Madison wells at Edgemont and Provo, South Dakota. Madison wells F-9, F-10, and F-11 (Map 3-7) will be monitored for the level, quality, and quantity of water, if they are accessible.

- Observation wells will be installed in or near locations OW-4, OW-5, OW-6, OW-7, OW-8, and OW-9. Well OW-8 now exists as ETSI well M-1. Periodic water-level measurements will be made from these wells. Except when initially installed, no water quality samples will be collected from these wells.

Plan 2: Niobrara County and City of Gillette Well Fields

- The monitoring procedures outlined under Plan 1 will be implemented.

- The Gillette wells will be monitored for discharge rates. Periodic water level measurements would be made on any unpumped Gillette wells.

Plan 3: Crook County Well Field Only

- All Madison ground-water wells in the well-field area will be monitored, where possible. These will include the Madison wells at Bell Creek, Montana; Crook County, Wyoming; and Butte and Lawrence counties, South Dakota (wells P-1 through P-4, B-1 through B-9, and L-7, L-8, L-11, L-12, and L-13 noted on Map 3-7). Where practical, these wells will be monitored for water level, water quality, and the amount of water produced. In addition to the wells noted above, representative wells in Butte County lying within the predicted radius of influence of ETSI's pumping will be included in the monitoring program.

- Observation wells will be installed in or near locations OW-4, OW-5, OW-10, OW-11, and OW-12. Wells OW-10 and OW-11 will be completed to the Madison and well OW-12 to the Minnelusa. Periodic water-level measurements will be made from these wells. Except when initially completed, no water quality samples will be collected from these wells.

- A stream gage, measuring daily flow and similar to those used by the U.S. Geological Survey, will be installed on the Belle Fourche River near township 57 north, range 63 west in Wyoming (stream gage SG-15 on Map 4-5).

Plan 4: Crook County and Gillette Well Fields

- The monitoring procedures outlined under Plan 3 will be implemented as well as the Gillette part of Plan 2.

Plan 5: Combined Well-Field Alternative

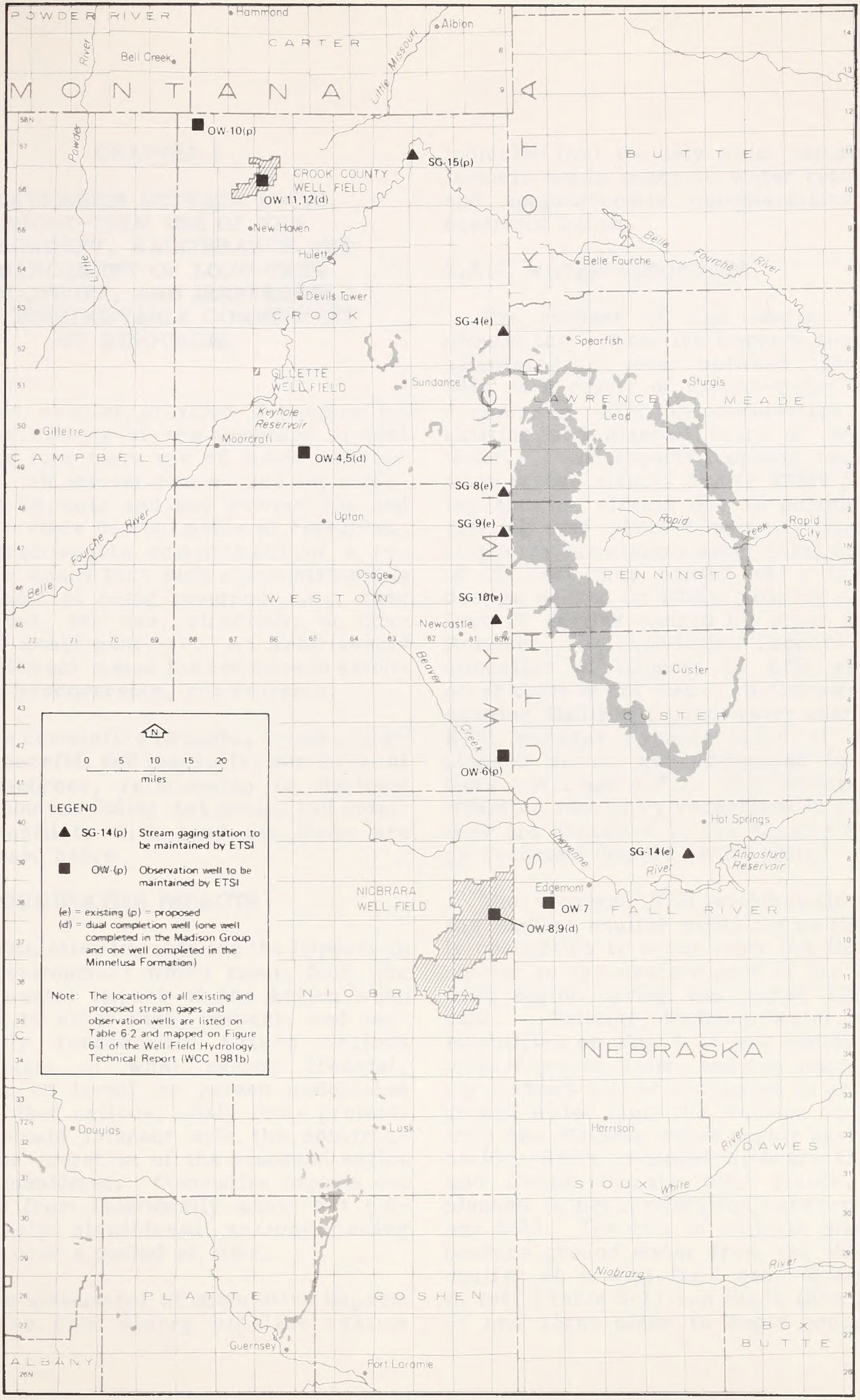
- The monitoring procedures outlined for Plans 1 and 3 will both be implemented.

TABLE 4-50

STREAM GAGING STATIONS TO BE SUPPORTED BY ETSI

USGS Stream Gaging Station No.	Gaging Station Name	State	Monitoring Location No. (Map 4-5)
06429905	Sand Creek near Ranch A, near Beulah	WY	SG-4
06429500	Cold Springs Creek at Buckhorn	WY	SG-8
06392900	Beaver Creek at Mallo Camp, near Four Corners	WY	SG-9
06392950	Stockade Beaver Creek near Newcastle	WY	SG-10
06400497	Cascade Springs, Hot Springs	SD	SG-14
New	Belle Fourche River, northeastern Crook County	WY	SG-15

Note: These stations will be maintained by ETSI in cooperation with USGS. They will be in addition to the 12 stream gaging stations being maintained by the USGS that are listed on Table 6-2 and shown on Figure 6-1 of the Well-Field Hydrology Technical Report (WCC 1981b).



* Funded and maintained by ETSI in cooperation with the USGS

Map 4-5. LOCATIONS OF EXISTING AND PROPOSED STREAM GAGES AND OBSERVATION WELLS* FOR THE ETSI MONITORING NETWORK

CHAPTER 5

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF THE ENVIRONMENT, MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY, AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This chapter provides a perspective of the effects of the proposed project on the long-term use of man's environment. Of special concern are any cumulative impacts and any irreversible and irretrievable commitments of resources. An irretrievable commitment of a resource means that such a commitment is incapable of being reversed; i.e., once initiated, the use, direction, or condition would continue. An irretrievable commitment means the resource is essentially irrecoverable, not reusable.

The cumulative impacts, trends, long-term benefits and tradeoffs, commitment of resources, relationship to National Environment Policy Act goals, and possible conflicts with land use plans are discussed below.

5.A CUMULATIVE IMPACTS

Cumulative impacts are the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal, state, or local) or person undertakes such other actions. Only those projects that would interact with the construction or operation of the proposed action were considered. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The assessment of cumulative impacts for the coal slurry pipeline system indicated that the only major cumulative impacts would occur to water resources and socioeconomic considerations, as described below.

5.A.1 WATER RESOURCES

The purpose of this section is to discuss the cumulative impacts that are calculated to occur between 1985 and 2035 as a result of ground-water withdrawals by ETSI in conjunction with existing and planned users of Madison water. These impacts represent combinations of the effects due to ETSI's pumping and the effects due to pumping by existing and planned users. For instance, a cumulative water-level decline of 25 feet may consist of 1 foot of decline caused by ETSI's pumping and 24 feet of decline caused by other users. However, for cumulative impacts, this allocation of impacts to ETSI and to other users is not made. Withdrawals by existing Madison ground-water users and ETSI without consideration of other planned users, were discussed in Sections 4.A.1 and 4.F.1. The impacts that would be caused by reductions in stream flow are discussed in the Aquatic Biology Technical Report (WCC 1981g).

The proposed ETSI withdrawals from the Madison aquifer would not be the only production to occur from the Madison aquifer in the western part of the Black Hills region during the period 1985 to 2035. Existing Madison water users (identified on Map 3-7) will continue to produce ground water, and new water supply systems will be developed to produce ground water from the Madison aquifer. Only two Madison water supply systems, besides ETSI's proposed Niobrara County and Crook County well fields, are planned to begin operation between 1980 and 2035. The city of Gillette plans to produce ground water from the Madison aquifer at a well field near Moorcroft in 1981 (Table 5-1) and Black Hills Power and Light plans to begin producing

TABLE 5-1

PUMPING SCHEDULE FOR CITY OF GILLETTE WELL FIELD NEAR MOORCROFT, WYOMING

Time Period (years)	Total Pumping Rate: cfs (acre-feet per year)	Amount Supplied to City of Gillette: cfs (acre-feet per year)	Maximum Amount That Could Be Available to ETSI: cfs (acre-feet per year)
1985-1995	15.60* (11,292)	4.19 (3032)	11.41 (8260)
1995-2005	15.60 (11,292)	5.91 (4272)	9.69 (7020)
2005-2015	15.60 (11,292)	6.77 (4902)	8.83 (6390)
2015-2025	15.60 (11,292)	7.23 (5232)	8.37 (6060)
2025-2035	15.60 (11,292)	7.46 (5402)	8.14 (5890)

Source: Montgomery 1979.

*Equivalent to 10 million gallons per day

Note: The pumping schedule outlined in this table was used in conjunction with the pumping schedules outlined in Tables 3-4 and 4-3 to simulate cumulative pumping by all Madison ground-water users.

ground water from the Madison aquifer for a new power plant near Osage in the 1990s. The ground water produced for these two new projects is projected to average 6.2 cubic feet per second (cfs) (4500 acre-feet per year) for the city of Gillette, and 2.0 cfs (1450 acre-feet per year) for Black Hills Power and Light.

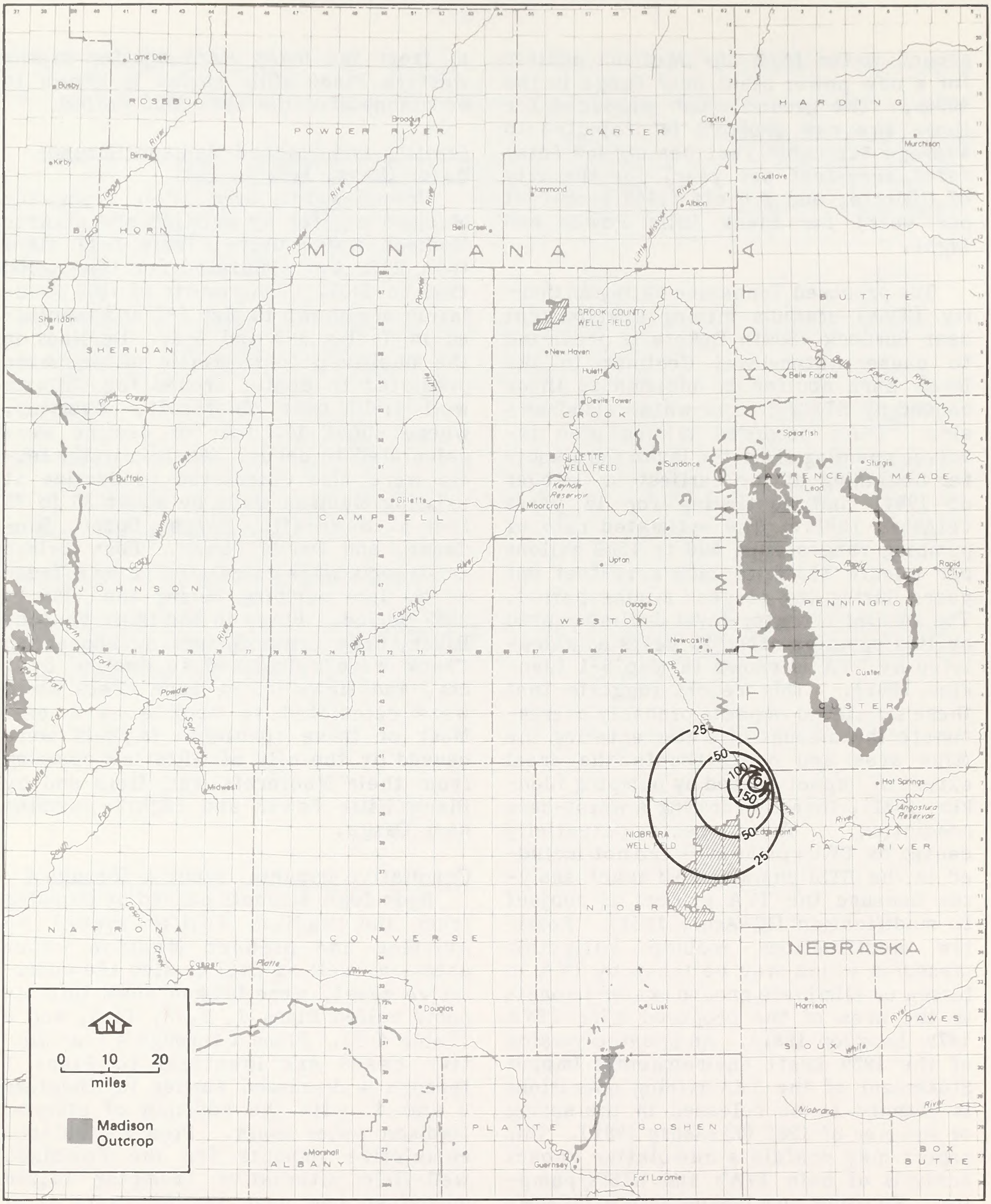
The proposed Tennessee Valley Authority (TVA) uranium mining development near Burdock, South Dakota is predicted to cause water-level declines in the Inyan Kara aquifer in addition to those caused by ETSI's ground-water withdrawals. TVA's proposed mining plan involves pumping from the Inyan Kara aquifer beginning at the earliest in October of 1984, and continuing for 15 years (ElAshry 1981). The estimated rate of pumping ranges from 800 to 1500 gallons per minute (1300 to 2400 acre-feet per year) during the 15-year mining period. The amount of water-level decline caused by this pumping after 15 years as calculated by TVA is shown in Map 5-1 (Jenkins 1981). This report suggests that these simulated impacts probably overestimate the amount of water entering the mine area and overestimate the areal extent of impact caused by pumping (Jenkins 1981), thereby forming a worst-case prediction. The impacts potentially caused by TVA's pumping were not included in the ETSI cumulative impact analyses because the TVA project is subject to modification (El-Ashry 1981). Possible modifications include mitigation measures which may be taken by TVA to lessen or eliminate ground-water impacts in the area of the proposed mine (TVA 1979; Langdon 1981). An updated version of the 1979 Draft Environmental Impact Statement of the TVA mining operations is planned to be released in the spring or summer of 1982 (El-Ashry 1981). This report may contain a cumulative impact analysis of both TVA's and ETSI's pumping. No other new large-scale withdrawal from the Inyan Kara aquifer in the western Black Hills region is known to be planned for the 1985-2035 period.

Existing and Planned Madison Ground-Water Users, 1985 to 2035

Ground-water production from the Madison aquifer by existing and planned Madison water users (Table 3-4) other than ETSI was simulated for the period 1985 to 2035. The results of this simulation are shown in Map 5-2 and tabulated in Tables 5-2 and 5-3. Declines in the Madison potentiometric surface were predicted to center around the Gillette well field near Moorcroft, Wyoming, where about 140 feet of decline were calculated to occur. Madison water levels were also calculated to decline at existing Madison wells by about 30 to 75 feet at Newcastle, Osage, Upton, Sundance, and Devils Tower. Four springs or streams were calculated to be affected by this pumping during the 1985 to 2035 period. Flows in the Belle Fourche River, Crow Creek Springs, and Spearfish Creek were calculated to decline by 1 cfs, and flows in the Sand Creek basin were calculated to decline by 3 cfs. Most of these simulated impacts were caused by the city of Gillette's pumping from their Moorcroft well field and by Black Hills Power and Light's pumping near Osage.

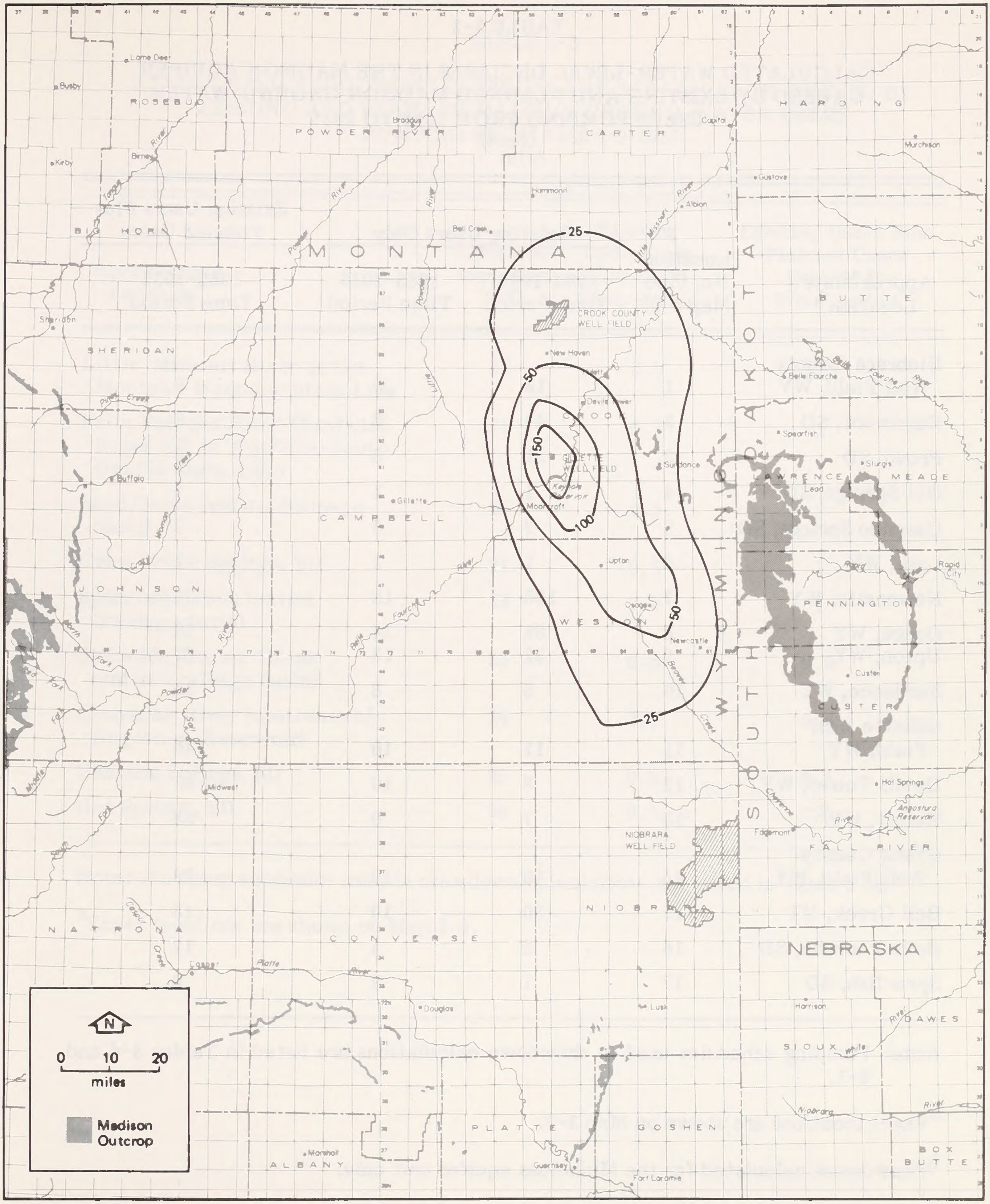
Cumulative Impacts, Plans 1 Through 6

Hydrologic impacts caused by pumping from the Madison aquifer system by existing and planned Madison water users, as well as ETSI (called the cumulative case), were broken down into six parts called Plans 1, 2, 3, 4, 5, and 6 (Table 4-2). Plans 1 through 4 (cumulative case) are identical to Plans 1 through 4 discussed earlier in Chapters 3 and 4, with the addition of planned Madison water users. Plan 5 simulated cumulative impacts for the combined well-field alternative (pumping 10,250 acre-feet per year for 50 years from



Data source: Jenkins, 1981

Map 5-1. POTENTIAL DECLINES IN LAKOTA (Inyan Kara Group) WATER LEVELS CAUSED BY 15 YEARS OF PUMPING BY THE TENNESSEE VALLEY AUTHORITY AT THE PROPOSED BURDOCK, SOUTH DAKOTA, URANIUM MINE



Map 5-2. CALCULATED WATER-LEVEL DECLINES (in feet) IN THE MADISON POTENTIOMETRIC SURFACE FOR THE YEAR 2035 WITH PUMPING BY EXISTING AND PLANNED MADISON WATER USERS ONLY

TABLE 5-2

CALCULATED WATER-LEVEL DECLINES IN THE MADISON AQUIFER CAUSED BY EXISTING AND PLANNED MADISON GROUND-WATER USERS PUMPING FROM 1900 TO 2035 (feet)

Approximate Location[a]	Location No. (See Map 3-9)	Existing Users Only: 1900-1980 Time Period	Existing Users Only: 1985-2035 Time Period	Existing Users Plus Planned Users: 1985-2035 Time Period
Niobrara County Well Field, WY	1	18	9	9
Edgemont, SD	2	44	8	8
Provo, SD	3	31	8	8
Hot Springs, SD	4	1	1	1
Cascade Springs, SD	5	3	3	3
Lusk, WY	6	1	1	1
Newcastle, WY	7	130	18	32
Osage, WY	8	68	14	76
Upton, WY	9	32	13	67
Sundance, WY	10	5	8	36
Gillette Well Field, WY	11	11	10	140
Devils Tower, WY	12	8	10	65
Hulett, WY[b]	13	7	9	53
Crook County Well-Field, WY	14	10	10	29
Bell Creek, MT	15	30	10	18
Belle Fourche, SD	16	2	4	12
Spearfish, SD	17	1	2	6

Note: Pumping schedules used in drawdown calculations are listed in Tables 3-4 and 5-1.

[a]Exact locations are shown on Map 3-9.

[b]Drawdowns calculated for the Minnelusa aquifer unit only.

TABLE 5-3

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW CAUSED BY EXISTING AND PLANNED MADISON GROUND-WATER USERS PUMPING FROM 1985 TO 2035 (cfs)

Approximate Location[a]	Location (See Map 3-9)	Existing Users Only 1985-2035 Time Period	Existing Users Plus Planned Users 1985-2035 Time Period
Little Missouri River at the Montana-Wyoming State Line	18	0.5	0.5
Belle Fourche River (Keyhole) Reservoir to Wyoming-South Dakota State Line)	19	0.5	1
Sand Creek (entire drainage basin)	20	0.5	3
Crow Creek Springs, SD	21	0.5	1
Spearfish Creek (entire drainage basin)	22	0.5	1
Stockade-Beaver Creek (entire drainage basin)	23	0.5	0.5
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5
Cascade Springs, SD	25	0.5	0.5
Hot Springs, SD	26	0.5	0.5

Note: Pumping schedules used in drawdown calculations are listed in Table 3-4.

[a]Exact locations are shown on Map 3-9.

both the Niobrara and Crook county well fields simultaneously, for a total production of 20,500 acre-feet per year from the Madison aquifer. Plans 1 through 5 are considered to portray reasonable worst-case impacts because the water level declines predicted for them were greater than those calculated to have a 50 percent exceedance probability (Well-Field Hydrology Technical Report, WCC 1981b). Although the parameter values used in these plans were the best estimates available when the Draft EIS was prepared, new information regarding the aquifer characteristics became available during the public comment period. Therefore, for comparison purposes, an additional plan was analyzed incorporating the new information in the numerical model. This plan, Plan 6, had the same pumping distribution as Plan 5 but utilized the current best estimates of the aquifer parameters.

Water-level declines in the Inyan Kara aquifer (Fall River and Lakota Formations), as caused by pumping from the Madison aquifer, were also simulated for the cumulative case. This was accomplished by numerically separating the "upper confining unit" into two layers. The upper layer represented the Inyan Kara aquifer, and the lower layer represented the confining beds between the Upper Minnelusa and the Inyan Kara aquifer. Cross sections depicting the stratigraphic relationships between the Madison and Inyan Kara groups are shown on Figure 5-1 (with color maps at end of this chapter).

Aquifer parameters were also adjusted to accommodate this additional layer (see the Well-Field Hydrology Technical Report, WCC 1981b). In addition to making possible the prediction of impacts within the upper aquifers, this modification of the model tended to slightly reduce the predicted drawdowns within the Madison and the adjacent Minnelusa and Red River formations. However, this reduction in predicted drawdowns was small, less than 10 percent, and did not significantly differ from the results presented earlier in this section.

For wells in geologic units other than the Madison and Inyan Kara aquifers, the predicted impacts are discussed below:

1. Wells in confined aquifers (away from outcrop areas) above the Madison and below the Inyan Kara aquifer (Maps 3-10, 3-11) were calculated to have declines in water levels of up to 90 percent of the reduction in potentiometric surface predicted for the Madison aquifer (Table 5-4). Where these geologic units were under unconfined (water-table) aquifer conditions, such as in and near outcrop areas (see Maps 3-10, 3-11), water-level declines were calculated to be less than 25 feet. In the Black Hills region and eastern Powder River Basin, relatively few wells in these geologic units are located in areas where potentiometric surface declines were calculated to be more than 25 feet (Maps 3-10, 3-11). Pressure heads in petroleum wells completed in these geologic units may have declines of up to 90 percent of the decline predicted for the Madison aquifer at that location.

2. Wells completed in Tertiary and Quaternary age sediment, such as the Lance, Fox Hills, and Arikaree formations, the White River Group, or valley fill (alluvium) would not be significantly affected by pumping from the Madison aquifer (Table 5-4). These wells are generally separated from the Madison by thick layers of low-permeability Cretaceous shales. These shallow wells are also often located in

TABLE 5-4

GENERALIZED SUMMARY OF PREDICTED HYDROLOGIC IMPACTS ON WELLS IN THE WESTERN BLACK HILLS REGION DUE TO PUMPING FROM THE MADISON AQUIFER, 1985 TO 2035

Well Category	Typical Depth	Geologic/Aquifer Unit	Predicted Impacts	Comments
Shallow well	Less than 300 feet	Quaternary-Tertiary age sediment, and alluvial valley fill. The Arikaree, White River, Lance, and Fox Hills formations are examples of these units	None.	Shallow wells are hydraulically isolated from the Madison aquifer by thick, low-permeability Cretaceous shales, and/or are located in areas where the aquifer is under unconfined (water table) aquifer conditions. Therefore, hydrologic impacts on these wells would be insignificant.
Inyan Kara well	Up to 500 feet	Inyan Kara Group	See Tables 5-5 to 5-17 and discussion in this chapter.	
Wells in Jurassic, Triassic, Permian, and Pennsylvanian age rock and in unconfined parts of the aquifer	Up to 400 feet	Sundance, Spearfish, and Minnelusa formations	Less than 25 feet of water-level decline.	Wells in unconfined parts of these geologic units are located in and near outcrop areas. Hydrologic impacts on these wells would be insignificant. See Maps 3-10 and 3-11.
Wells in Jurassic, Triassic, Permian, and Pennsylvanian age rock and in confined parts of the aquifer	Generally less than 2000 feet	Sundance, Spearfish, and Minnelusa formations	Potentiometric surface decline of up to 90 percent of that predicted for the Madison aquifer at that location.	Wells in confined parts of these geologic units are located away from outcrop areas and are generally deeper than wells in the same geologic unit but located in outcrop areas. Relatively few wells are located in these areas, except where petroleum wells are located.
Madison well	Up to 5000 feet	Madison Group	See Chapters 4 and 5.	

areas where the aquifer is under unconfined (water-table) conditions, meaning that impacts would be much less severe than for similar wells in confined units.

Calculated changes in ground-water quality as a result of pumping from the Madison aquifer are not measurably different than that discussed under Plans 1 through 4 in Chapter 4 and therefore are not discussed further in this section.

Hydrologic impacts in the following subsections are described separately for time intervals of 5, 10, 25, and 50 years from 1985, covering the period 1985-2035, for each of the six pumping plans. A set of diagrams has been constructed for each of these time intervals and each of the six pumping plans. In each diagram, the drawdowns are mapped (see color maps at end of this chapter), areas which contain the majority of the known wells impacted by water-level declines are highlighted, and one to four sets of typical wells completed in the Madison, Inyan Kara, and shallow aquifers at various locations are sketched. These typical wells depict how ground-water levels are predicted to change through time, beginning in the year 1985 when ETSI would begin pumping, to the year 2035 when the ETSI project is scheduled to end. By using the proper water-level decline map and the corresponding typical well in each composite figure, extrapolations can be made to assess predicted impacts for almost any well in the western Black Hills region. In addition, Tables 5-5 through 5-17 are helpful in determining predicted water-level declines and predicted spring and stream flow reductions at specific locations in the Black Hills region for Plans 1 through 6. A description of water-level impacts accompanies each set of drawdown maps. Stream flow and stream flow reductions are also described for each of the six plans.

Plan 1, Cumulative Case. Calculated water-level declines for this case are presented and discussed on Figure 5-2 and Maps 5-3 through 5-6 (color maps at end of this chapter). Predicted spring and stream flow reductions are listed in Table 5-11.

Plan 2, Cumulative Case. Calculated water-level declines for this case are presented and discussed on Figure 5-3 and Maps 5-7 through 5-10 (color maps at end of this chapter). Predicted spring and stream flow reductions are listed in Table 5-12.

Plan 3, Cumulative Case. Calculated water-level declines for this case are presented and discussed on Figure 5-4 and Maps 5-11 through 5-14 (color maps at end of this chapter). Predicted spring and stream flow reductions are listed in Table 5-13.

Plan 4, Cumulative Case. Calculated water-level declines for this case are presented and discussed on Figure 5-5 and Maps 5-15 through 5-18 (color maps at end of this chapter). Predicted spring and stream flow reductions are listed in Table 5-14.

Plan 5, Cumulative Case. Plan 5 differs from Plans 1, 2, 3, and 4 in that ETSI's pumping was simulated using both the Niobrara County and Crook County well fields simultaneously. Pumping by all other existing and planned Madison water users was simulated in the same manner in Plan 5 as was done in Plans 1-4. Pumping from both the Niobrara County and Crook County well fields was simulated for a 50-year period using a rate of 10,250 acre-feet per year (14.16 cfs) for each well field for an annual total of 20,500 acre-feet per year (28.31 cfs). Since the amount of water pumped from each ETSI well field would be half that used in Plans 1 and 3, pumping from the Niobrara County well field was simulated using only two nodes

Table 5-5

CALCULATED WATER-LEVEL DECLINES, PLAN 1, CUMULATIVE CASE
(feet)

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year): 5 Years (1990) Madison	5 Years (1990) Inyan Kara	10 Years (1995) Madison	10 Years (1995) Inyan Kara	25 Years (2010) Madison	25 Years (2010) Inyan Kara	50 Years (2035) Madison	50 Years (2035) Inyan Kara
Niobrara County Site, WY	1	340	14	430	37	560	120	670	240
Edgemont, SD	2	71	3	120	7	210	22	300	45
Provo, SD	3	82	5	110	-	200	-	280	1
Hot Springs, SD	4	1	-	1	-	3	-	8	-
Cascade Springs, SD	5	4	-	7	-	18	-	34	-
Lusk, WY	6	-	-	-	-	2	4	6	18
Newcastle, WY	7	6	-	8	-	21	-	32	-
Osage, WY	8	5	3	9	5	60	17	76	32
Upton, WY	9	9	3	15	5	45	16	67	31
Sundance, WY	10	4	-	7	-	21	-	36	-
Gillette Well Field, WY	11	37	-	47	-	110	-	140	-
Devils Tower, WY	12	12	-	18	-	45	-	65	-
Hulett, WY	13	9	-	14	-	33	-	53	-
Crook County Site, WY	14	3	1	6	2	16	5	29	10
Bell Creek, MT	15	1	1	3	3	9	7	18	15
Belle Fourche, SD	16	1	-	2	-	5	1	12	2
Spearfish, SD	17	-	-	1	-	2	-	6	-

Note: A dash (-) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations are shown on Map 3-9.

Table 5-6

CALCULATED WATER-LEVEL DECLINES, PLAN 2, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year): 5 Years (1990)		10 Years (1995)		25 Years (2010)		50 Years (2035)	
		Madison	Inyan Kara	Madison	Inyan Kara	Madison	Inyan Kara	Madison	Inyan Kara
Niobrara County Site, WY	1	200	9	260	22	370	76	470	160
Edgemont, SD	2	43	2	72	7	140	14	200	30
Provo, SD	3	49	3	83	8	150	34	230	81
Hot Springs, SD	4	-	-	1	-	2	-	6	-
Cascade Springs, SD	5	2	-	4	-	11	-	24	-
Lusk, WY	6	-	-	-	-	1	2	5	12
Newcastle, WY	7	6	-	10	-	25	-	34	-
Osage, WY	8	12	3	22	6	81	21	100	39
Upton, WY	9	33	4	55	9	96	26	120	49
Sundance, WY	10	15	-	25	-	47	-	68	-
Gillette Well Field, WY	11	210	-	260	-	300	-	330	1
Devils Tower, WY	12	52	-	79	-	120	-	140	-
Hulett, WY	13	36	-	57	-	88	-	110	-
Crook County Site, WY	14	11	1	20	3	39	8	58	17
Bell Creek, MT	15	3	2	6	3	17	9	32	21
Belle Fourche, SD	16	2	-	4	-	12	2	22	4
Spearfish, SD	17	-	-	1	-	4	-	11	-

Note: A dash (-) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations are shown on Map 3-9.

Table 5-7

CALCULATED WATER-LEVEL DECLINES, PLAN 3, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year): 5 Years (1990) Madison	5 Years (1990) Inyan Kara	10 Years (1995) Madison	10 Years (1995) Inyan Kara	25 Years (2010) Madison	25 Years (2010) Inyan Kara	50 Years (2035) Madison	50 Years (2035) Inyan Kara
Niobrara County Site, WY	1	1	-	2	-	4	-	9	-
Edgemont, SD	2	-	-	2	-	3	-	8	-
Provo, SD	3	-	-	2	-	3	-	8	-
Hot Springs, SD	4	-	-	-	-	-	-	1	-
Cascade Springs, SD	5	-	-	-	-	1	-	3	-
Lusk, WY	6	-	-	-	-	-	-	1	-
Newcastle, WY	7	6	-	9	-	22	-	35	-
Osage, WY	8	6	3	12	6	69	19	93	36
Upton, WY	9	13	3	24	6	67	19	100	41
Sundance, WY	10	7	-	14	-	37	-	65	-
Gillette Well Field, WY	11	54	-	80	-	170	-	230	-
Devils Tower, WY	12	49	-	80	-	140	-	200	-
Hulett, WY	13	42	-	70	-	130	-	180	-
Crook County Site, WY	14	220	11	270	25	340	62	390	100
Bell Creek, MT	15	35	4	63	10	110	37	170	86
Belle Fourche, SD	16	5	-	11	1	30	4	55	11
Spearfish, SD	17	1	-	3	-	14	-	32	-

Note: A dash (-) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations are shown on Map 3-9.

Table 5-8

CALCULATED WATER-LEVEL DECLINES, PLAN 4, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year) 5 Years (1990) Madison	5 Years (1990) Inyan Kara	10 Years (1995) Madison	10 Years (1995) Inyan Kara	25 Years (2010) Madison	25 Years (2010) Inyan Kara	50 Years (2035) Madison	50 Years (2035) Inyan Kara
Niobrara County Site, WY	1	1	-	2	-	4	-	9	-
Edgemont, SD	2	-	-	2	-	3	-	8	-
Provo, SD	3	-	-	2	-	3	-	8	-
Hot Springs, SD	4	-	-	-	-	-	-	1	-
Cascade Springs, SD	5	-	-	-	-	1	-	3	-
Lusk, WY	6	-	-	-	-	-	-	1	-
Newcastle, WY	7	7	-	11	-	22	-	39	-
Osage, WY	8	13	3	23	7	78	22	110	42
Upton, WY	9	35	4	60	9	110	28	150	55
Sundance, WY	10	16	-	29	-	58	-	88	-
Gillette Well Field, WY	11	220	-	280	-	350	-	400	-
Devils Tower, WY	12	74	-	120	-	180	-	230	-
Hulett, WY	13	56	-	91	-	150	-	200	-
Crook County Site, WY	14	140	7	180	17	260	46	310	80
Bell Creek, MT	15	23	3	42	7	87	28	130	69
Belle Fourche, SD	16	4	-	10	1	28	4	52	10
Spearfish, SD	17	1	-	3	-	13	-	31	-

Note: A dash (-) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations are shown on Map 3-9.

Table 5-9

CALCULATED WATER-LEVEL DECLINES, PLAN 5, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year): 5 Years (1990) Madison	5 Years (1990) Inyan Kara	10 Years (1995) Madison	10 Years (1995) Inyan Kara	25 Years (2010) Madison	25 Years (2010) Inyan Kara	50 Years (2035) Madison	50 Years (2035) Inyan Kara
Niobrara County Site, WY	1	230	9	280	23	340	70	410	130
Edgemont, SD	2	25	1	48	2	90	9	140	19
Provo, SD	3	32	2	58	6	100	23	160	54
Hot Springs, SD	4	-	-	-	-	1	-	4	-
Cascade Springs, SD	5	1	-	3	-	8	-	17	-
Lusk, WY	6	-	-	-	-	1	2	4	11
Newcastle, WY	7	6	-	9	-	21	-	34	-
Osage, WY	8	5	3	10	6	64	18	85	34
Upton, WY	9	11	3	19	6	56	17	85	36
Sundance, WY	10	6	-	11	-	29	-	50	-
Gillette Well Field, WY	11	45	-	64	-	140	-	190	-
Devils Tower, WY	12	30	-	49	-	93	-	130	-
Hulett, WY	13	25	-	42	-	80	-	110	-
Crook County Site, WY	14	110	6	140	13	180	33	210	56
Bell Creek, MT	15	18	3	33	6	62	22	92	51
Belle Fourche, SD	16	3	-	7	1	18	5	33	14
Spearfish, SD	17	-	-	1	-	6	-	19	-

Note: A dash (-) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations are shown on Map 3-9.

Table 5-10

CALCULATED WATER-LEVEL DECLINES, PLAN 6, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year): 5 Years (1990)		10 Years (1995)		25 Years (2010)		50 Years (2035)	
		Madison	Inyan Kara	Madison	Inyan Kara	Madison	Inyan Kara	Madison	Inyan Kara
Niobrara County Site, WY	1	290	-	330	3	420	17	470	48
Edgemont, SD	2	61	1	93	2	140	8	170	19
Provo, SD	3	77	2	110	5	160	20	200	47
Hot Springs, SD	4	7	-	12	-	22	-	34	-
Cascade Springs, SD	5	20	-	36	-	58	-	78	-
Lusk, WY	6	-	-	1	-	6	-	19	2
Newcastle, WY	7	5	-	7	-	20	-	29	-
Osage, WY	8	7	2	12	3	58	9	74	19
Upton, WY	9	12	2	21	4	55	12	79	28
Sundance, WY	10	8	-	15	-	38	-	59	-
Gillette Well Field, WY	11	40	-	55	-	120	-	160	-
Devils Tower, WY	12	31	-	47	-	85	-	120	-
Hulett, WY	13	27	-	42	-	75	-	100	-
Crook County Site, WY	14	98	2	120	6	150	18	180	36
Bell Creek, MT	15	21	2	34	4	59	15	86	39
Belle Fourche, SD	16	5	-	9	-	23	2	40	13
Spearfish, SD	17	2	-	3	-	11	-	28	-

Note: A dash (-) indicates a calculated water-level decline of less than 1 foot.

[a]Exact locations are shown on Map 3-9.

TABLE 5-11

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW
PLAN 1, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year)			
		5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Little Missouri River at the Montana-Wyoming State Line	18	0.5	0.5	0.5	0.5
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	1	1	2	2
Sand Creek (entire drainage basin)	20	0.5	0.5	1	2
Crow Creek Springs, SD	21	0.5	0.5	0.5	1
Spearfish Creek (entire drainage basin)	22	0.5	0.5	0.5	1
Stockade-Beaver Creek (entire drainage basin)	23	0.5	0.5	0.5	0.5
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5	1	1
Cascade Springs, SD	25	1	1	2	4
Hot Springs, SD	26	0.5	0.5	1	2

[a]Exact locations are shown on Map 3-9.

TABLE 5-12

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW
PLAN 2, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year)			
		5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Little Missouri River at the Montana-Wyoming State Line	18	0.5	0.5	1	1
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	2	2	2	3
Sand Creek (entire drainage basin)	20	1	1	3	4
Crow Creek Springs, SD	21	0.5	0.5	1	1
Spearfish Creek (entire drainage basin)	22	0.5	0.5	1	1
Stockade-Beaver Creek (entire drainage basin)	23	0.5	0.5	1	1
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5	1	1
Cascade Springs, SD	25	0.5	1	1	2
Hot Springs, SD	26	0.5	0.5	1	1

[a]Exact locations are shown on Map 3-9.

TABLE 5-13

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW
PLAN 3, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year) 5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Little Missouri River at the Montana-Wyoming State Line	18	1	1	1	1
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	2	3	4	4
Sand Creek (entire drainage basin)	20	1	1	3	4
Crow Creek Springs, SD	21	0.5	1	1	2
Spearfish Creek (entire drainage basin)	22	0.5	0.5	1	1
Stockade-Beaver Creek (entire drainage basin)	23	0.5	0.5	1	1
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5	0.5	0.5
Cascade Springs, SD	25	0.5	0.5	0.5	0.5
Hot Springs, SD	26	0.5	0.5	0.5	0.5

[a]Exact locations are shown on Map 3-9.

TABLE 5-14

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW
PLAN 4, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year)			
		5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Little Missouri River at the Montana-Wyoming State Line	18	1	1	1	1
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	2	3	4	4
Sand Creek (entire drainage basin)	20	1	2	3	5
Crow Creek Springs, SD	21	0.5	1	1	2
Spearfish Creek (entire drainage basin)	22	0.5	0.5	1	2
Stockade-Beaver Creek (entire drainage basin)	23	0.5	0.5	1	1
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5	0.5	0.5
Cascade Springs, SD	25	0.5	0.5	0.5	0.5
Hot Springs, SD	26	0.5	0.5	0.5	0.5

[a]Exact locations are shown on Map 3-9.

TABLE 5-15

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW
PLAN 5, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year)			
		5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Little Missouri River at the Montana-Wyoming State Line	18	1	1	1	1
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	2	2	3	4
Sand Creek (entire drainage basin)	20	0.5	1	2	3
Crow Creek Springs, SD	21	0.5	0.5	1	2
Spearfish Creek (entire drainage basin)	22	0.5	0.5	1	1
Stockade-Beaver Creek (entire drainage basin)	23	0.5	0.5	0.5	0.5
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5	0.5	1
Cascade Springs, SD	25	0.5	0.5	1	2
Hot Springs, SD	26	0.5	0.5	0.5	1

[a]Exact locations are shown on Map 3-9.

TABLE 5-16

NEW PARAMETER ESTIMATES USED IN MADISON AQUIFER MODEL FOR PLAN 6

Parameter	Value Used in Plans 1 through 5	Value Used in Plan 6	Basis for Change in Plan 6
Transmissivity of the Madison aquifer	0.03 ft^2/sec	0.03 ft^2/sec in the vicinity of the Niobrara County well field, 0.045 ft^2/sec in the vicinity of the Crook County well field	- Gillette well field pump test results showing high transmissivity - High yield Madison well recently drilled by ETSI at the Crook County well field - Overestimation of historical drawdowns in the Madison aquifer at Osage, Upton, and Newcastle when value of 0.03 ft^2/sec is used - Madison pump tests at Newcastle and Osage showing high transmissivity - Geochemical age of Madison ground water near Osage and Newcastle, based on isotope geochemistry, is less than 100 years before present (B.P.) (Fitzwater 1980, 1981) - Cooley, Neff, and Konikow (1980) used value of 0.07 ft^2/sec for Madison in Crook County area
Leakage coefficient between the Madison and Minnelusa aquifers	10^{-10} sec^{-1} where the upper Minnelusa contains less than 50 percent evaporites; 10^{-11} sec^{-1} where the upper Minnelusa contains more than 50 percent evaporites	10^{-11} sec^{-1} where the upper Minnelusa contains less than 50 percent evaporites; 10^{-13} sec^{-1} where upper Minnelusa contains more than 50 percent evaporites	- Study by Eisen (1981) shows that 10^{-11} sec^{-1} is upper bound for leakage coefficient based on water quality data. Eisen (1981) shows that in some areas northwest of the Black Hills, potentials in the Minnelusa aquifer are greater than those in the Madison aquifer. Also, he can show that the observed water quality is inconsistent when a leakage coefficient of 10^{-10} sec^{-1} is used - Gries' (1980) work on Minnelusa Formation - Tenney (1966) and his mapping of the various lithologic facies of the Minnelusa Formation
Leakage coefficient of the Upper Confining Unit	4 x 10^{-12} sec^{-1}	10^{-12} sec^{-1}	- Lithologically similar strata 1000 feet thick in western South Dakota is shown by Bredehoeft and Neuzil (1980) to have an average leakage coefficient of 10^{-12} sec^{-1}
Monocline transmissivity reduction factor	0.01	0.018	- Mean value in probability function of Section 7, Well Field Hydrology Technical Report (WCC 1981b)

TABLE 5-17

CALCULATED REDUCTIONS IN SPRING AND STREAM FLOW
PLAN 6, CUMULATIVE CASE

Approximate Location[a]	Location No. (See Map 3-9)	Years After ETSI Begins Pumping (Calendar Year)			
		5 Years (1990)	10 Years (1995)	25 Years (2010)	50 Years (2035)
Little Missouri River at the Montana-Wyoming State Line	18	1	1	1	1
Belle Fourche River (Keyhole Reservoir to Wyoming-South Dakota State Line	19	2	2	3	4
Sand Creek (entire drainage basin)	20	0.5	0.5	1	2
Crow Creek Springs, SD	21	0.5	1	1	2
Spearfish Creek (entire drainage basin)	22	0.5	1	1	2
Stockade-Beaver Creek (entire drainage basin)	23	0.5	1	1	2
Cheyenne River (upstream of Angostura Reservoir)	24	0.5	0.5	1	1
Cascade Springs, SD	25	1	1	2	3
Hot Springs, SD	26	1	1	2	2

[a]Exact locations are shown on Map 3-9.

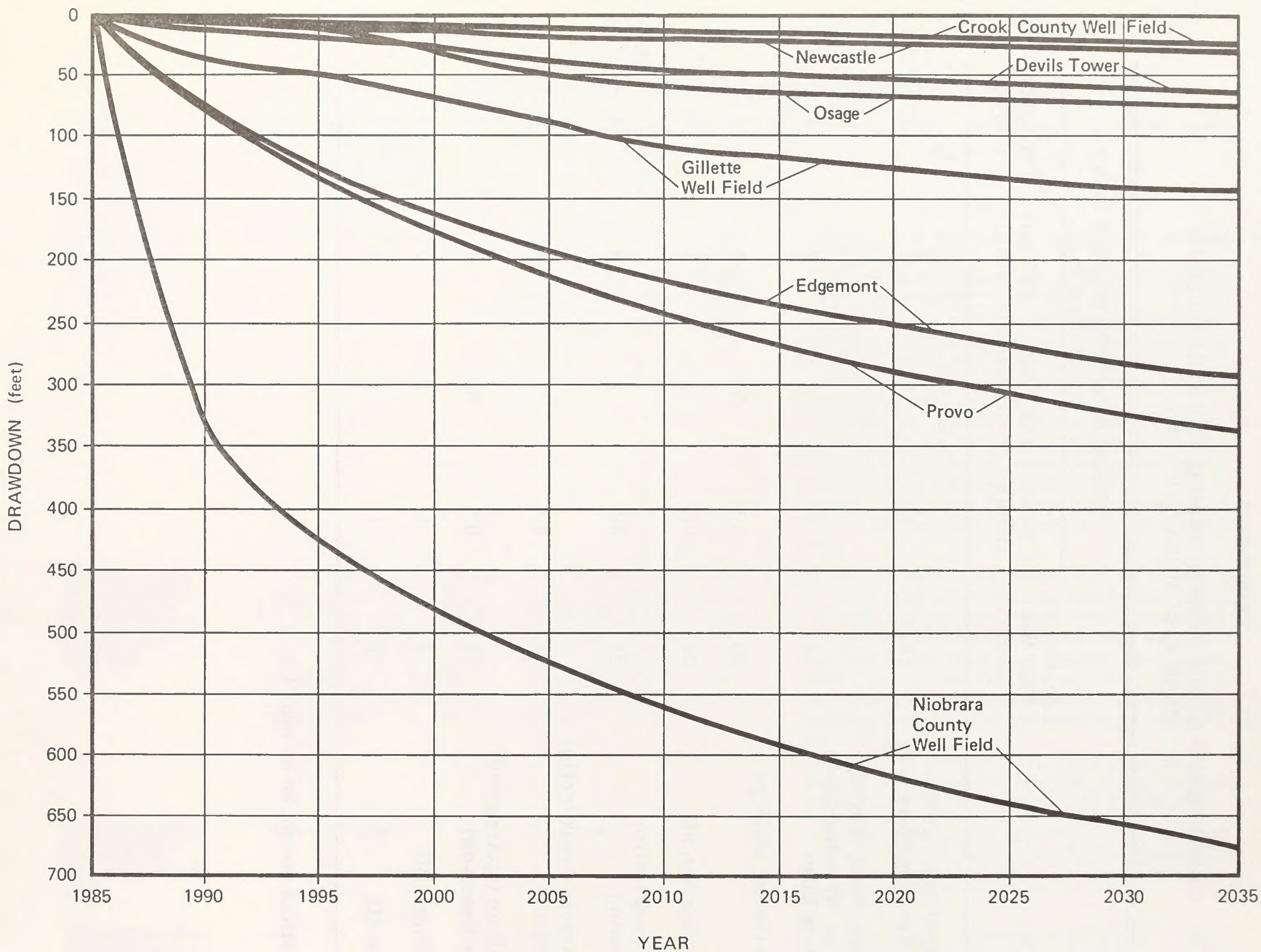


Figure 5-2. TIME-DRAWDOWN PLOT FOR THE MADISON AQUIFER FOR PUMPING BY EXISTING AND PLANNED USERS, WITH ETSI PUMPING FROM NIOBRARA COUNTY WELL FIELD ONLY (PLAN 1)

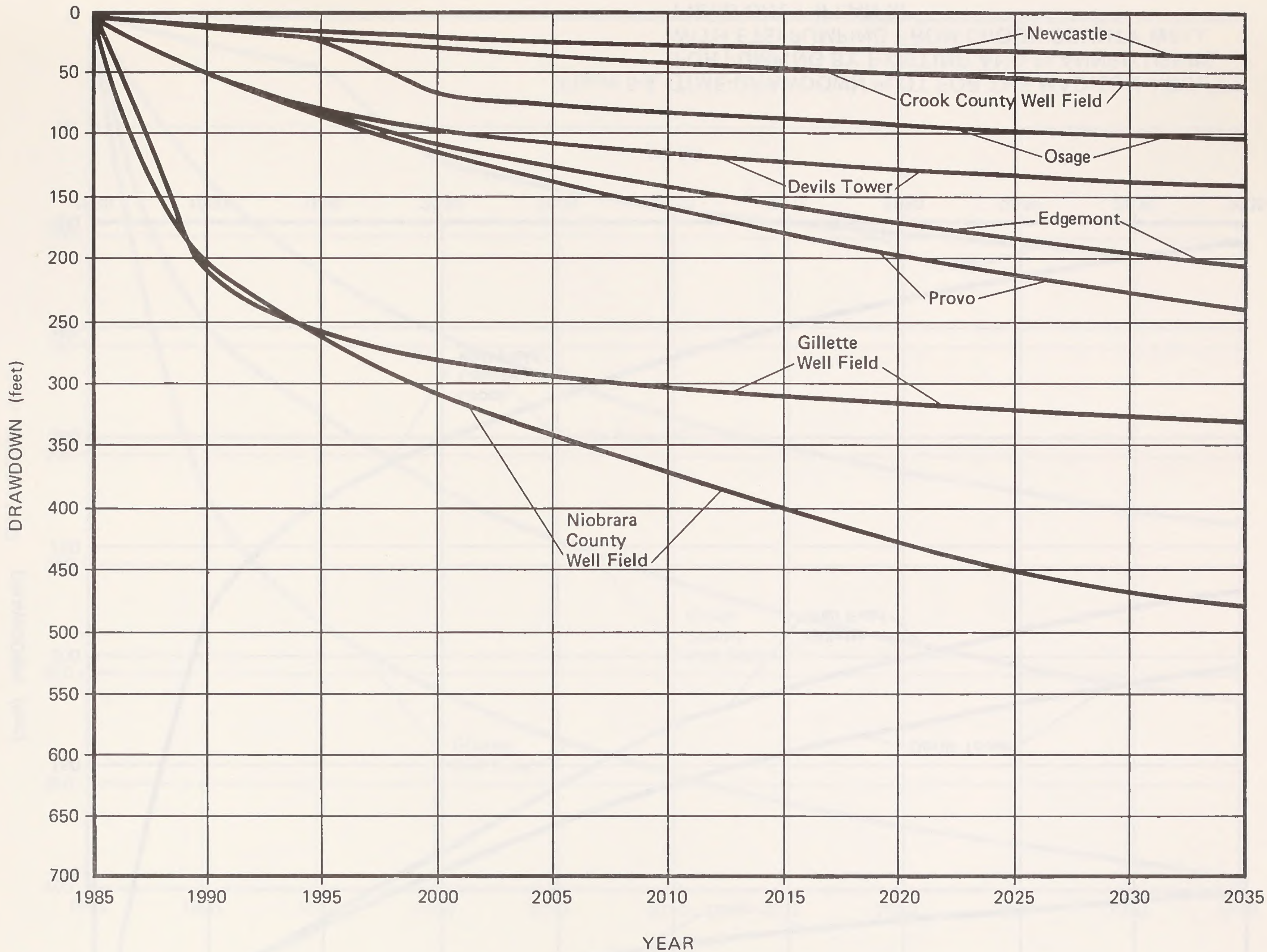


Figure 5-3. TIME-DRAWDOWN PLOT FOR THE MADISON AQUIFER FOR PUMPING BY EXISTING AND PLANNED USERS, WITH ETSI PUMPING FROM BOTH NIOBRARA COUNTY AND GILLETTE WELL FIELDS (PLAN 2)

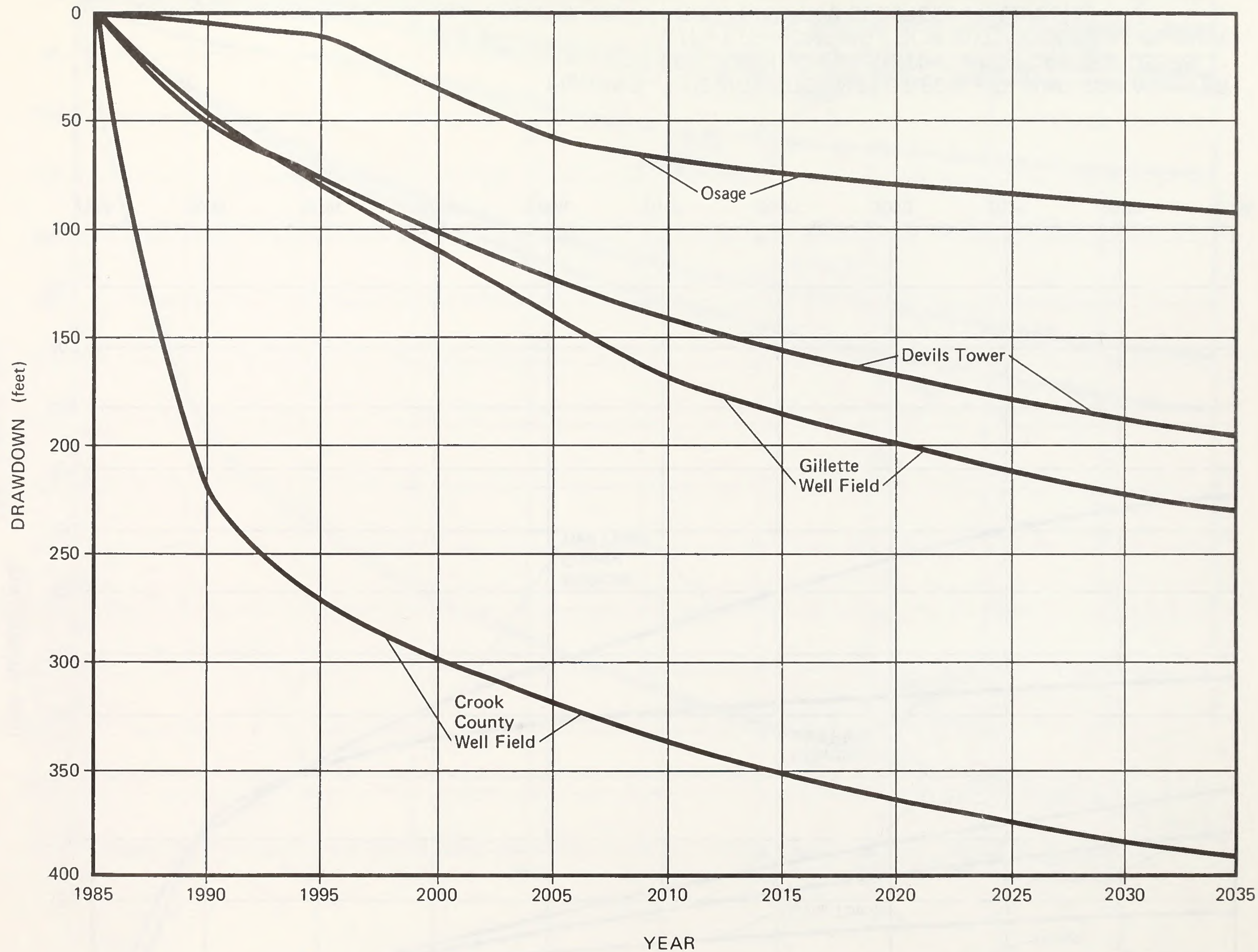


Figure 5-4. TIME-DRAWDOWN PLOT FOR THE MADISON AQUIFER FOR PUMPING BY EXISTING AND PLANNED USERS, WITH ETSI PUMPING FROM CROOK COUNTY WELL FIELD ONLY (PLAN 3)

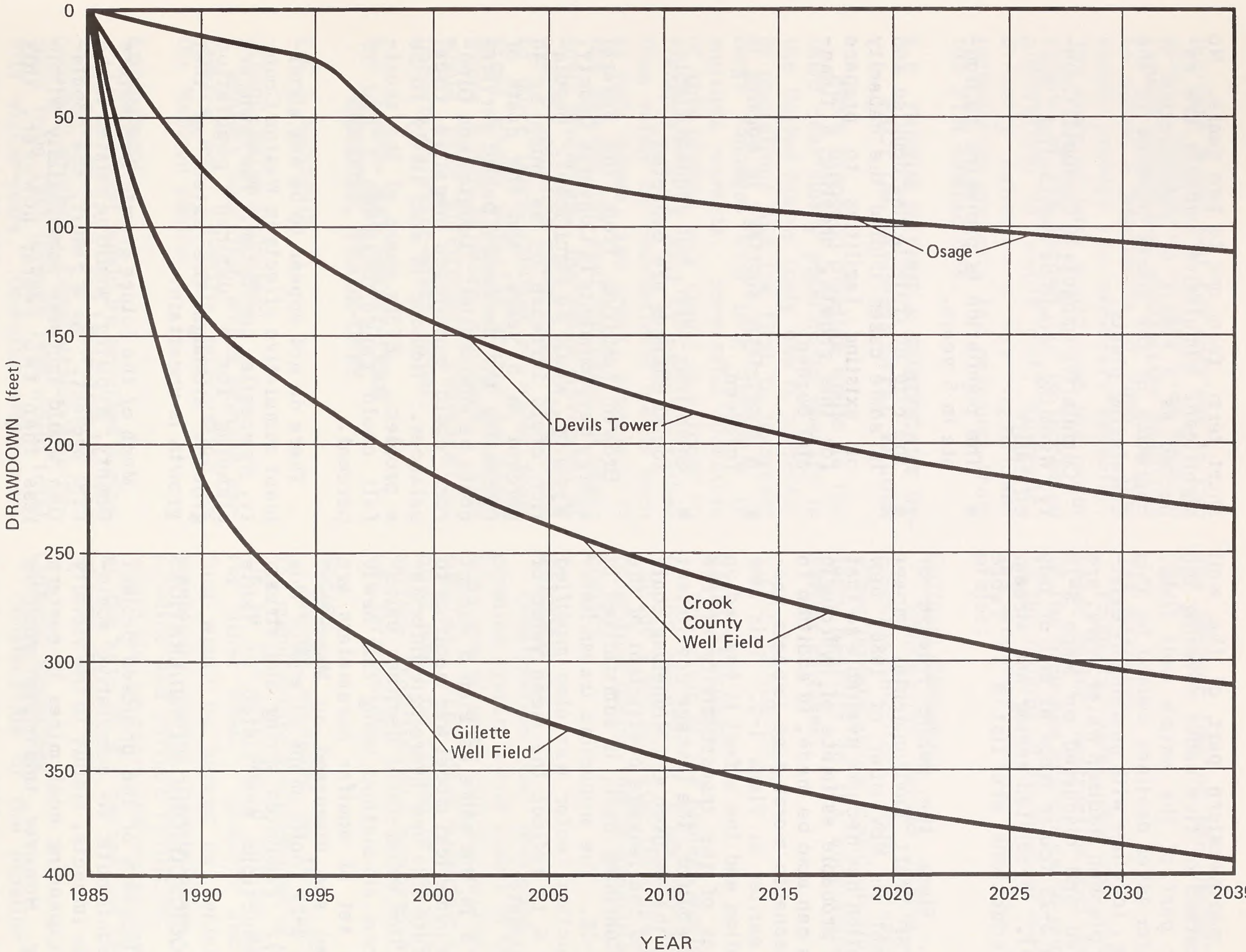


Figure 5-5. TIME-DRAWDOWN PLOT FOR THE MADISON AQUIFER FOR PUMPING BY EXISTING AND PLANNED USERS, WITH ETSI PUMPING FROM BOTH CROOK COUNTY AND GILLETTE WELL FIELDS (PLAN 4)

in the southwestern part of the well field instead of five nodes covering the greater part of the entire well field. The water-level declines caused by this pumping, together with pumping by existing and planned Madison water users, are presented and discussed on Maps 5-19 through 5-22 (color maps at end of this chapter). Predicted spring and stream flow reductions are listed in Table 5-15.

Plan 6. Since the public release of the ETSI Draft Environmental Impact Statement in November of 1980, new information has become available so that a more probable estimate of hydrologic impacts can also be made, in addition to the reasonable worst-case impacts presented earlier in Plans 1-5. This new information and the effect it has had on estimates of the transmissivity of the Madison aquifer, the leakage coefficient between the Madison and Minnelusa aquifers, and the leakage coefficient of the Upper Confining unit, is summarized in Table 5-16. The monocline transmissivity reduction factor was also modified in Plan 6 to reflect the mean value of this parameter.

Plan 6 is the same as Plan 5 except that the numerical model was modified to incorporate this new hydrologic information. The water-level declines calculated from simulations using this newly updated set of aquifer parameters are presented and discussed on Maps 5-23 through 5-26 (color maps at end of this chapter). Predicted spring and stream flow reductions are listed in Table 5-17.

5.A.2 SOCIOECONOMIC CONSIDERATIONS

Construction of the proposed project would contribute to cumulative socioeconomic impacts, mainly in the vicinity of the expanding coal mines in eastern Wyoming. However, this impact would be short term, from one to two years. No significant cumulative impacts are expected as a result of construction or operation of the slurry pipeline or the dewatering plants.

Cumulative impacts in Campbell County, Wyoming, would be substantial. Specifically:

- The population is projected to double in 5 years.
- The city of Gillette has doubled and in some cases tripled the capacity of existing facilities to prepare for this growth, creating a financial burden.
- A short-term shortage in housing is foreseen.
- Some long-term, but unquantifiable, social changes are expected.

Growth resulting from the several energy developments in Converse County, Wyoming, would be significant. Population could increase by as much as 40 percent in 5 years, and the costs of increasing the necessary public services could be substantial. Douglas and Glenrock could experience negative fiscal balances. Housing is also likely to be a problem. ETSI's share of the shortfall could range between 1 and 10 percent.

There do not appear to be any significant cumulative effects in Weston County, Newcastle, and Upton. The towns are planning for a "desired" population growth, although the extent of that growth is uncertain.

Much of the future growth in Niobrara County, Wyoming, would be related to the ETSI project. As a result, the population would increase substantially within less than two years; however, this increase would last for only one to two years. Plans have already been made to expand water and wastewater facilities to serve a population of 3000. This should provide the necessary capacity. The town of Lusk would bear the major portion of the burden due to increased population; it would not, however, directly experience any significant increase in property tax revenues from the ETSI components.

5.B TRENDS HAVING A SIGNIFICANT IMPACT ON ENVIRONMENTAL VALUES

ETSI's proposed pipeline would be the third coal slurry pipeline to operate in the United States (only one is currently in operation) and the first to transport large tonnages over long distances to multiple markets. Successful operation of this project may result in a trend to transport more coal by pipeline rather than solely by conventional means such as rail, barge, and truck, especially if the demand for coal increases as presently projected. Increased movement of coal by pipeline could result in a trend to move large volumes of water from areas where water is scarce to areas where water is more abundant. This would have significant, undetermined impacts on water-scarce areas.

5.C LONG- AND SHORT-TERM BENEFITS, TRADE-OFFS

5.C.1 BENEFITS

Ground-Water Hydrology

Project operation would provide extensive new scientific information on the Madison aquifer.

Employment

Employment would be provided during both construction and operation of the proposed project. Construction employment from 1983 through 1989 would total 9712 worker-years. Operation employment would total 37,650 person-years during the 50-year life of the project (53 x 50).

Tax Revenues

Property, sales, and use taxes imposed during construction and operation of the proposed project could contribute to the funding of government services in the counties crossed by the pipeline project.

Cultural Resources

Information gained during cultural resource inventory, data recovery, and other investigations would provide long-term benefits to the understanding of earlier cultures.

5.C.2 TRADE-OFFS

Water Resources

Operation of the project would result in the removal of 1,025,000 acre-feet (20,500 x 50) of water from the Madison formation during the 50-year life of the project.

Materials

Construction and operation of the pipeline system would result in the one-time use of some building materials and supplies. Many other materials and supplies could be reused or recycled when surface facilities are removed at project termination.

Energy

Energy expended on this project in the manufacture and transport of materials to the site would not be available for other uses. Gasoline and diesel fuel would be burned by vehicles and machinery during construction of the pipeline and surface facilities. Energy would also be consumed during operation, at the rate of 4.0 percent of the total energy transported.

Cultural Resources

Construction of the pipeline system could potentially destroy some unknown subsurface historical or archaeological remains. There would be a loss of knowledge because any excavated sites would be precluded from future scientific studies employing techniques not yet developed.

Visual Resources

The visual resources in the project area, primarily near surface facilities, would be adversely affected.

Some impacts would be short term (associated with the construction period), others would be long term, in some cases extending beyond the life of the project (e.g., recovery of the Madison Group potentiometric surface, and re-establishment of woodland areas).

5.D COMMITMENT OF RESOURCES

Construction and operation of the proposed project would result in the commitment of some environmental resources and energy. Environmental resources that would be committed include:

- Water. Loss of a maximum of 1 million acre-feet of water that would be unavailable for other uses.
- Vegetation. Loss of 6389 acres of woodland would be a long-term commitment of resources.
- Wildlife. Some wildlife and aquatic life would be irretrievably lost during project construction (short term). These would consist primarily of small terrestrial animals lost during right-of-way clearing and fish and aquatic invertebrates lost during construction at stream crossings. Production of wildlife habitat (vegetation) would also be lost until disturbed areas are reclaimed. At surface facilities, these losses would constitute a long-term commitment of resources. Aquatic resources of the Black Hills may also be seriously affected.
- Cultural Resources. Some subsurface sites may be irretrievably and permanently damaged or destroyed during construction. Mitigation through recovery of data requires the commitment of a resource to a use that may preclude future scientific studies employing techniques not yet developed.
- Steel. Since the pipeline would be left in the ground at the time of project abandonment, the 725,000 tons of steel used to form the pipeline would be a permanent commitment of this resource.
- Concrete. The estimated 90,000 cubic yards of concrete used to construct this project would be a permanent, irreversible commitment of this resource.
- Fuel. The fuel used in vehicles and other machinery during construction and operation would be a permanent, irreversible commitment of the resource.
- Energy. The proposed action would also consume energy at the rate of 664,000 Btu/ton of coal, which would be equivalent to 4.0 percent of the total energy (coal) transported.
- Paleontology. Destruction of paleontological resources would be an irreversible, permanent commitment of the resource.

5.E RELATIONSHIPS TO NATIONAL ENVIRONMENTAL POLICY ACT GOALS

Section 101 of the National Environmental Policy Act outlines a national environmental policy that all federal agencies are charged to carry out. In order to do this, the agencies must use all practicable means to ensure that their actions fulfill six goals. These goals are listed below and the relationships of the proposed action and its alternatives to these goals are discussed.

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations. The proposed action, Crook County well field alternative, and combined well-field alternative could affect ground-water levels in the Madison and Inyan Kara aquifers for a period of 100 years. This could affect the future beneficial use of these aquifers for agriculture, recreation, wildlife, and aquatic resources. Use of the Oahe and treated wastewater alternatives would not adversely affect the use of the environment by future generations. Use of the treated wastewater alternative could improve the environment by improving the quality of the streams the wastewater is removed from.

2. Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surrroundings. Neither the proposal nor any alternatives would hinder this goal from being achieved. Although the productivity of one area may be reduced as a result of the drawdown, if electrical rates are lowered as a result of the project or any of its alternatives, then the productivity of the market areas could be increased. None of the alternatives would result in the creation of an unhealthful situation. None of the alternatives would significantly change the existing esthetics or cultural surroundings.

3. Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences. Use of any of the well field alternatives has the potential for causing unintended consequences. The widest range of beneficial uses would be obtained by the use of the Oahe or wastewater alternatives. The Oahe alternative would provide the opportunity for communities to improve their water supply. Use of the treated wastewater alternative would apply a beneficial use to water that now has limited use. Use of the no-action all-rail alternative could increase the risk to health and safety from an increase in the number of trains and impact on communities as a result of increased train traffic.

4. Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice. Neither the proposed action nor any alternative would hinder achievement of this goal. Cultural and historic aspects would not be significantly affected by any alternative. All with the exception of no-action all-rail alternative would allow for variety and individual choice. The no-action alternative would not provide for a choice of long-distance coal transportation modes.

5. Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities. Operation of any of the alternatives or the proposed action would not significantly affect the

current population growth. If electrical rates are lowered or the rate increase slowed by implementation of any of the coal slurry alternatives, this would assist in maintaining the current standard of living, and sharing of life's amenities. Use of a non-well-field source of water, without potential impact on other users, would maintain a wide sharing of amenities.

6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources. Neither the proposal nor any of the alternatives would negatively or positively affect this goal. Use of the wastewater alternative, although resulting in recycling, does not involve the recycling of a depletable resource.

5.F CONFLICTS WITH LAND USE PLANS, CONTROLS, AND CONSTRAINTS

The proposed action and alternatives would cross areas under the jurisdiction of planning authorities responsible for preparation and documentation of plans for a variety of resources. These plans range from State Comprehensive Outdoor Recreation Plans (SCORP) to the plans of local, special-purpose districts. Numerous federal plans, including those developed for Bureau of Land Management (BLM) and Forest Service lands, also exist.

Rural lands designated by a state or federal agency for a special use, such as wilderness, recreation, agriculture, or grazing, have been reviewed and conflicts noted under the appropriate section. Specifically, the project plans present no conflicts with either BLM Management Framework Plans in Wyoming (Bessinger 1980) or Forest Service land-use plans for the Thunder Basin National Grassland (Olsen 1980).

City, county, and regional land-use plans have been collected and anticipated conflicts noted by local authorities. These plans serve generally as guidelines for development rather than as legally restrictive documents and have been found to accommodate utility-related development as a necessary element in the urban infrastructure.

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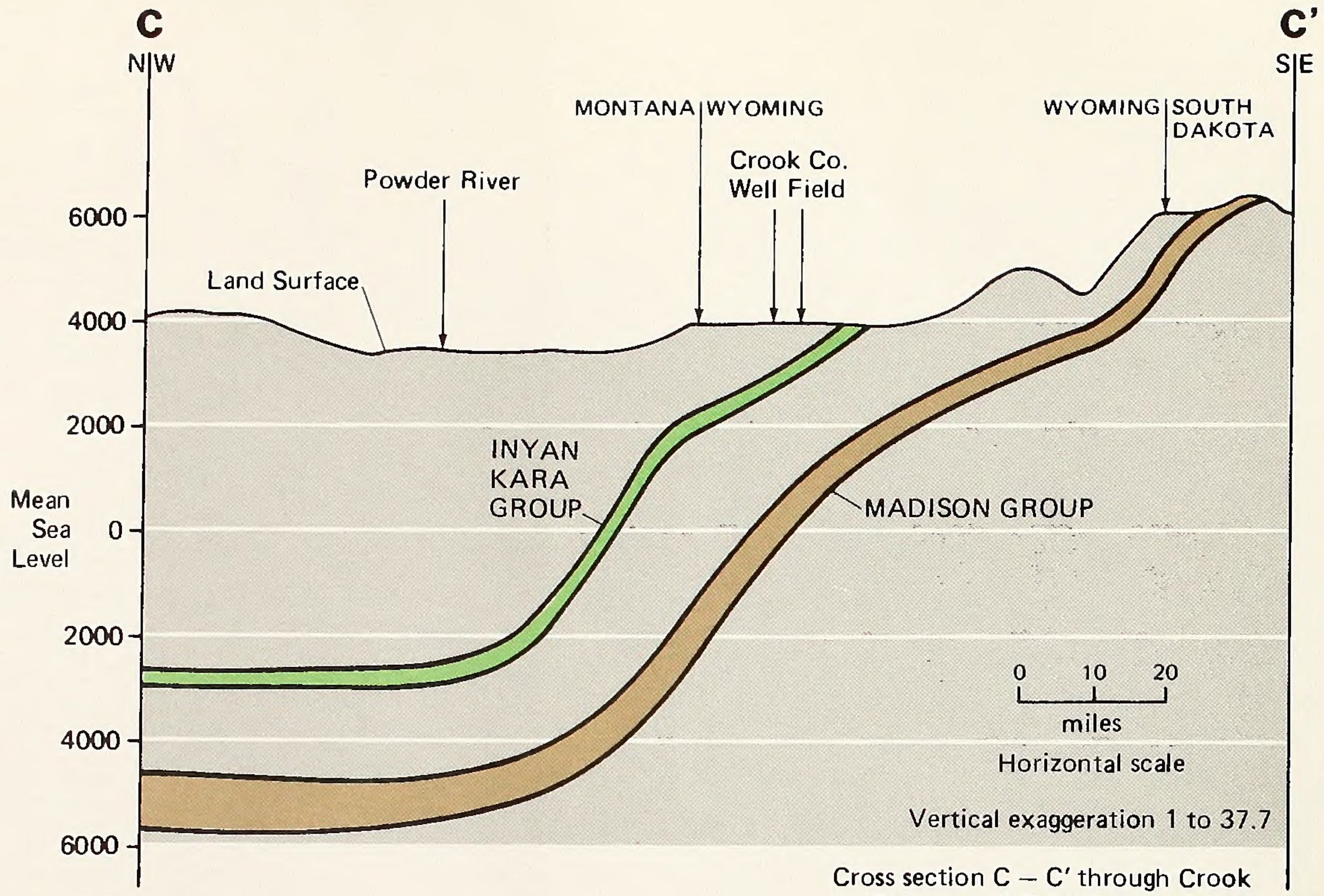
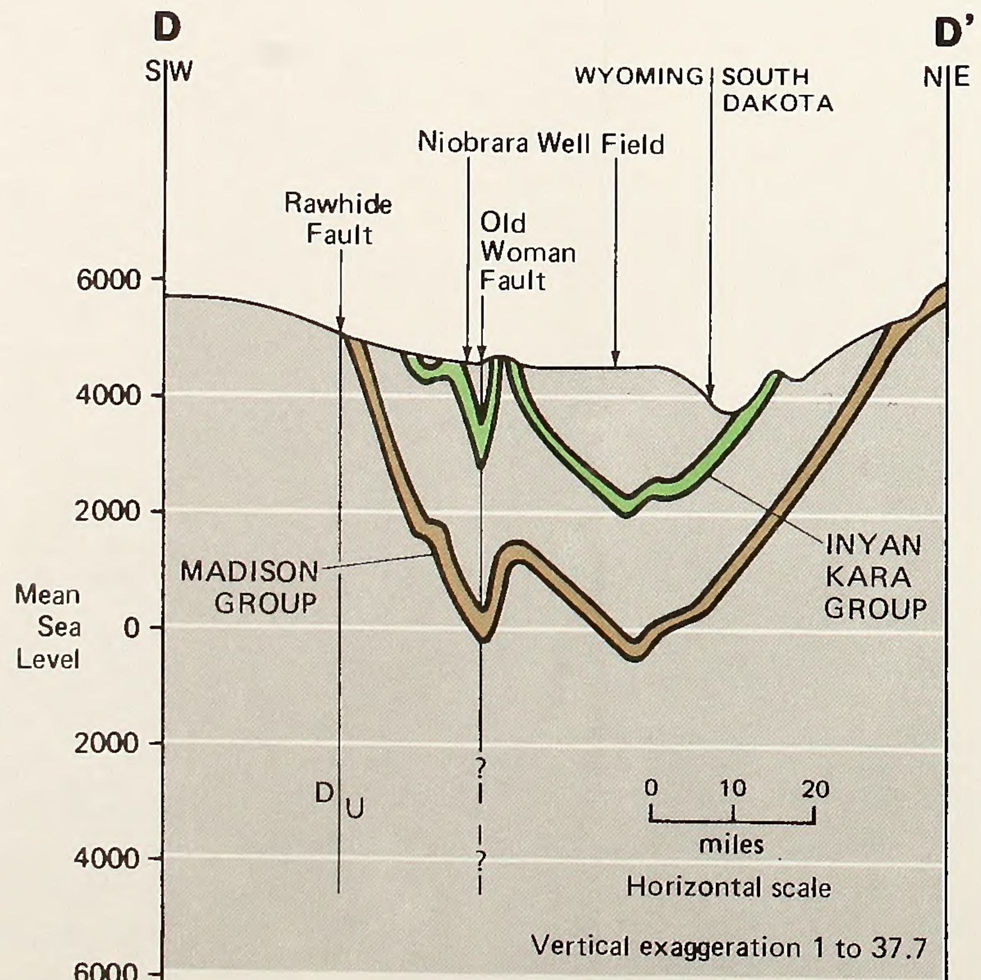
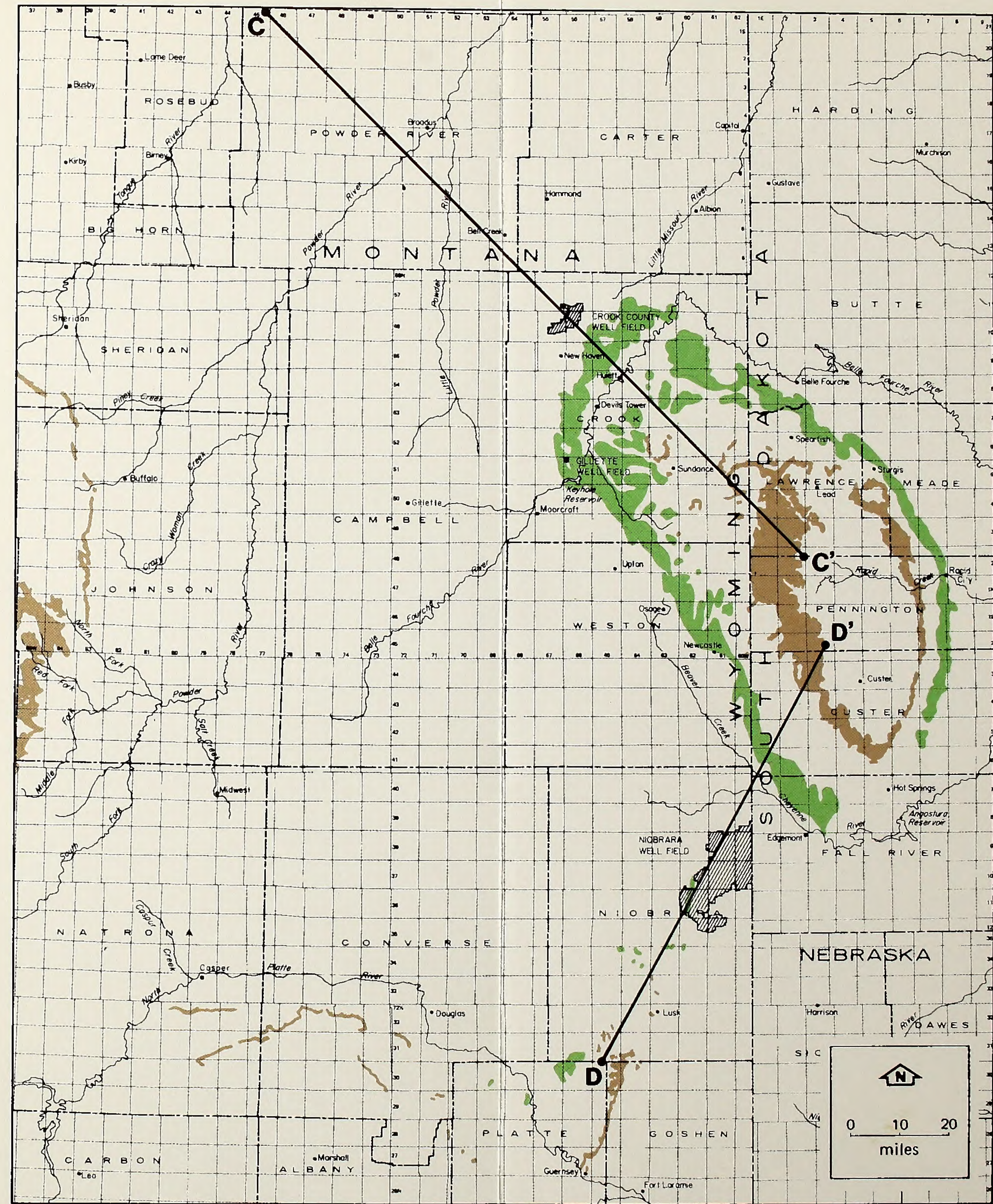


Cross section C – C' through Crook County well field showing Inyan Kara and Madison groups.



Cross section D – D' through Niobrara County well field showing Inyan Kara and Madison groups.

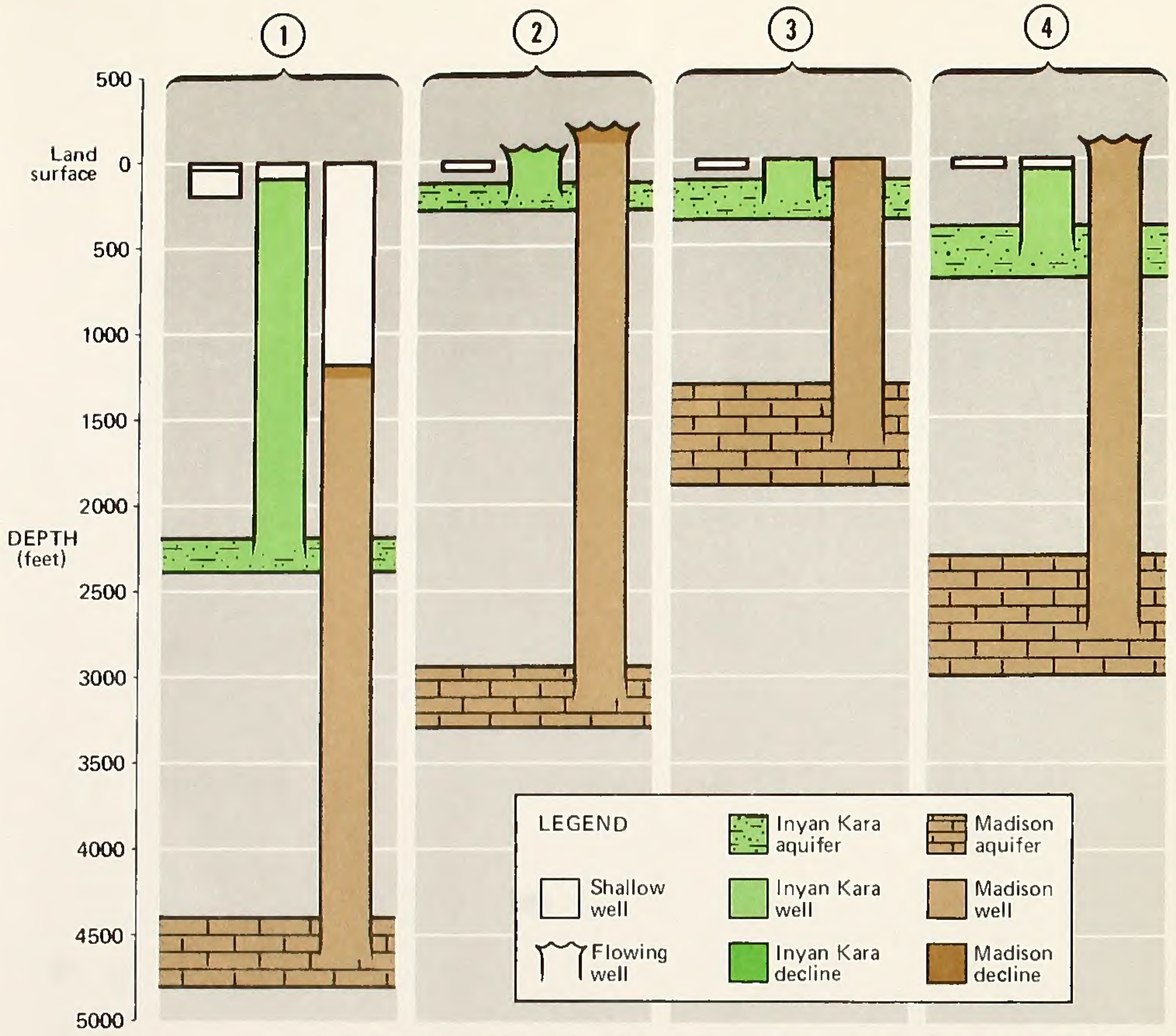
Cross sections C—C' and D—D' depict the relationships between the land surface, the Black Hills and Hartville uplifts, and the Inyan Kara and Madison strata. Outcrops of Inyan Kara and Madison strata form a narrow, elliptical band around the core of the Black Hills. Toward the southwest, the Madison also outcrops in the Hartville Uplift. Both the Inyan Kara and Madison groups dip westward from the outcrops on the western flanks of the Black Hills and toward the deeper parts of the Powder River Basin. The Inyan Kara Group is separated from the Madison by about 2000 feet of siltstone, limestone, sandstone, and shale. The rock units between the Madison and Inyan Kara generally yield little water to wells in the western Black Hills and eastern Powder River Basin region. Above the Inyan Kara Group can be more than 3000 feet of very low permeability shales. These shales hydraulically separate the Inyan Kara and Madison aquifers below from the shallow, near-surface aquifers above. The Inyan Kara and Madison aquifers are under unconfined (water-table) conditions in and near these outcrops, and confined (artesian) conditions away from these outcrop areas.



Inyan Kara Outcrop

Madison Outcrop

Figure 5-1. CROSS SECTIONS THROUGH THE CROOK COUNTY AND NIOBRARA COUNTY WELL FIELDS SHOWING THE STRATIGRAPHIC RELATIONSHIP BETWEEN THE INYAN KARA AND MADISON GROUPS



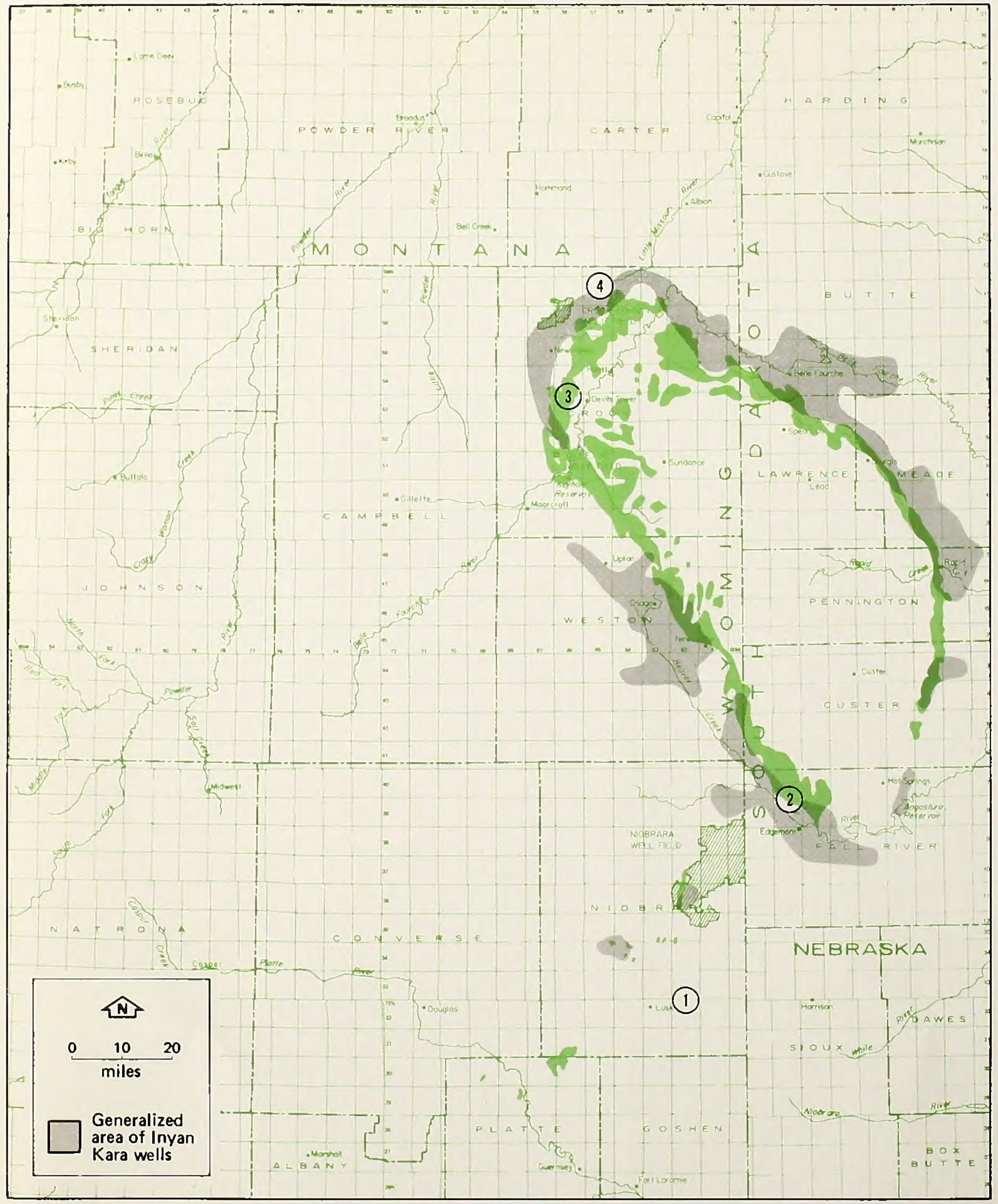
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

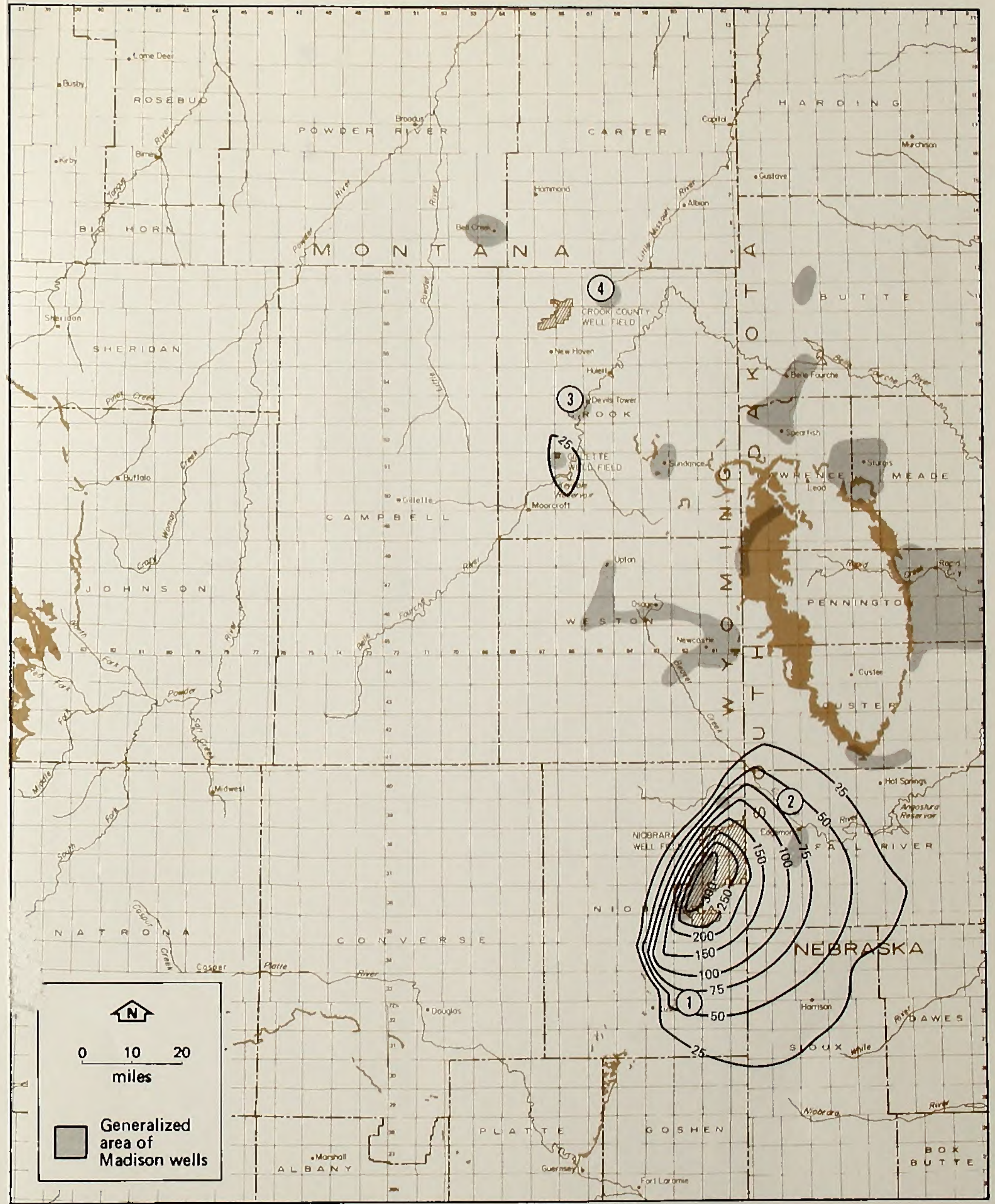
Water-level declines in the Inyan Kara aquifer as a result of ground-water withdrawals from the Madison aquifer were calculated to be 5 feet or less over the entire study area, except where confined (artesian) aquifer conditions exist near the Niobrara County well field (Table 5-5). Where the Inyan Kara aquifer is confined and near the Niobrara well field, Inyan Kara water-level declines are calculated to be no greater than 15 feet.

INYAN KARA

Calculated water-level declines in the Madison were concentrated in two areas: the Gillette well field near Moorcroft, Wyoming, and the Niobrara County well field (Table 5-5). About 40 feet of decline was calculated to occur in the Madison aquifer at the Gillette well field almost entirely as a result of pumping for the city of Gillette during the period 1985-1990. No water would be supplied to ETSI by Gillette under this pumping plan. Except for the vicinity of the Niobrara County well field and the Gillette well field, Madison water levels were calculated to be less than 15 feet, because ground-water withdrawals by other existing Madison water users near the Black Hills were projected to be relatively small (Table 3-4). Madison water levels were calculated to decline by about 340 feet in the Niobrara well field and by about 70 to 80 feet in the Edgemont-Provo, South Dakota, area during the period 1985-1990.

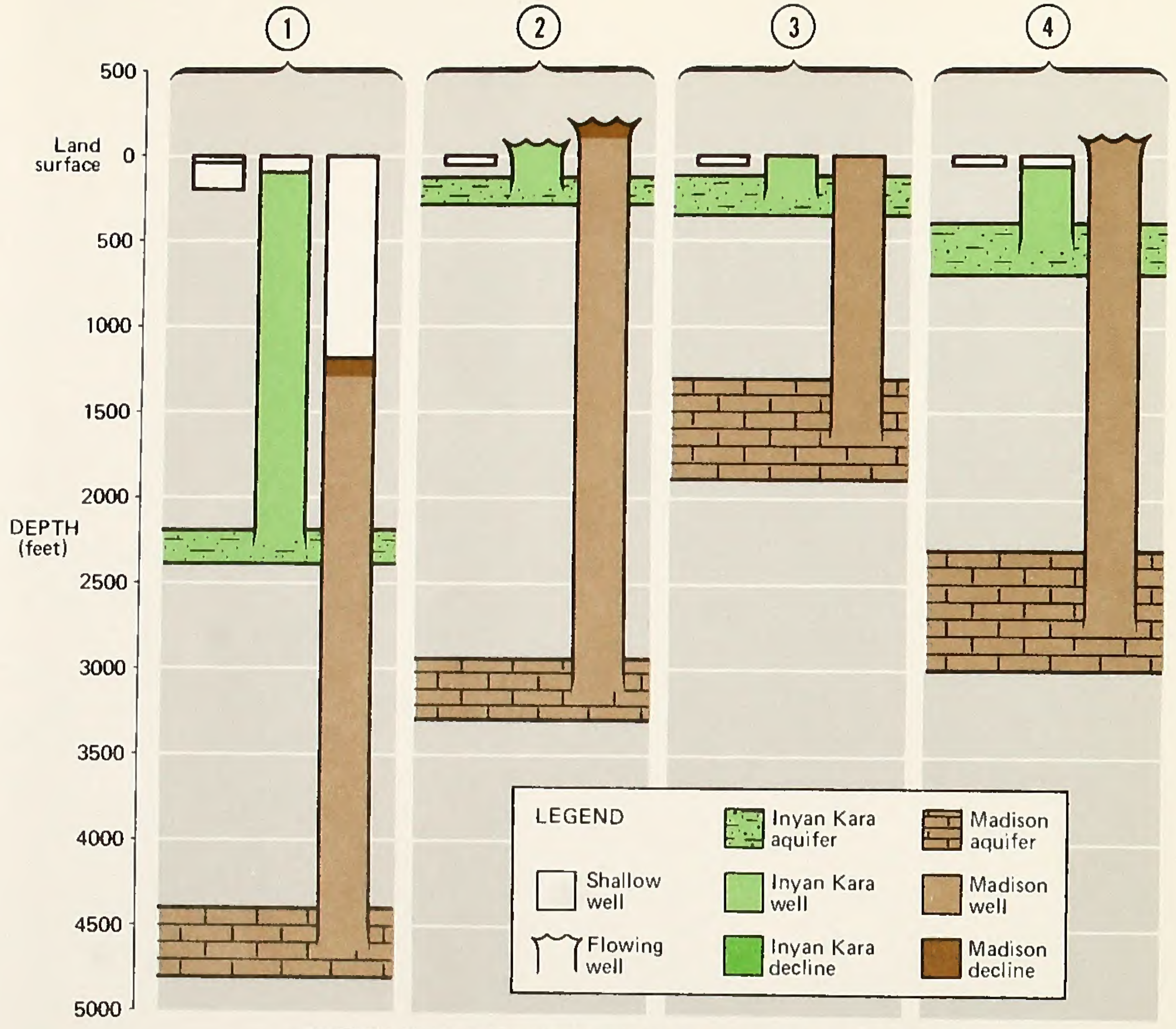
MADISON





Inyan Kara outcrop	(1) Location of typical wells of varying depths in affected aquifers	Cumulative case	Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI
Madison outcrop	25 Water-level declines (feet)	Plan 1	ETSI pumping from Niobrara County well field only

Map 5-3. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 5 YEARS, PLAN 1, CUMULATIVE CASE



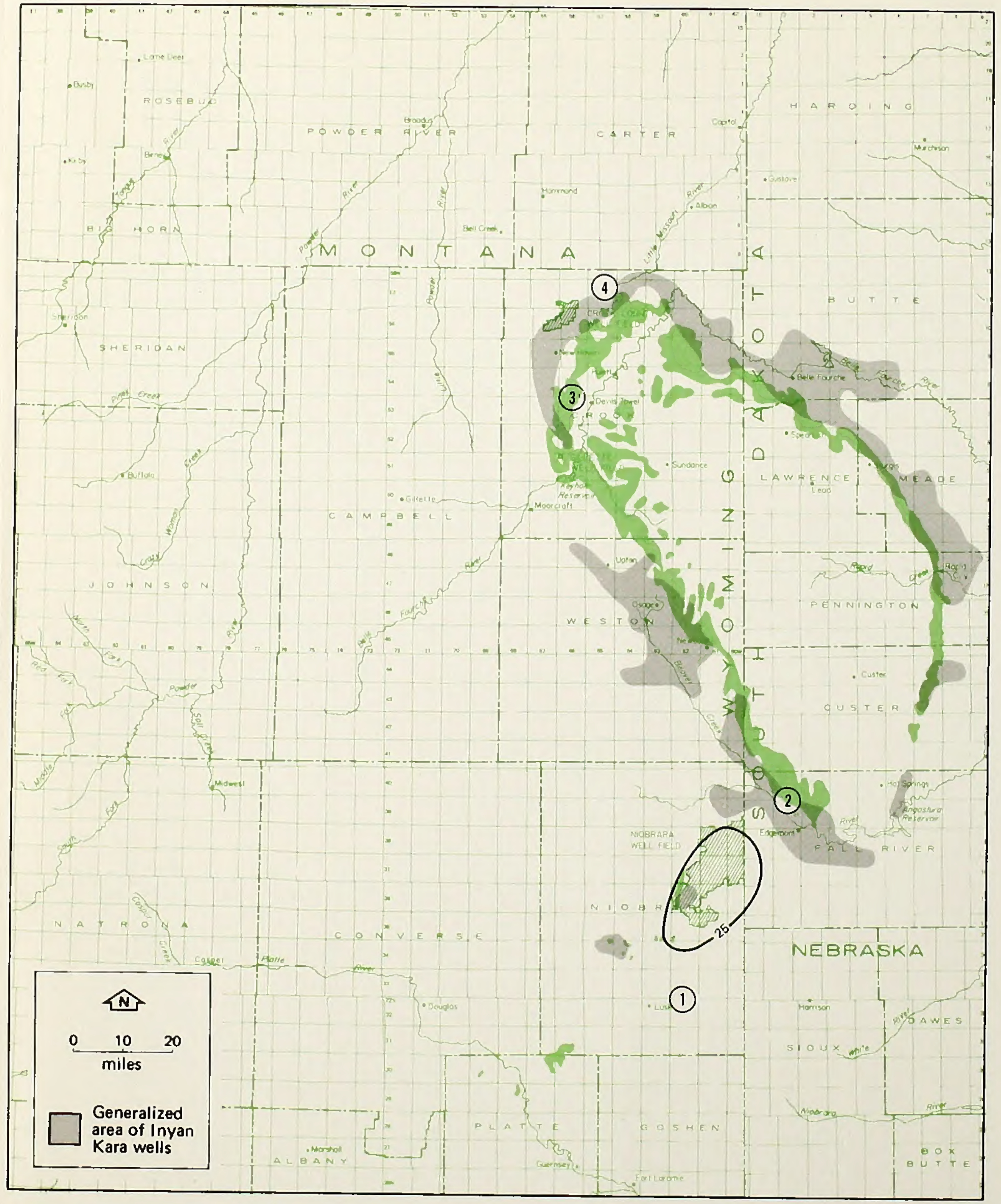
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

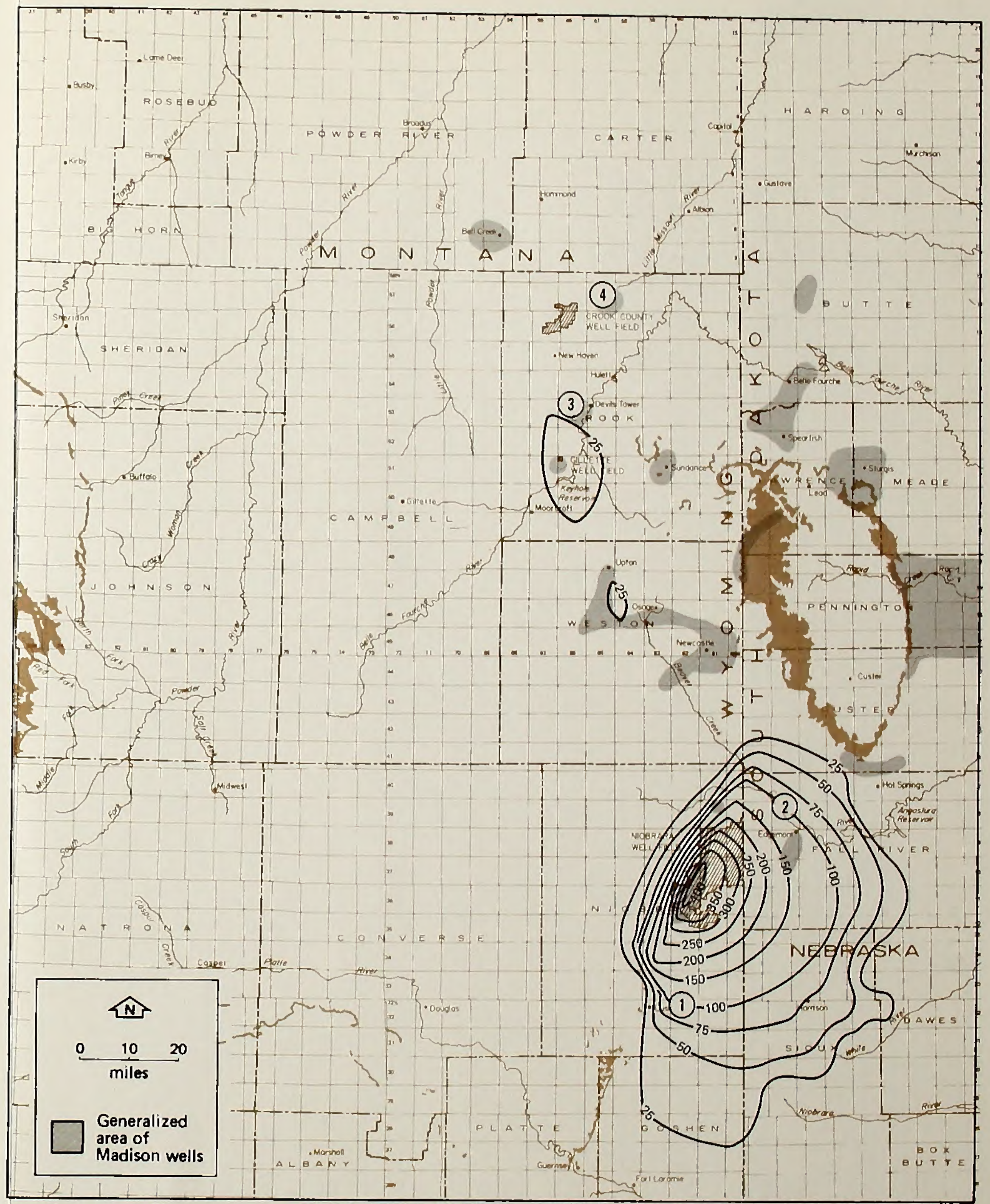
Of the Inyan Kara wells, only those within the ETSI Niobrara County well field were calculated to have more than 25 feet of drawdown as a result of pumping from the Madison aquifer (Table 5-5). Inyan Kara wells in the well-field area and under confined (artesian) aquifer conditions would have drawdowns of up to about 40 feet. No Inyan Kara wells in South Dakota, including those along the Cheyenne River, were calculated to have drawdowns exceeding 25 feet.

INYAN KARA

The areas affected by more than 25 feet of Madison water-level declines were similar to those described for the previous 5-year interval (Map 5-3). Madison wells at the Gillette well field and in the Edgemont-Provo area were calculated to have about 50 and 140 feet of drawdown, respectively (Table 5-5). Madison wells near Upton and Osage were calculated to have up to about 25 feet of drawdown. Water-level declines in Crook County were almost entirely due to pumping by other Madison users, especially the city of Gillette. Madison water wells at all locations, excluding those mentioned above and the ETSI well field, were calculated to have less than 20 feet of water-level decline.

MADISON





Inyan Kara outcrop

Madison outcrop

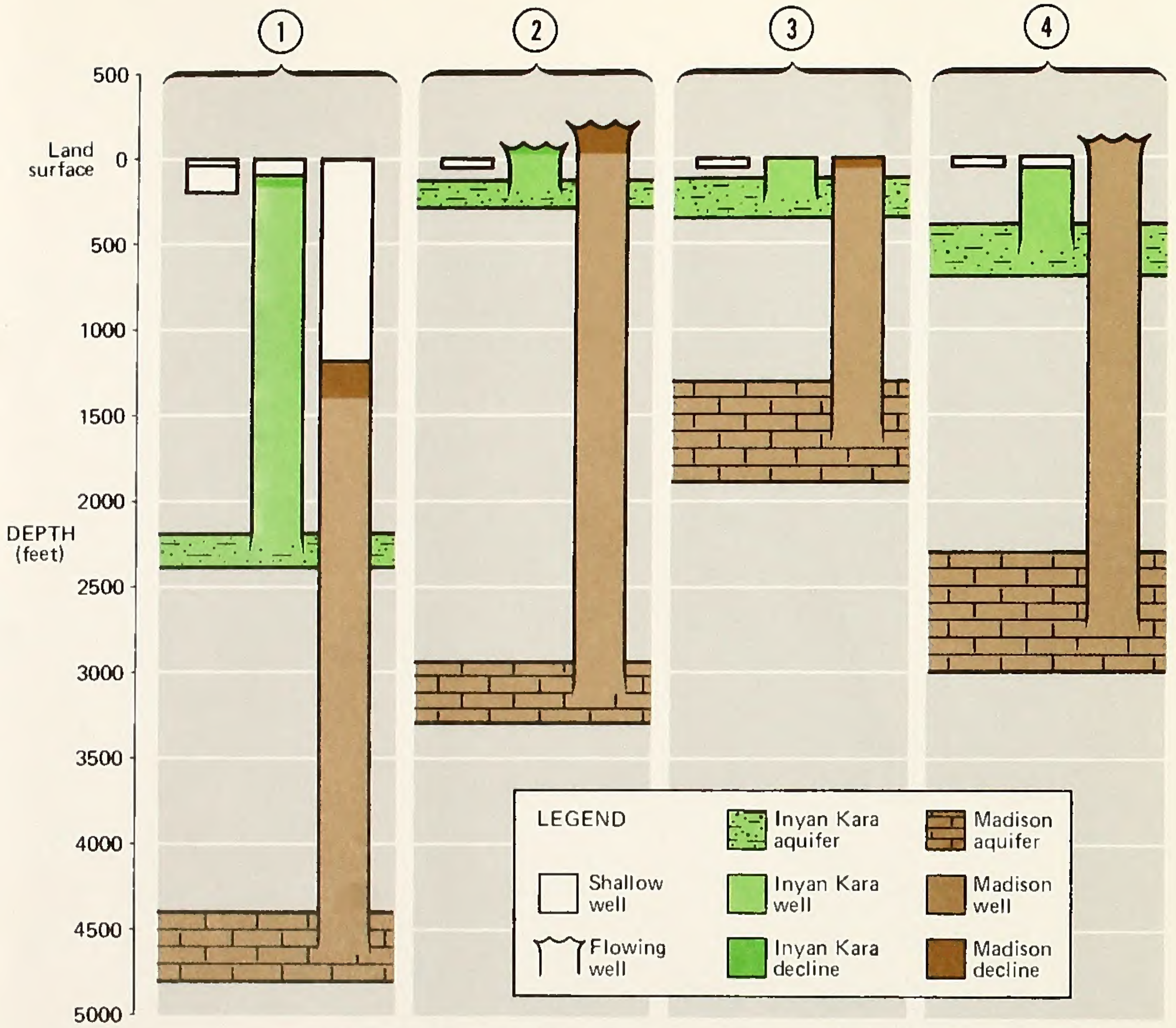
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 1 — ETSI pumping from Niobrara County well field only

Map 5-4. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 10 YEARS, PLAN 1, CUMULATIVE CASE



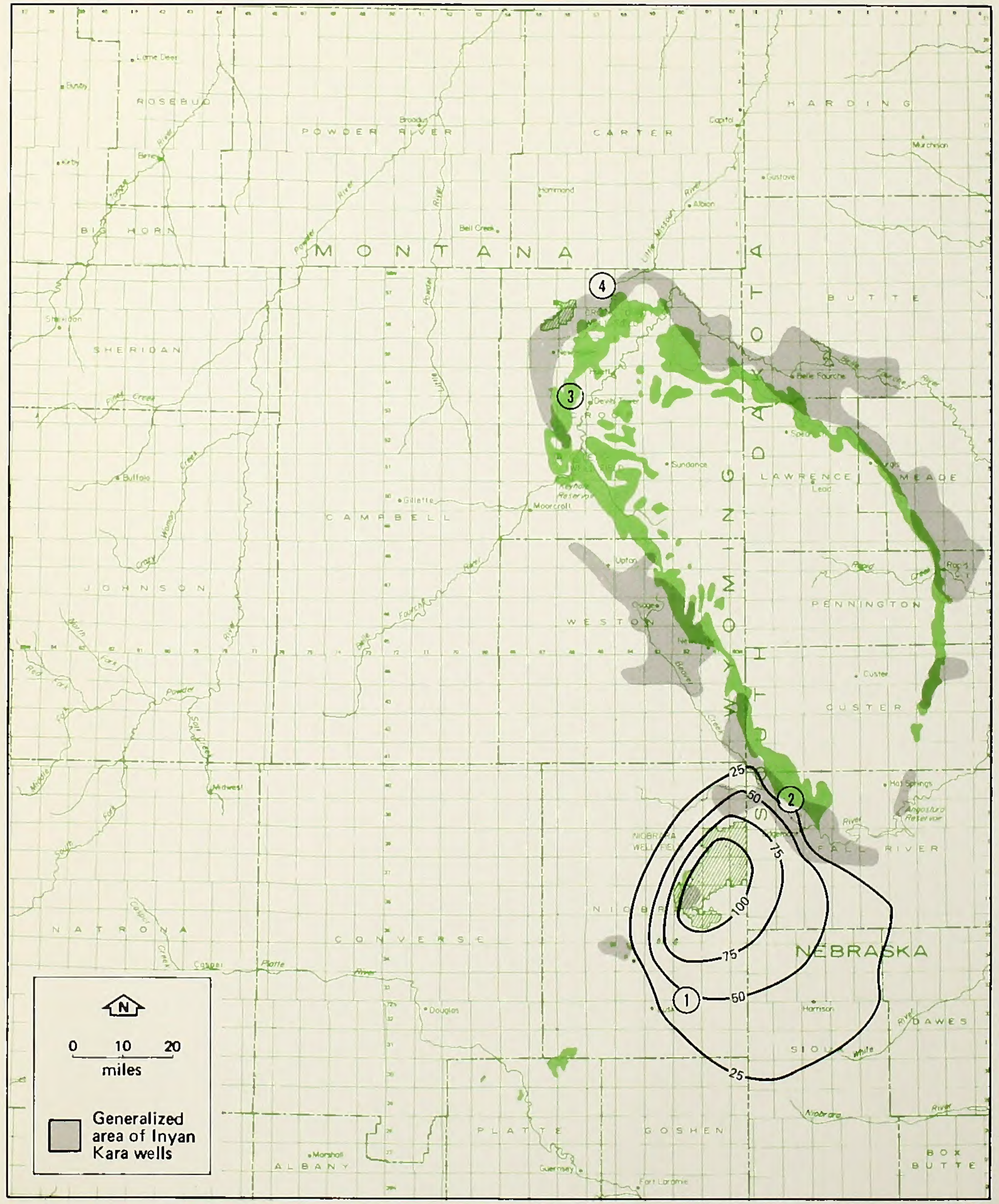
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

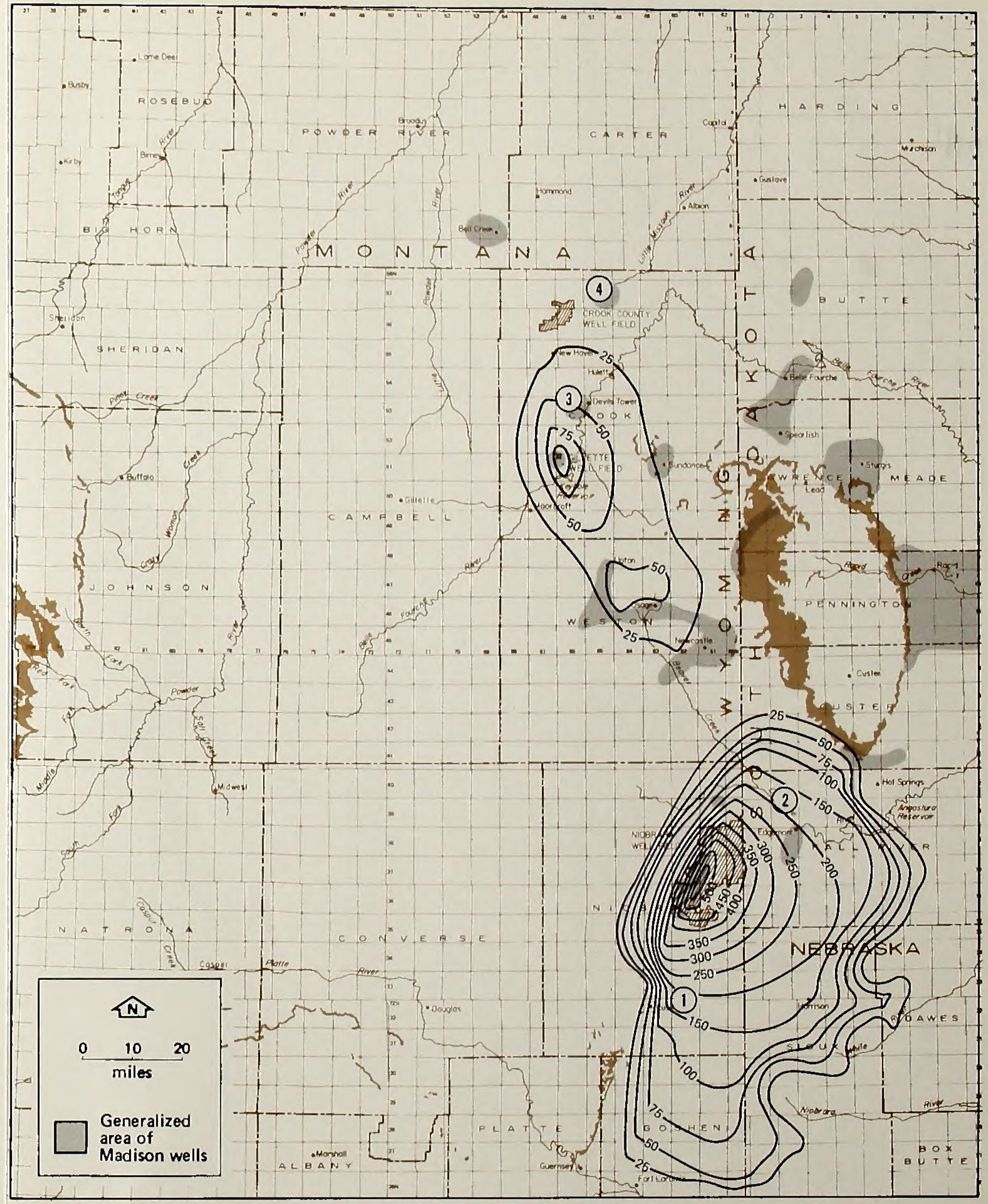
Calculated areas of Inyan Kara wells with more than 25 feet of drawdown were similar to those described for 10 years (Map 5-4), except for Inyan Kara wells south and west of the Cheyenne River in South Dakota (Table 5-5). Wells in confined parts of the Inyan Kara aquifer near the Niobrara County well field were calculated to have up to about 120 feet of drawdown. Wells in confined parts of the Inyan Kara aquifer south and west of the Cheyenne River were calculated to have up to about 75 feet of drawdown. North and east of the Cheyenne River, Inyan Kara water-level declines were calculated to be less than 25 feet. Less than 20 feet of drawdown was calculated to occur in the Inyan Kara aquifer in the Upton-Osage area.

INYAN KARA

The area of the Madison aquifer with more than 25 feet of drawdown was calculated to broaden from that area mapped at 10 years to include Upton and Osage (Table 5-5). Calculated Madison drawdowns in the Weston and Crook County areas were greatest at the Gillette well field (110 feet), with about 30 to 60 feet of decline near Upton, Osage, Hulett, and Devils Tower. These calculated drawdowns were largely due to simulated pumping by the city of Gillette at its well field near Moorcroft and to simulated pumping by Black Hills Power and Light near Osage. Calculated Madison water-level declines were greatest in the ETSI Niobrara County well field. Madison wells in the Edgemont-Provo area were calculated to have drawdowns of about 210 to 240 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

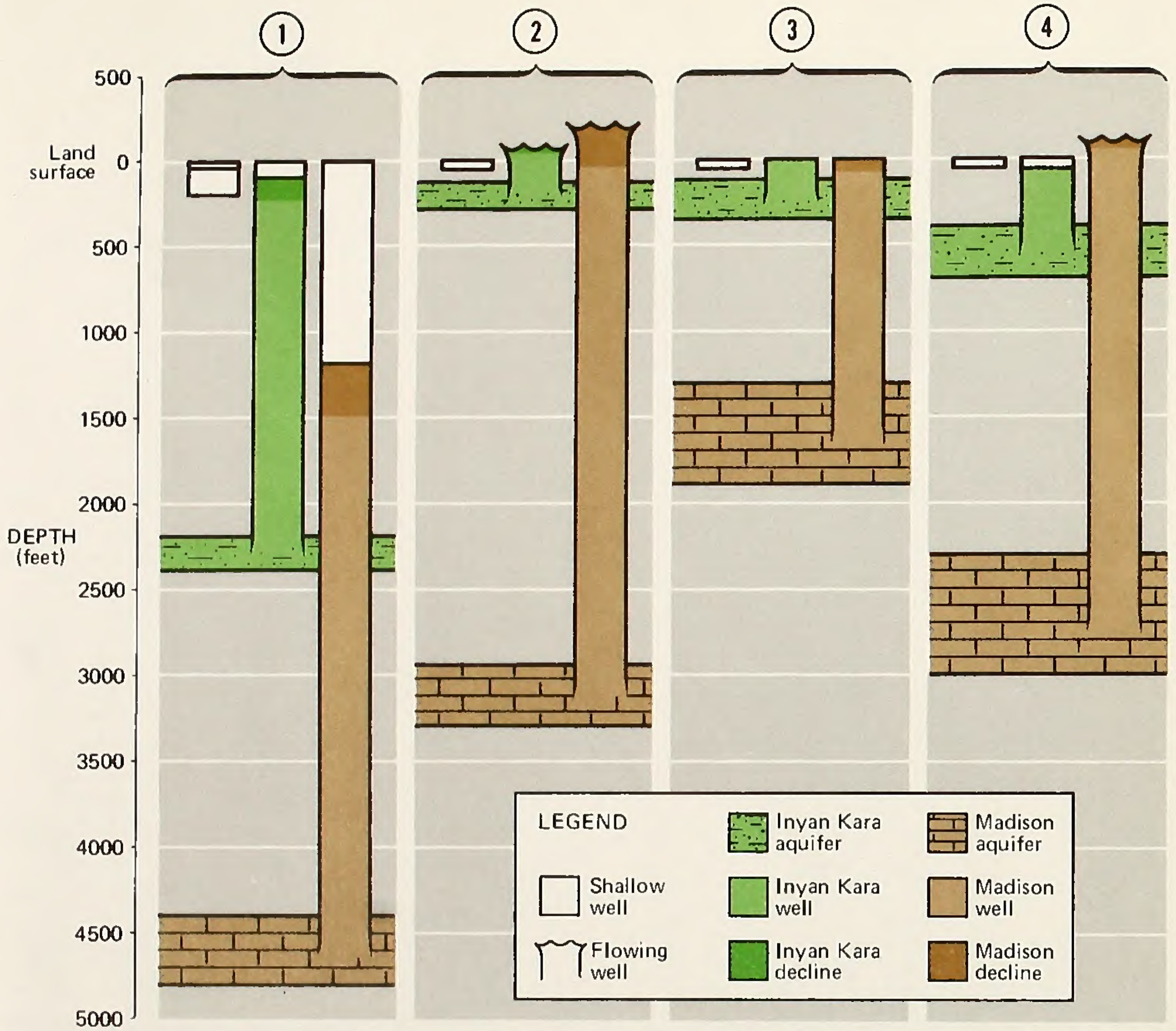
① Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 1 — ETSI pumping from Niobrara County well field only

Map 5-5. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 25 YEARS, PLAN 1, CUMULATIVE CASE



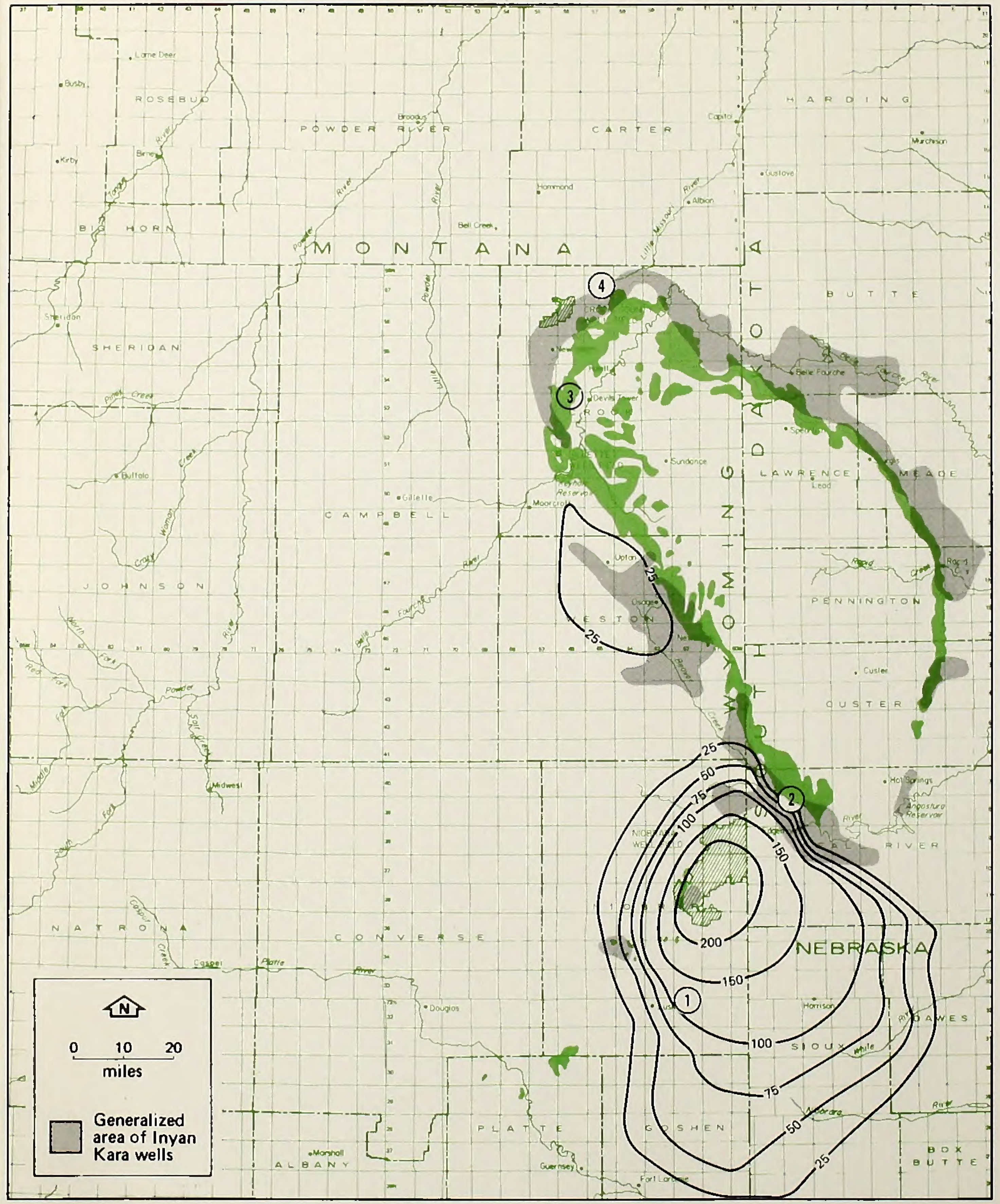
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

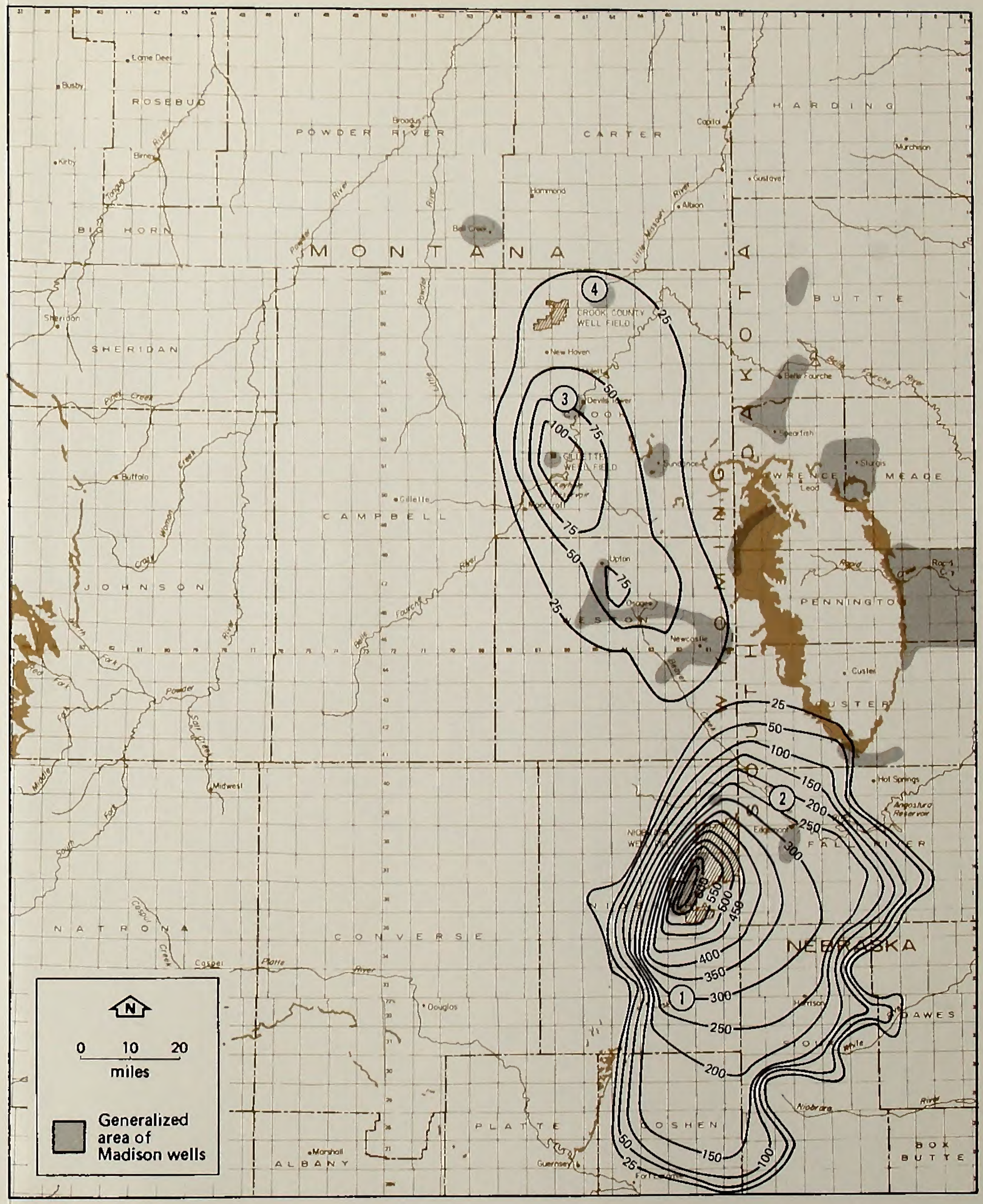
Water-level declines in Inyan Kara wells south and west of the Cheyenne River were calculated to decline by about 25 to 125 feet as a result of pumping from the Madison aquifer (Table 5-5). Water-level declines in Inyan Kara wells north and east of the Cheyenne River and in Inyan Kara outcrop areas in Wyoming were calculated to be less than 25 feet. Where Inyan Kara wells are under confined aquifer conditions, water levels in the Inyan Kara were calculated to decline by up to about 240 feet at the Niobrara County well field, with lesser amounts away from the well field. About 30 to 35 feet of decline was also calculated to occur in the Upton-Osage area when Black Hills Power and Light would be withdrawing water from the Madison aquifer.

INYAN KARA

Madison water-level declines were calculated to expand between 2010 and 2035 to areas north and south of the Gillette well field along the western flanks of the Black Hills (Table 5-5). Drawdowns in the vicinity of the Niobrara County well field were calculated to be greater than those for the 25-year interval. Madison water levels at Devils Tower, Hulett, Sundance, Osage, Upton, Newcastle, and Cascade Springs were calculated to decline by about 30 to 75 feet. Water levels in Madison wells at the Gillette well field were calculated to decline by 140 feet. In the Edgemont-Provo area, Madison water levels were calculated to decline by about 300 to 330 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

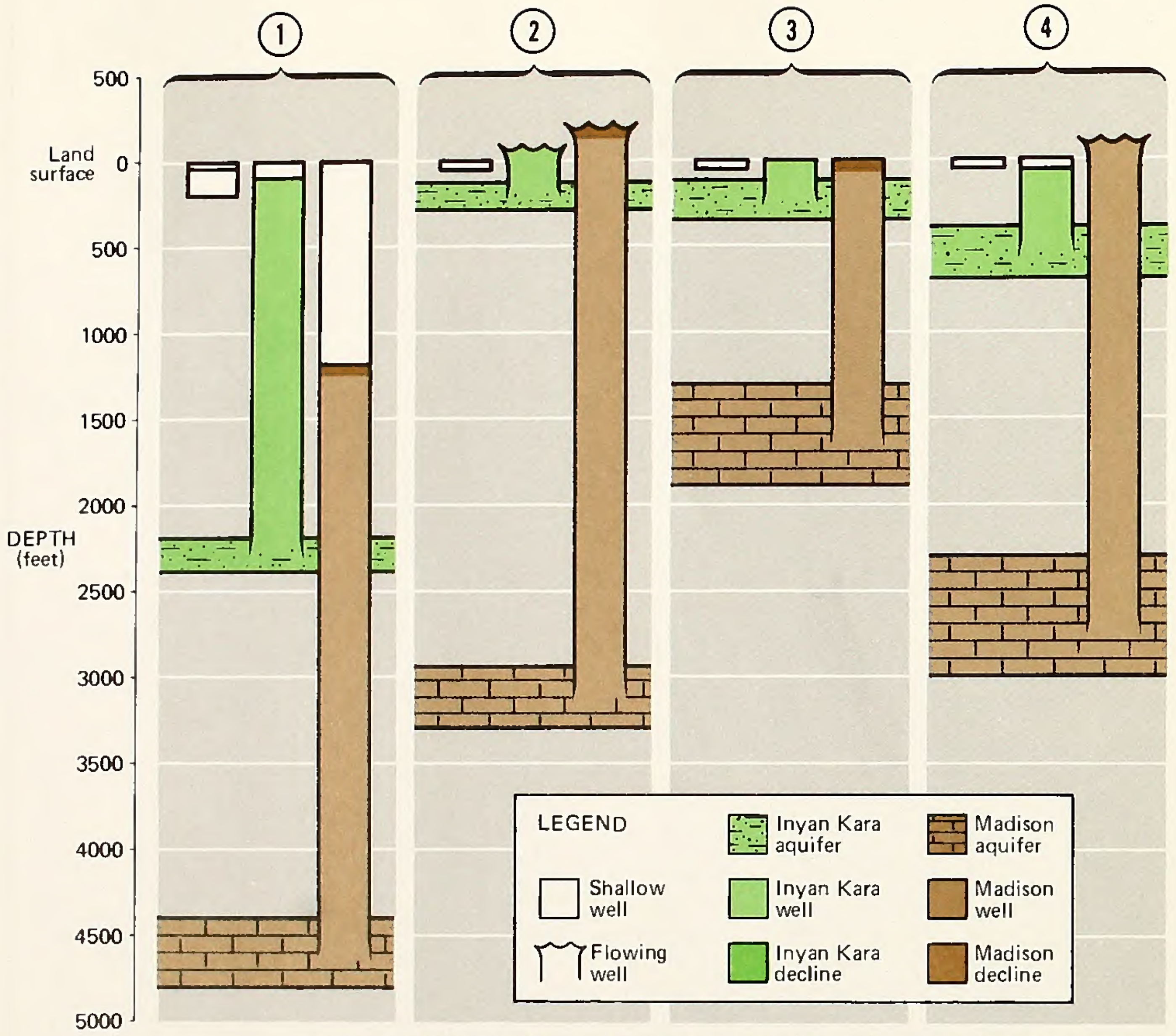
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case

Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Map 5-6. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 50 YEARS, PLAN 1, CUMULATIVE CASE



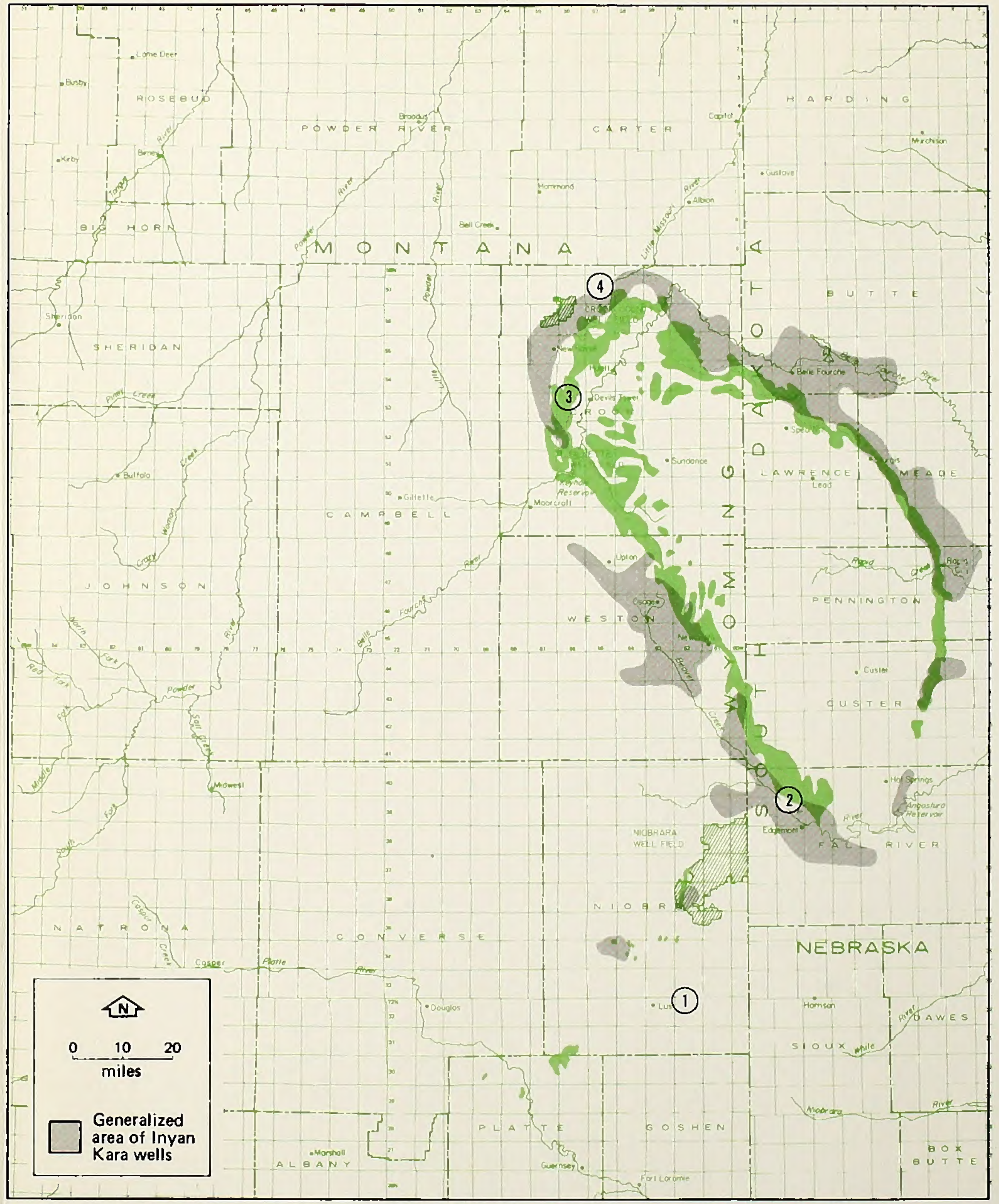
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

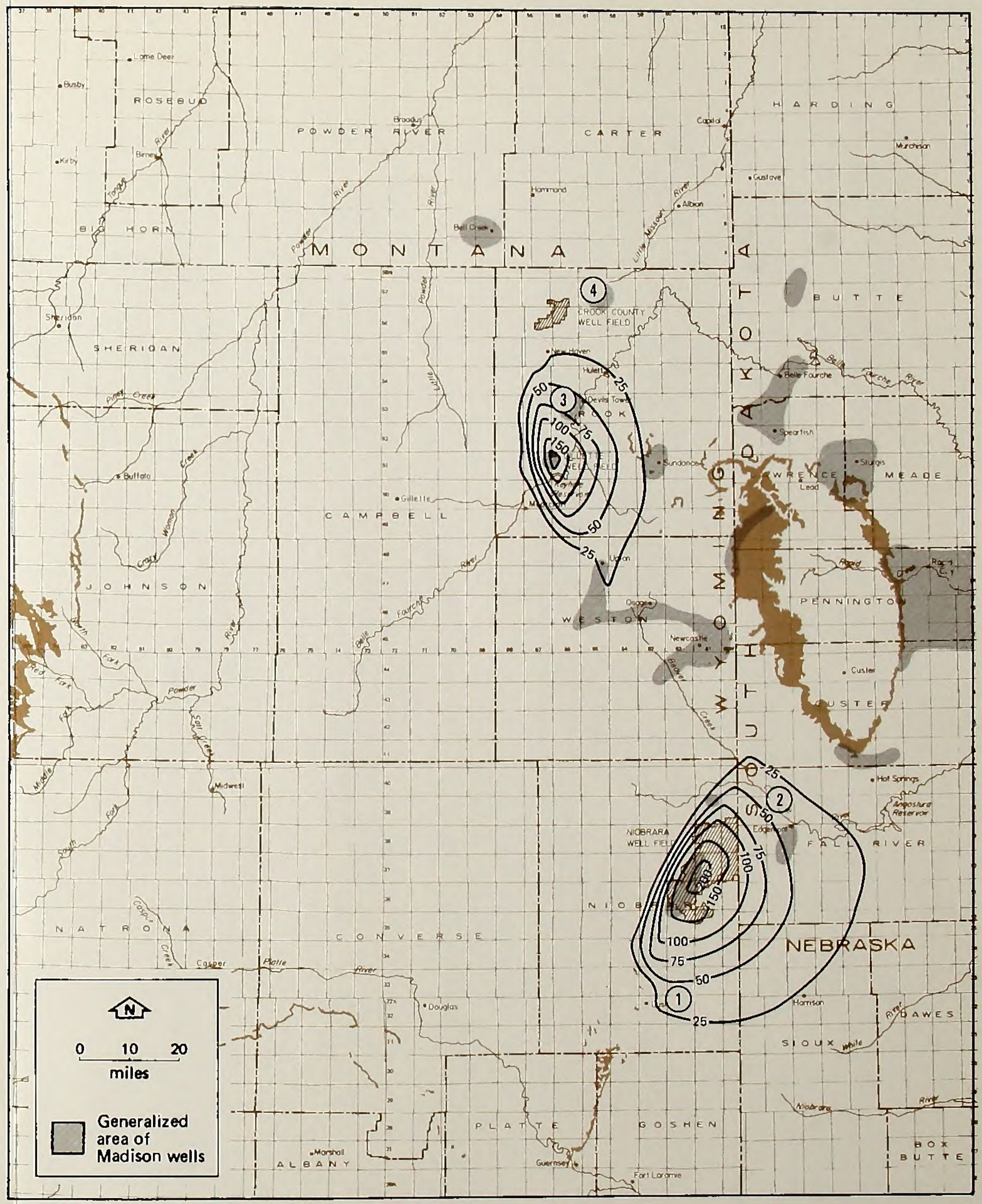
Water levels in the Inyan Kara aquifer were calculated to decline in all areas by less than 10 feet in the Inyan Kara aquifer 5 years after ETSI begins pumping as a result of ground-water withdrawal from the Madison aquifer (Table 5-6).

INYAN KARA

Declines in the Madison potentiometric surface were calculated to occur in two areas: the vicinity of the Gillette well field and near the Niobrara County well field (Table 5-6). Madison water levels were calculated to decline by about 50 feet at Devils Tower, about 30 to 35 feet at Hulett, and about 35 to 50 feet at Upton and the Edgemont-Provo area. The Madison potentiometric surface at the Gillette well field was calculated to decline by about 210 feet during this 5-year period, and water levels in the Niobrara well field were calculated to decline by about 200 feet. Madison wells in other areas were calculated to have less than 25 feet of water-level decline 5 years after ETSI begins pumping.

MADISON





Inyan Kara outcrop

Madison outcrop

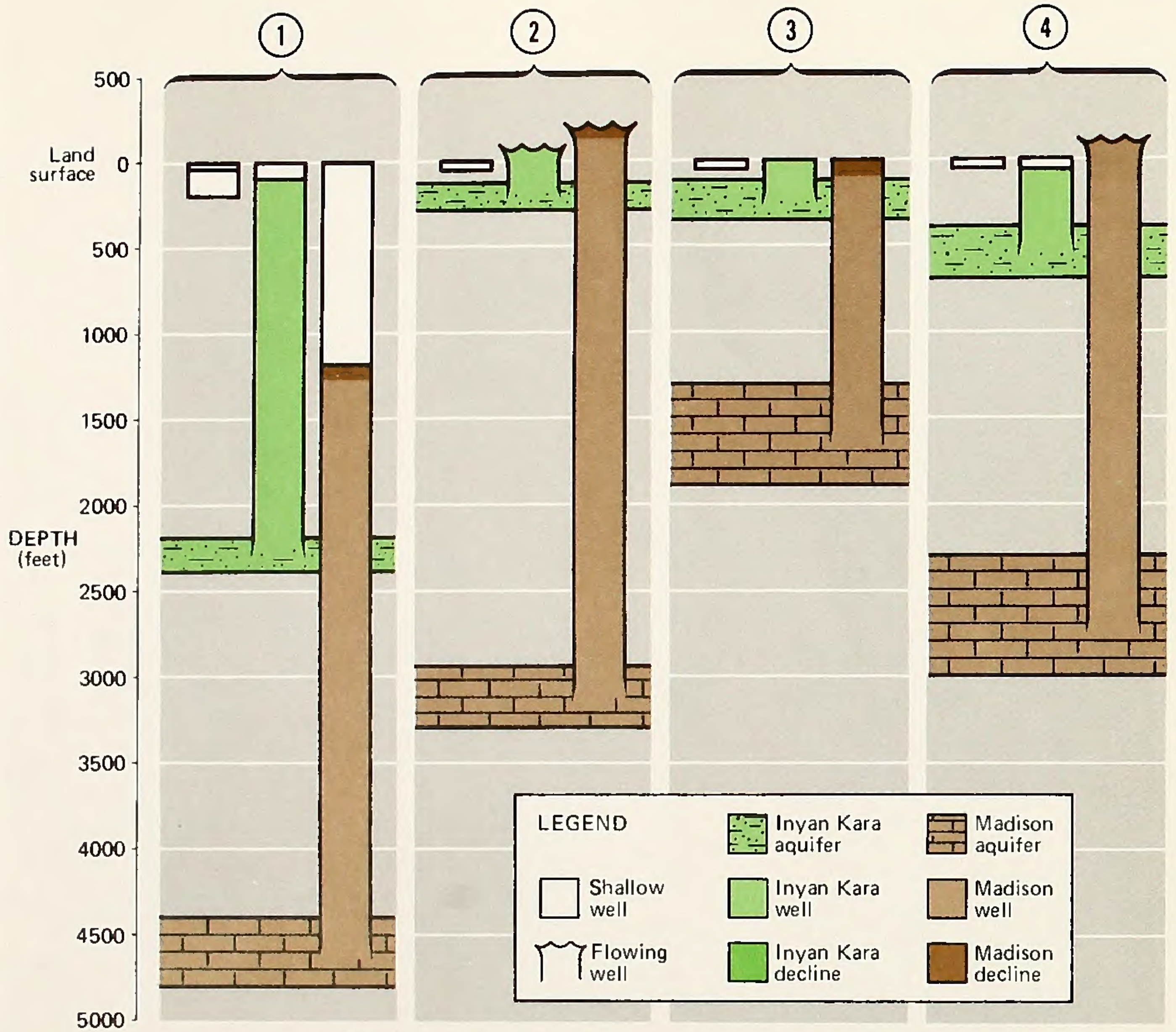
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 2 — ETSI pumping from Niobrara County and Gillette well fields

Map 5-7. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 5 YEARS, PLAN 2, CUMULATIVE CASE



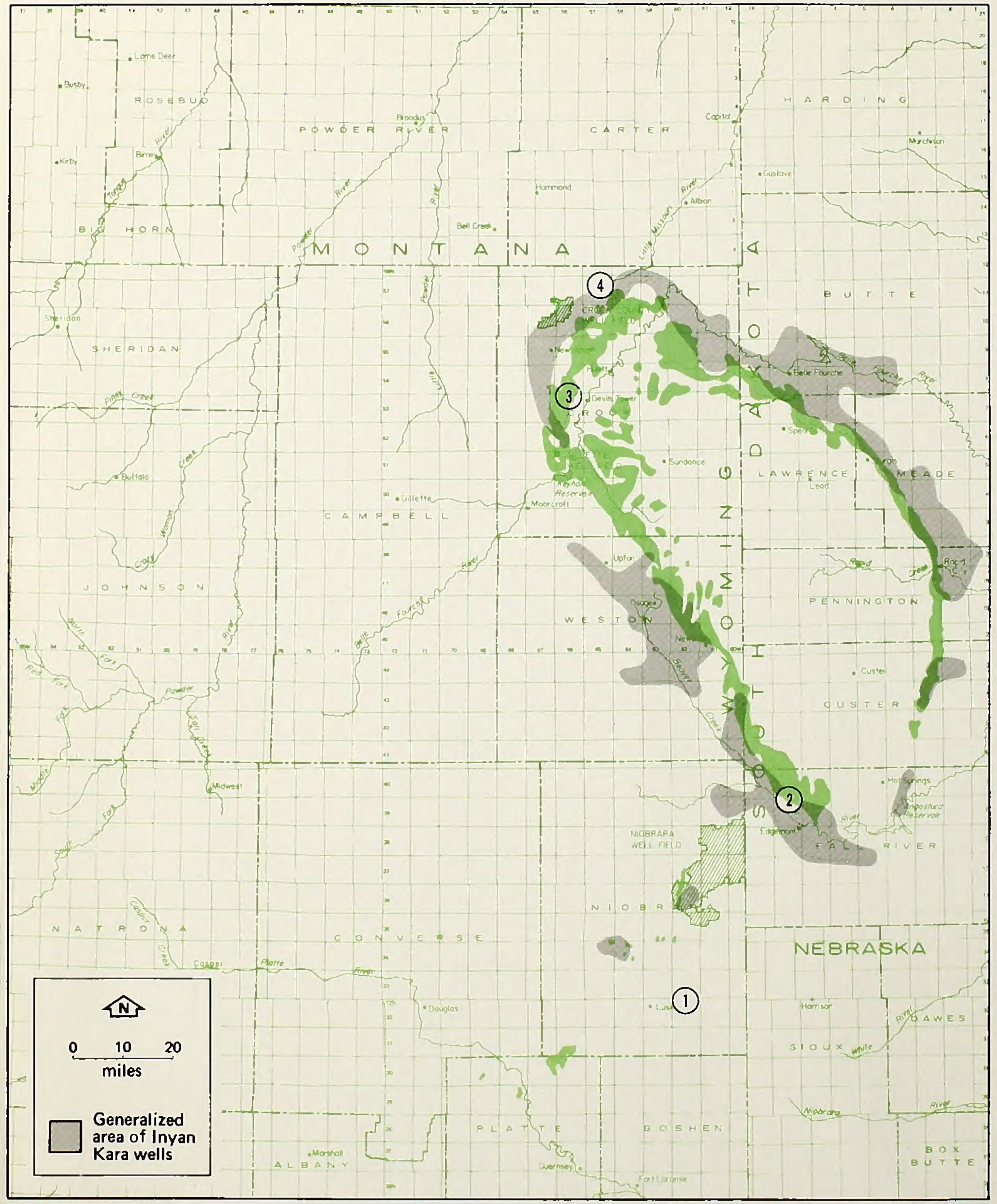
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

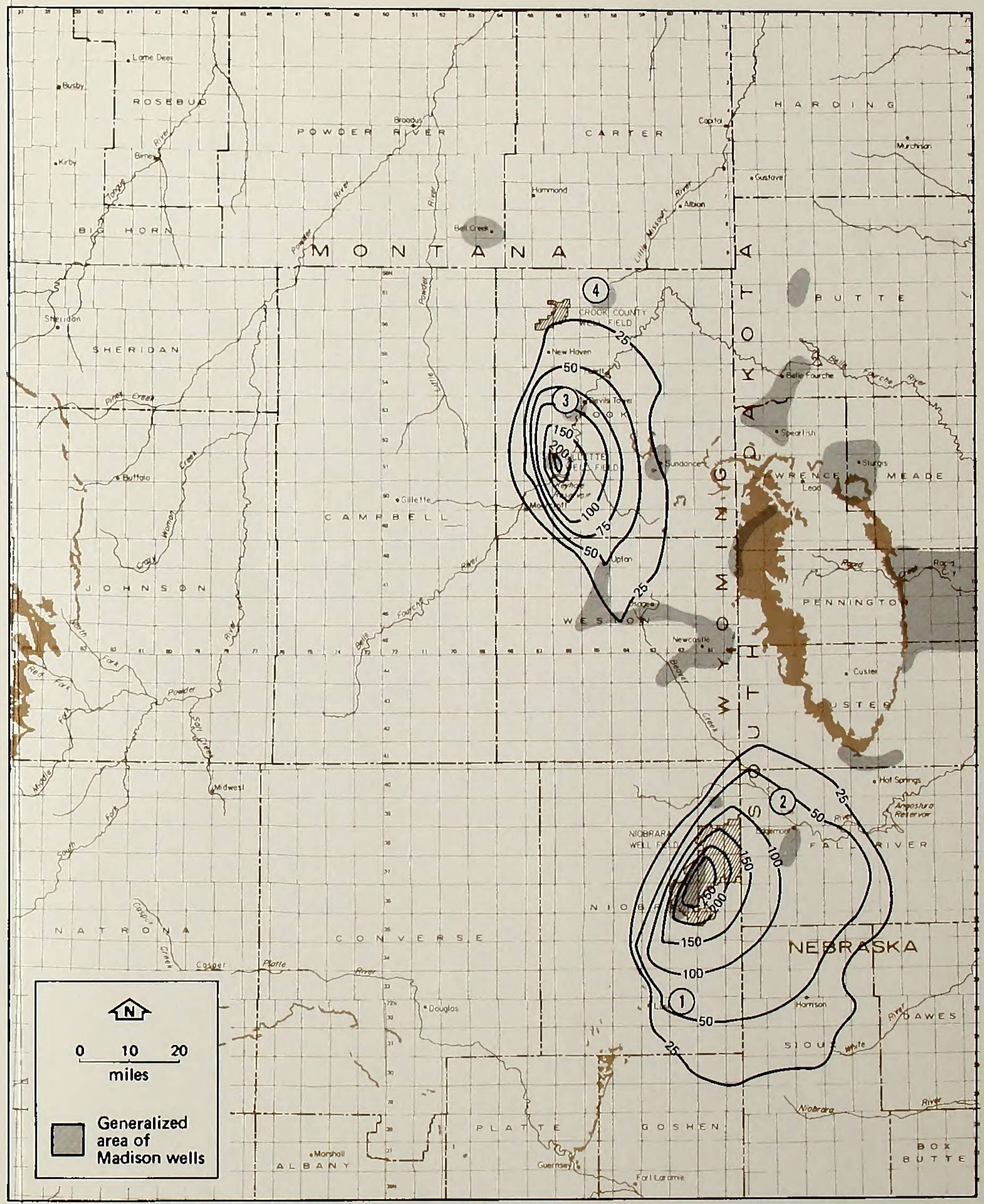
Except at the Niobrara County well field, water-level declines in the Inyan Kara aquifer were calculated to be less than 10 feet as a result of pumping from the Madison aquifer (Table 5-6). In the Niobrara County well field and where the Inyan Kara was under confined aquifer conditions, Inyan Kara water levels were calculated to decline by up to 22 feet.

INYAN KARA

Madison wells predicted to be affected by declines in the Madison potentiometric surface 10 years after ETSI begins pumping were similar to those described as being affected at the 5-year interval (Map 5-7). The only additional Madison well where declines were predicted to be more than 25 feet was the one at Sundance (Table 5-6). At Devils Tower, Upton, Edgemont-Provo, Hulett, Gillette well field, and Sundance, Madison water levels were calculated to decline by about 80, 55, 80, 60, 260, and 25 feet, respectively. Other producing Madison wells outside the Niobrara well field would have less than 25 feet of decline.

MADISON





Inyan Kara outcrop

Madison outcrop

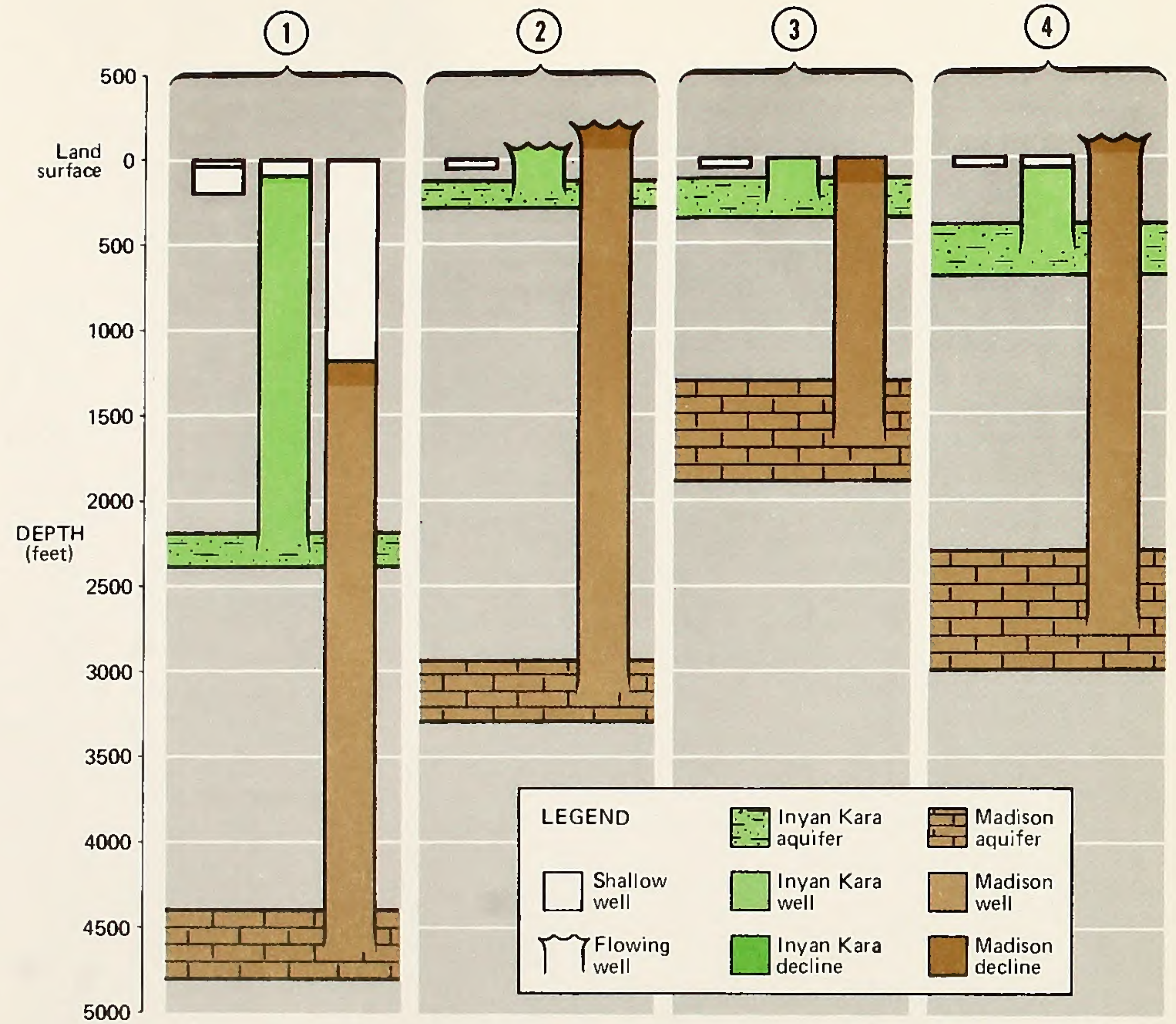
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 2 — ETSI pumping from Niobrara County and Gillette well fields

Map 5-8. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 10 YEARS, PLAN 2, CUMULATIVE CASE



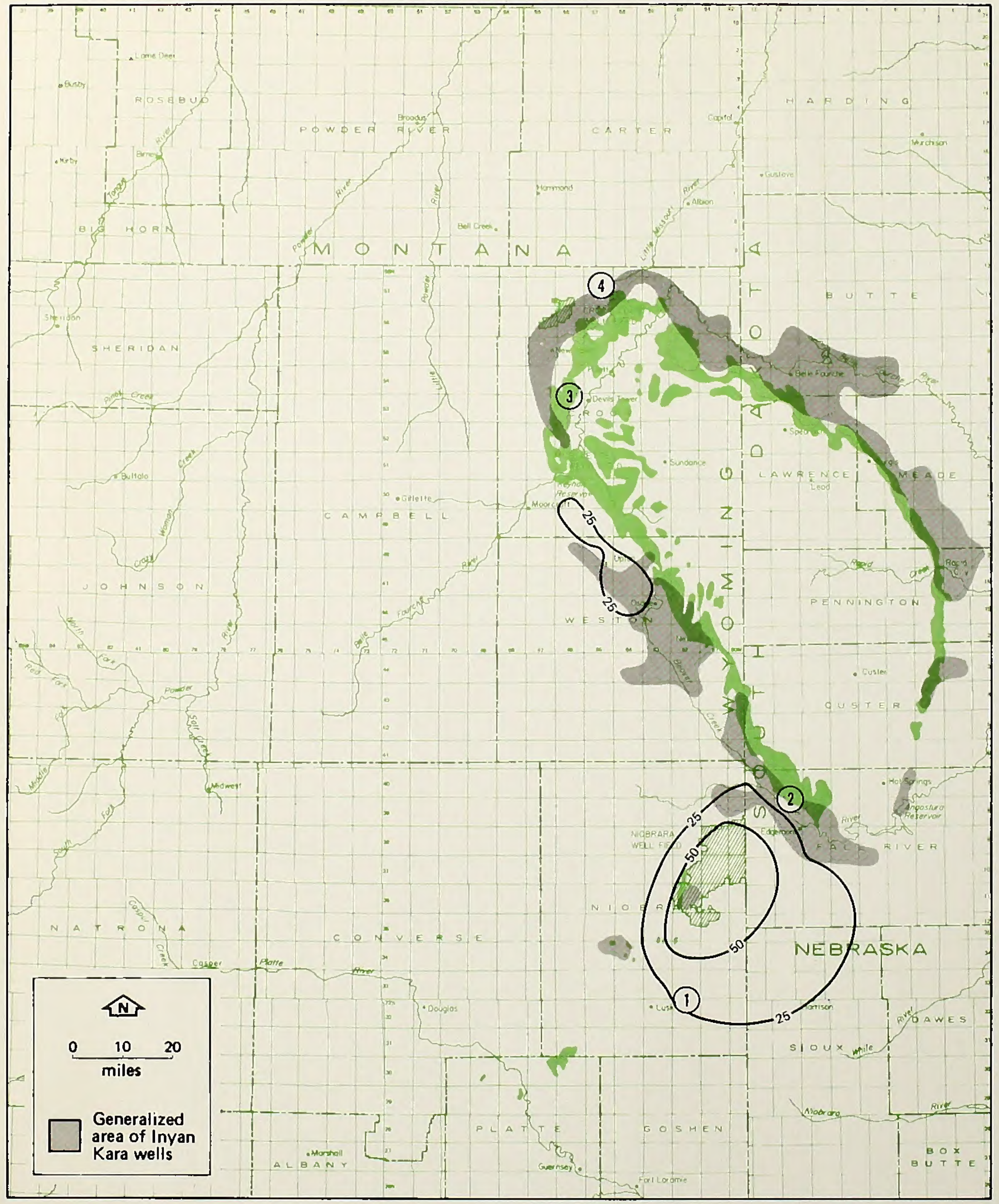
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

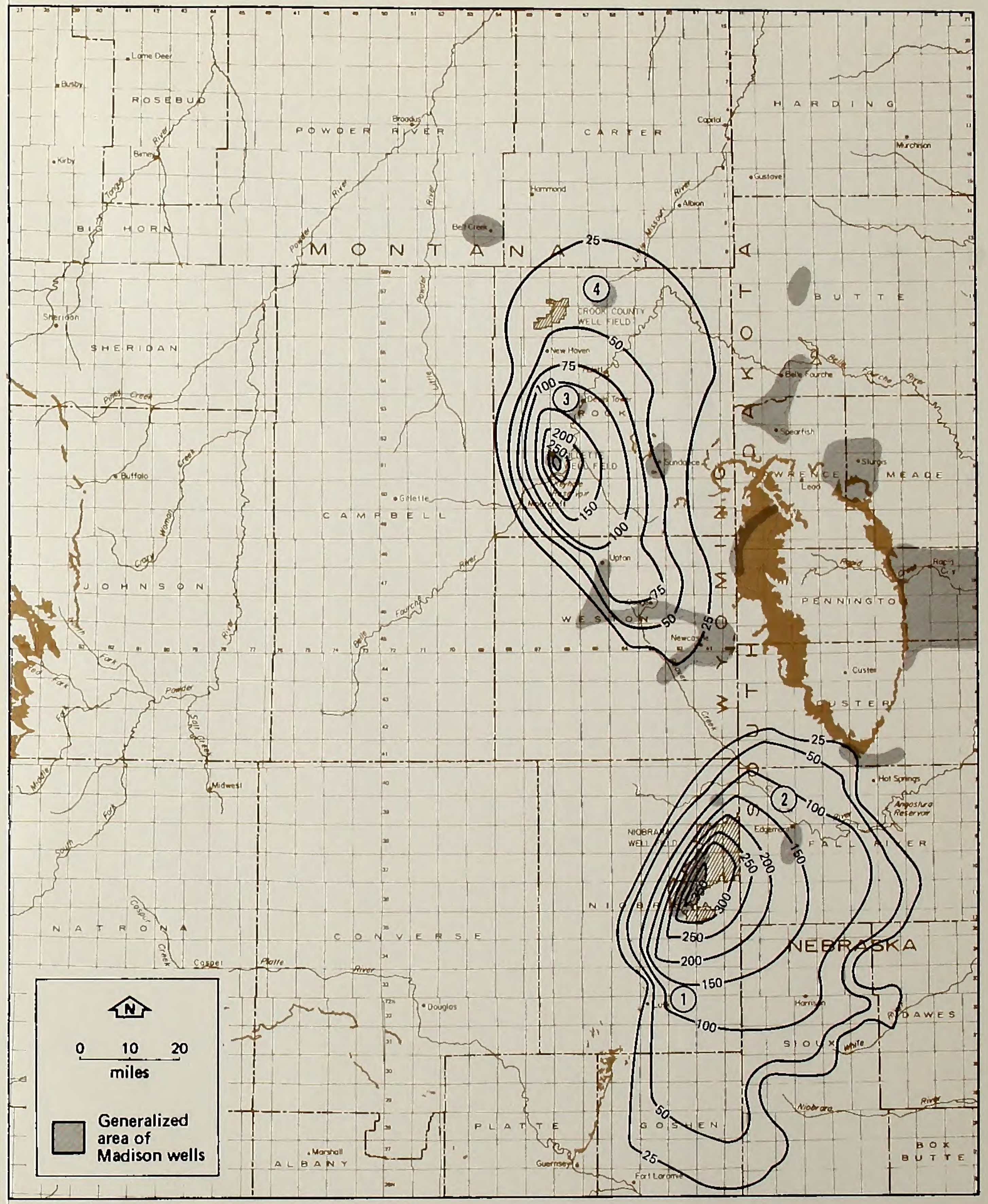
Water levels in Inyan Kara wells in the Upton-Osage area and along a small portion of the southern and western parts of the Cheyenne River would be affected by about 25 feet of decline (Table 5-6). Inyan Kara wells near Provo were calculated to have water-level declines of about 35 feet. Inyan Kara wells in confined parts of the Inyan Kara aquifer in the Niobrara County well field were calculated to have up to about 75 feet of water-level declines. Potentiometric surface declines in other areas of the Inyan Kara aquifer were calculated to be less than 25 feet as a result of ground-water withdrawals from the Madison aquifer.

INYAN KARA

Almost all Madison wells in Crook and Weston counties, Wyoming, were calculated to have more than 25 feet of water-level decline (Table 5-6). Except in the Edgemont-Provo area, no Madison wells in South Dakota or Montana would have water-level declines of more than 25 feet. The Madison potentiometric surface would decline by about 25 feet at Newcastle, 50 feet at Sundance, 80 to 95 feet at Upton and Osage, 90 feet at Hulett, 120 to 150 feet at Devils Tower and Edgemont-Provo, and 300 feet at the Gillette well field.

MADISON





Inyan Kara outcrop

Madison outcrop

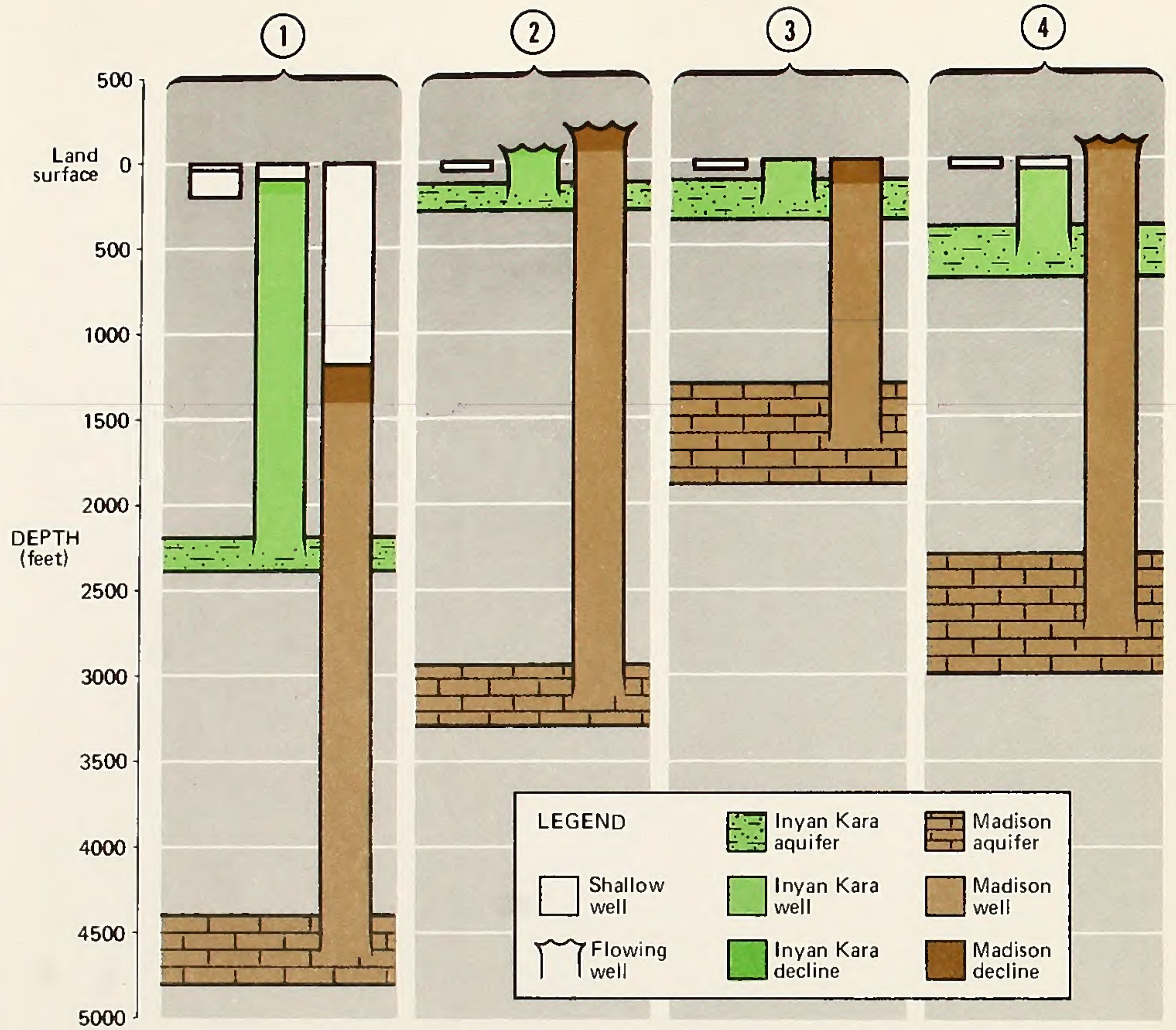
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 2 — ETSI pumping from Niobrara County and Gillette well fields

Map 5-9. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 25 YEARS, PLAN 2, CUMULATIVE CASE



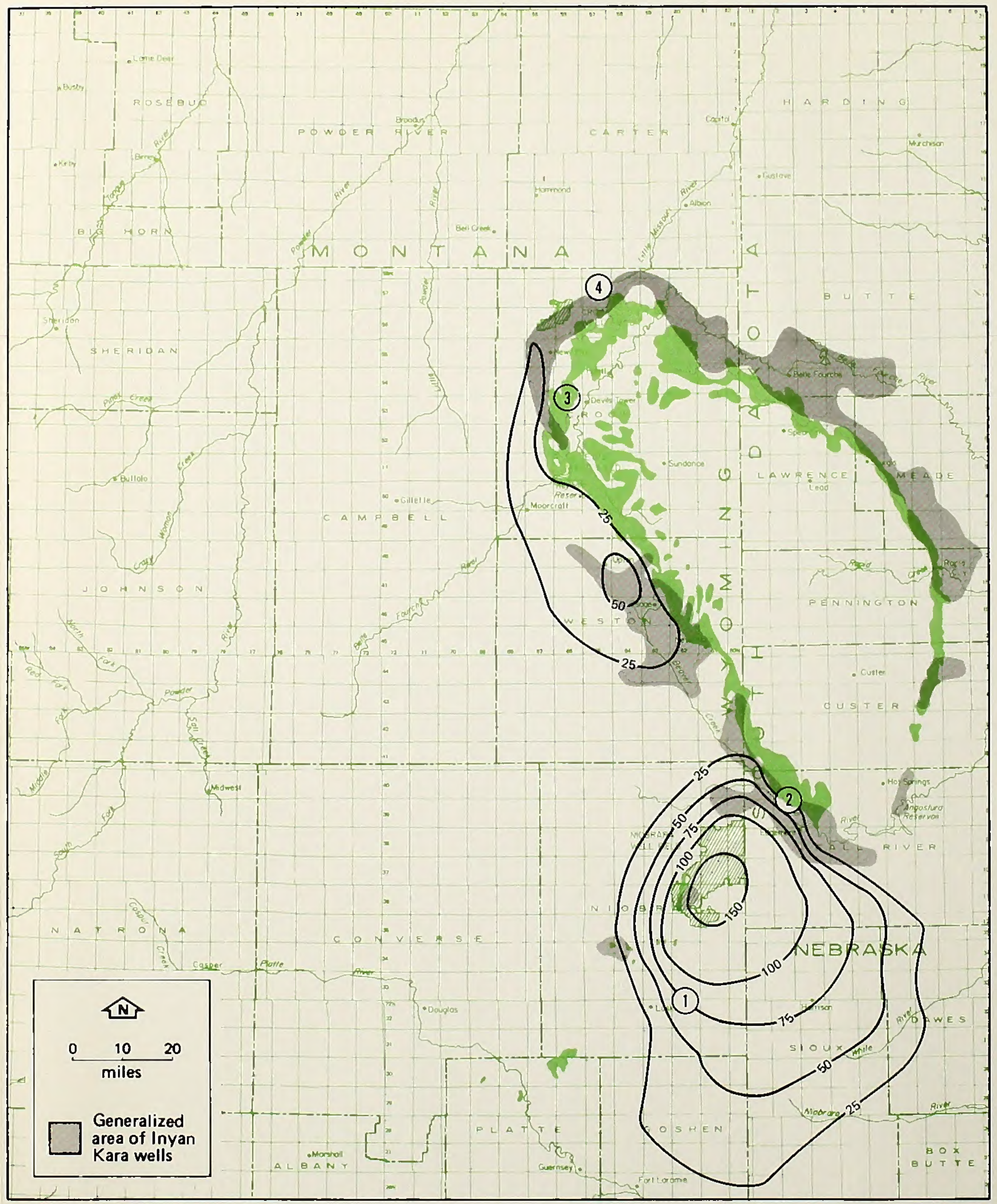
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

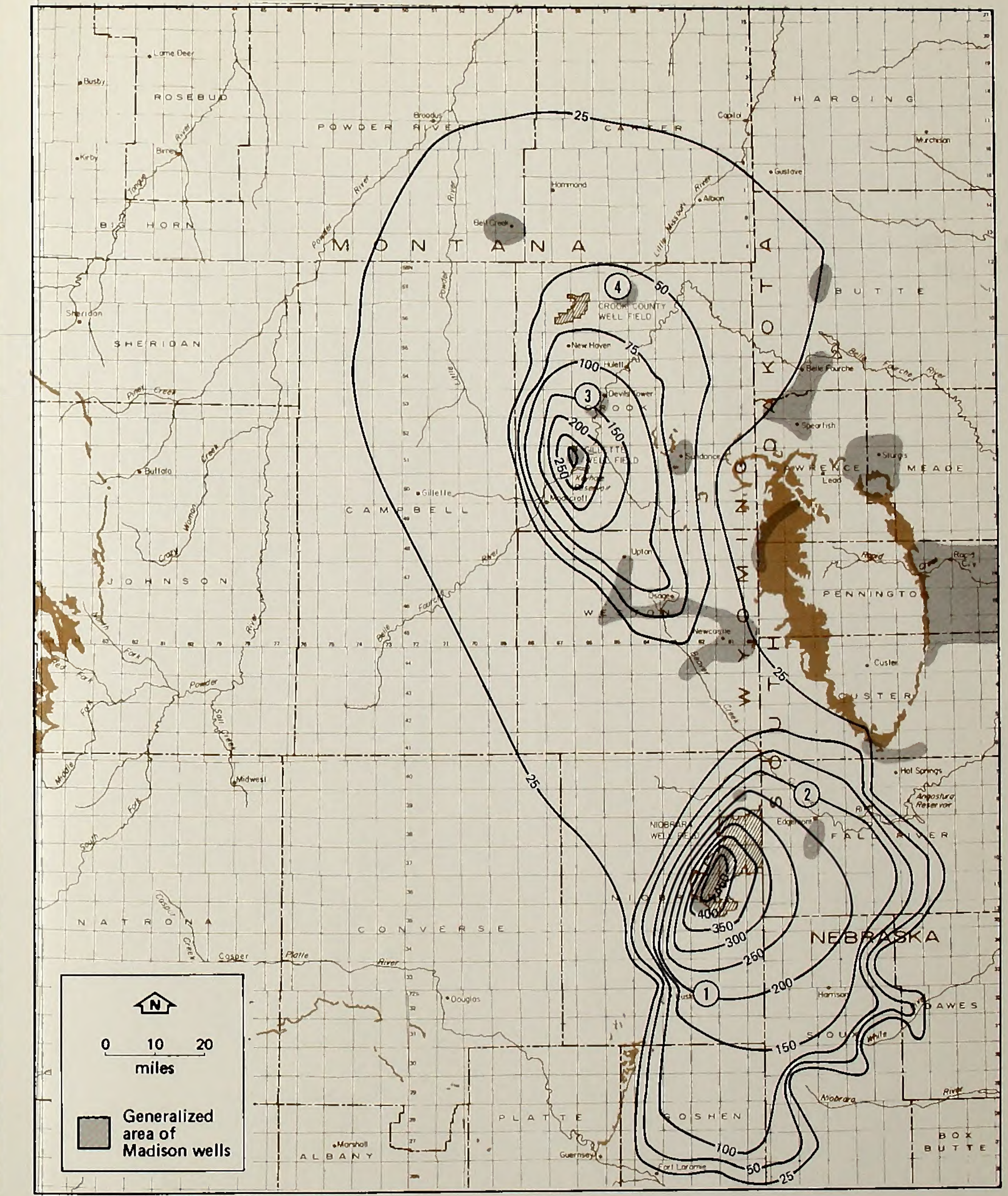
Areas with Inyan Kara wells calculated to be affected by potentiometric surface declines of more than 25 feet were located south of the Crook County well field, in the Upton-Osage-Newcastle area, along the Cheyenne River, and southwest of the Niobrara County well field (Table 5-6). Inyan Kara wells in the Upton-Osage area would have declines of up to 50 feet. Along and southwest of the Cheyenne River, Inyan Kara wells were calculated to have water-level declines of up to about 90 feet, with lesser amounts nearer the Cheyenne River and away from the Niobrara County well field. Inyan Kara wells in the Niobrara County well field were calculated to have up to about 160 feet of potentiometric surface declines as a result of Madison ground-water withdrawals.

INYAN KARA

Declines of more than 25 feet in the Madison potentiometric surface were calculated to occur in Madison wells in northeastern Wyoming, at one location in southern Montana, and in one area in northwestern South Dakota (Table 5-6). Water levels in Madison wells surrounding the Gillette well-field area were calculated to decline by about 30 feet at Bell Creek, 140 feet at Devils Tower, 330 feet in the Gillette well field, 70 feet at Sundance, 110 feet at Hulett, 100 to 120 feet at Upton and Osage, and 35 feet at Newcastle. Near the Niobrara County well field, Madison water levels were calculated to decline by about 200 to 230 feet at Edgemont and Provo. Madison wells in western Butte County, South Dakota, were calculated to have potentiometric surface declines of about 20 to 25 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

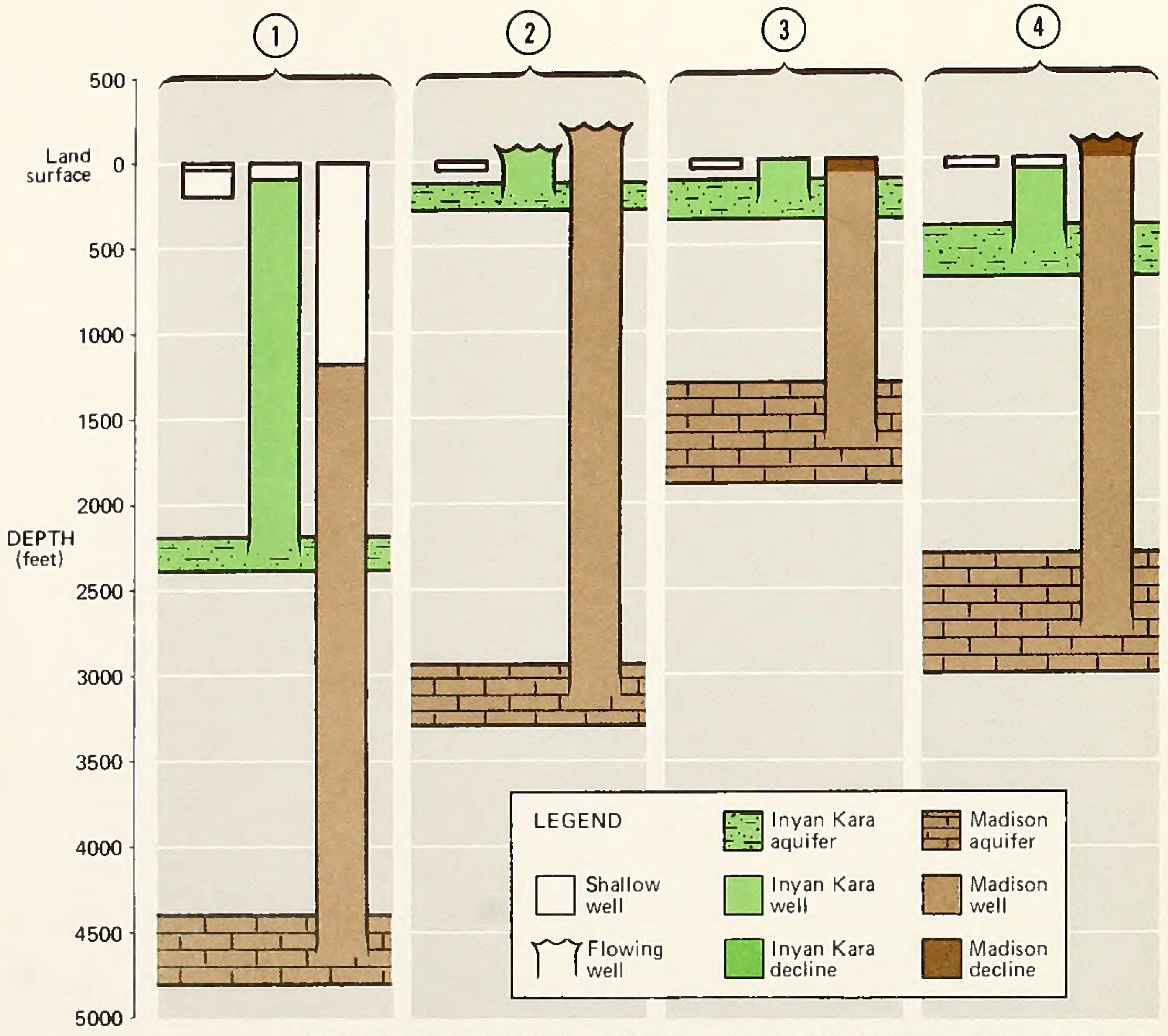
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 2 — ETSI pumping from Niobrara County and Gillette well fields

Map 5-10. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 50 YEARS, PLAN 2, CUMULATIVE CASE



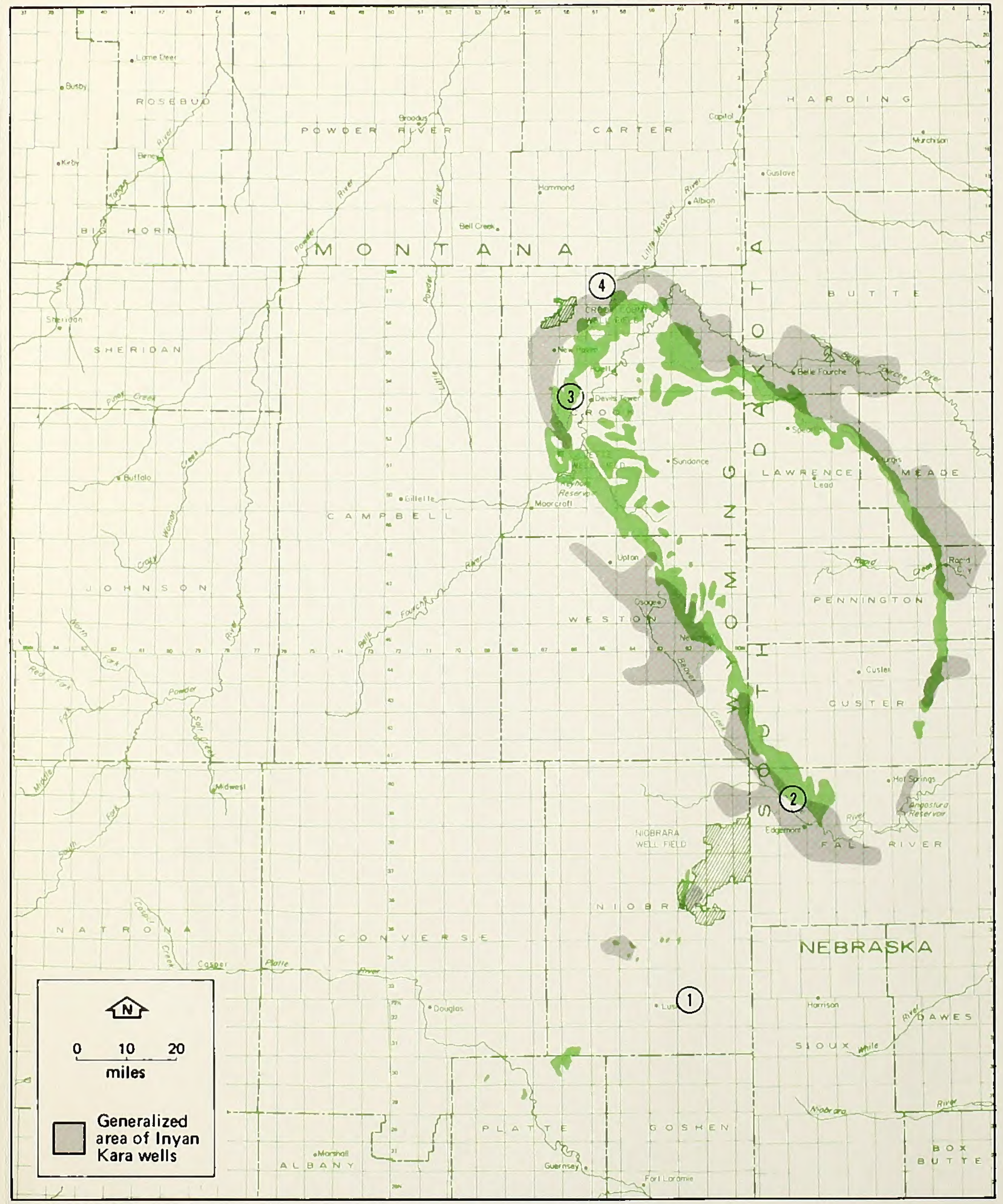
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

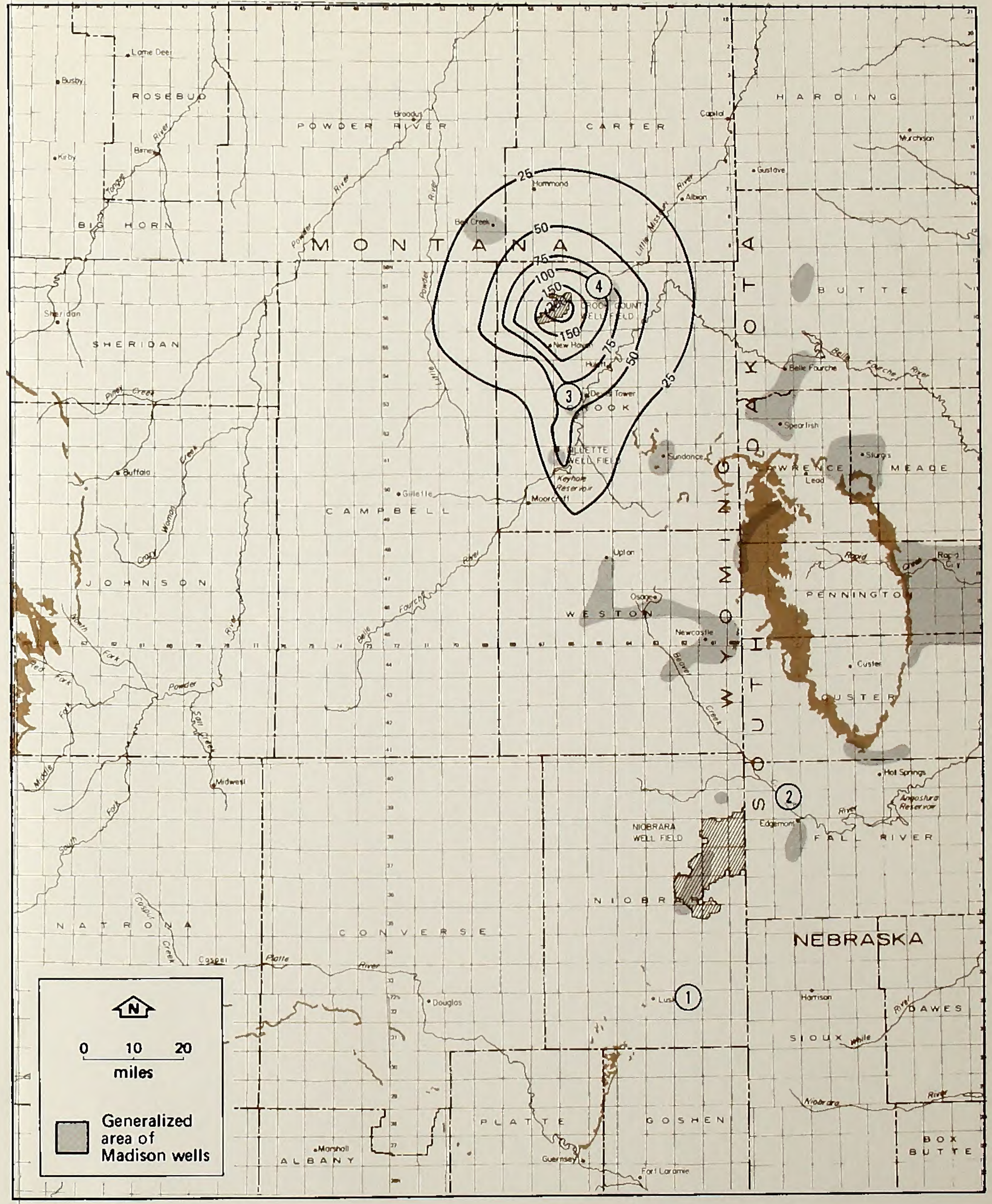
Water levels in the Inyan Kara aquifer were calculated to decline in almost all areas by less than 5 feet between 1986 and 1990 (Table 5-7). Only in confined parts of the Inyan Kara aquifer in the Crook County well-field area would declines greater than 5 feet occur. In these confined areas, Inyan Kara water levels were calculated to decline by less than 15 feet as a result of Madison ground-water withdrawals.

INYAN KARA

Water-level declines in the Madison aquifer were concentrated around the ETSI Crook County well field, with an extension south to the Gillette well field where the city of Gillette would also be pumping large amounts of Madison ground water (Table 5-7). Madison wells affected by more than 25 feet of water-level declines were located at Bell Creek, Devils Tower, Hulett, and the Gillette well field. Madison drawdowns at these locations range from about 35 to 60 feet. At USGS test well No. 1 (an unused observation well located about 6 miles east of the Crook County well field), Madison ground-water levels were calculated to decline by about 75 feet. All other Madison wells were calculated to have less than 25 feet of drawdown.

MADISON





Inyan Kara outcrop

Madison outcrop

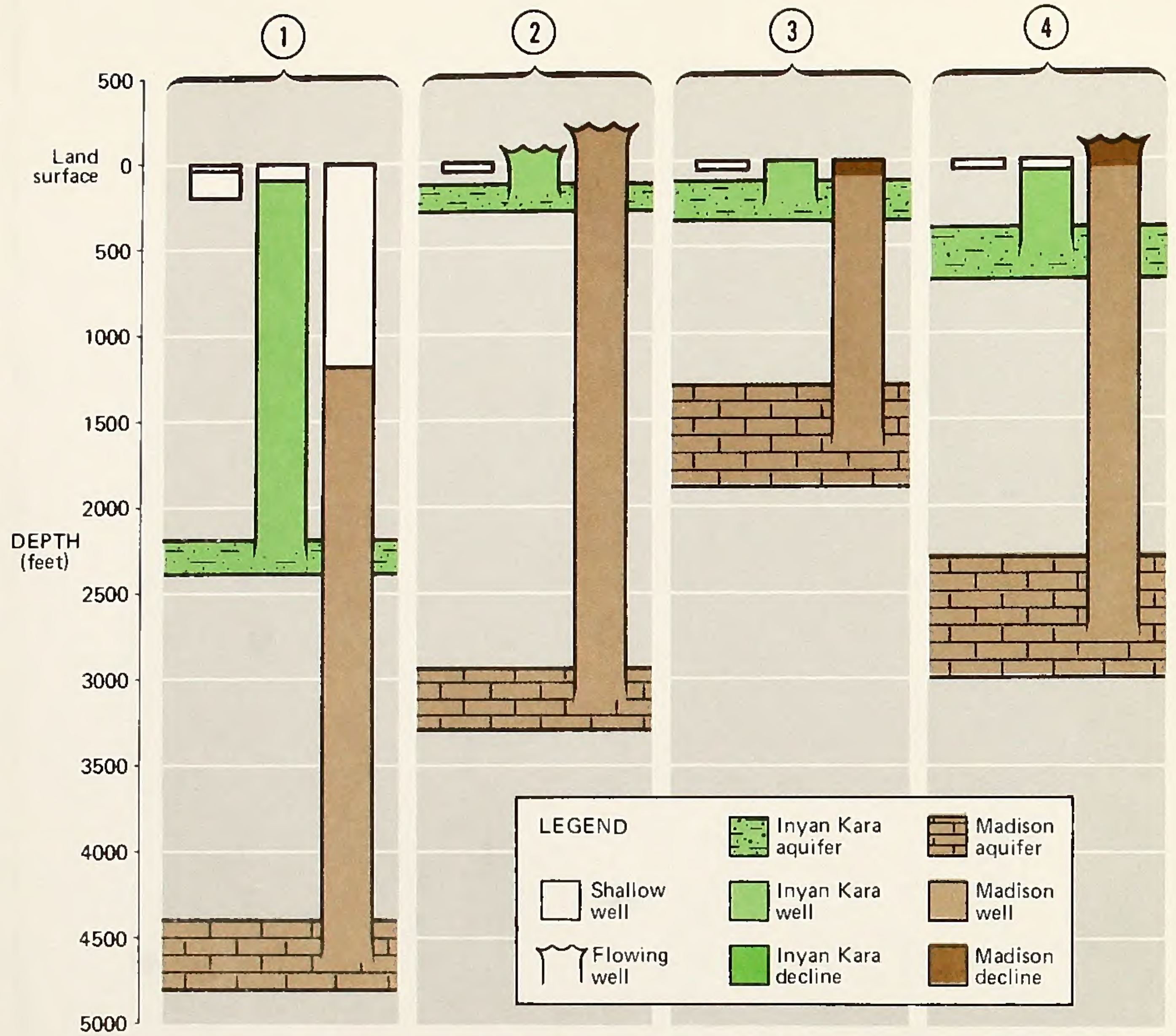
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 3 — ETSI pumping from Crook County well field only

Map 5-11. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 5 YEARS, PLAN 3, CUMULATIVE CASE



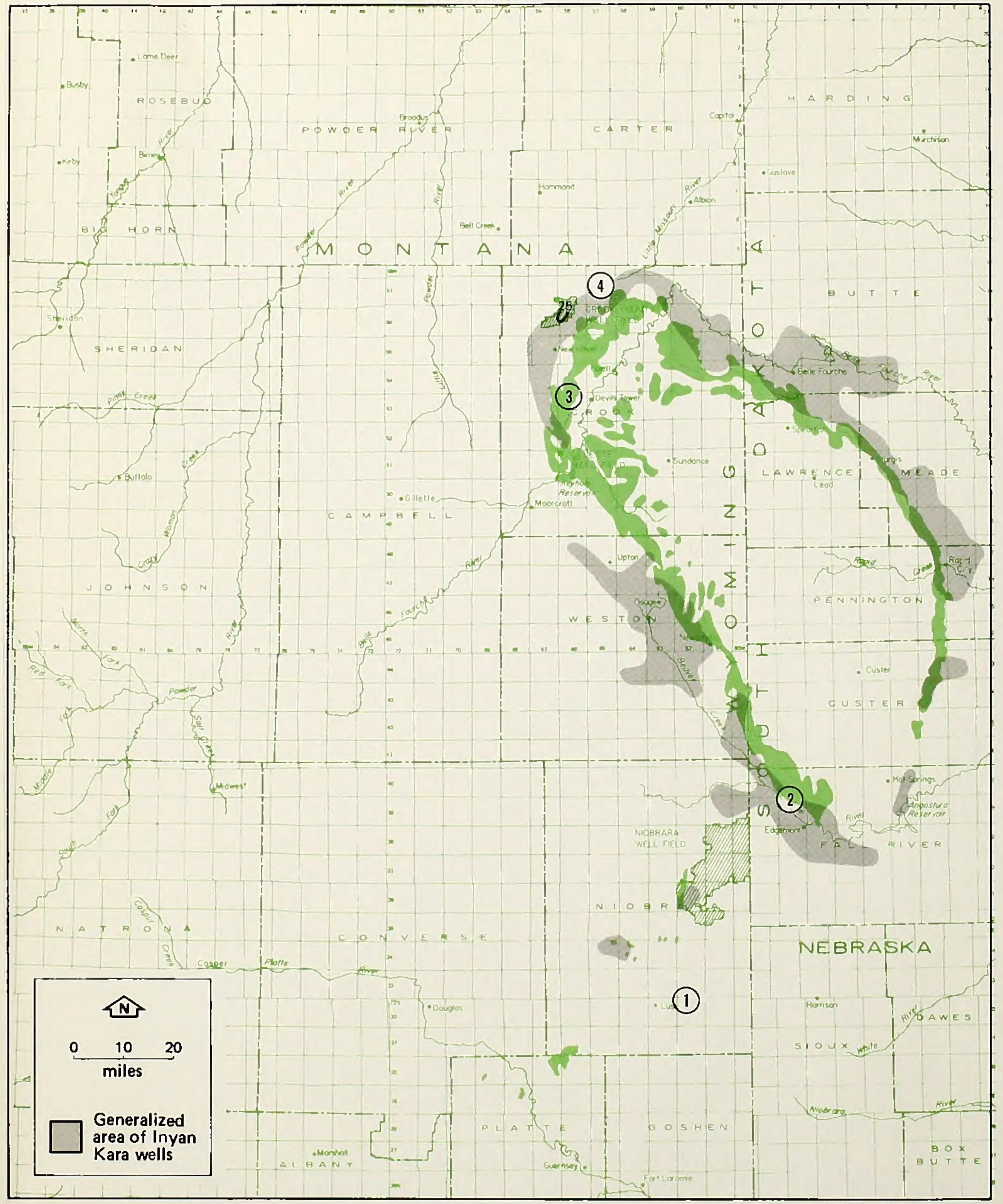
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

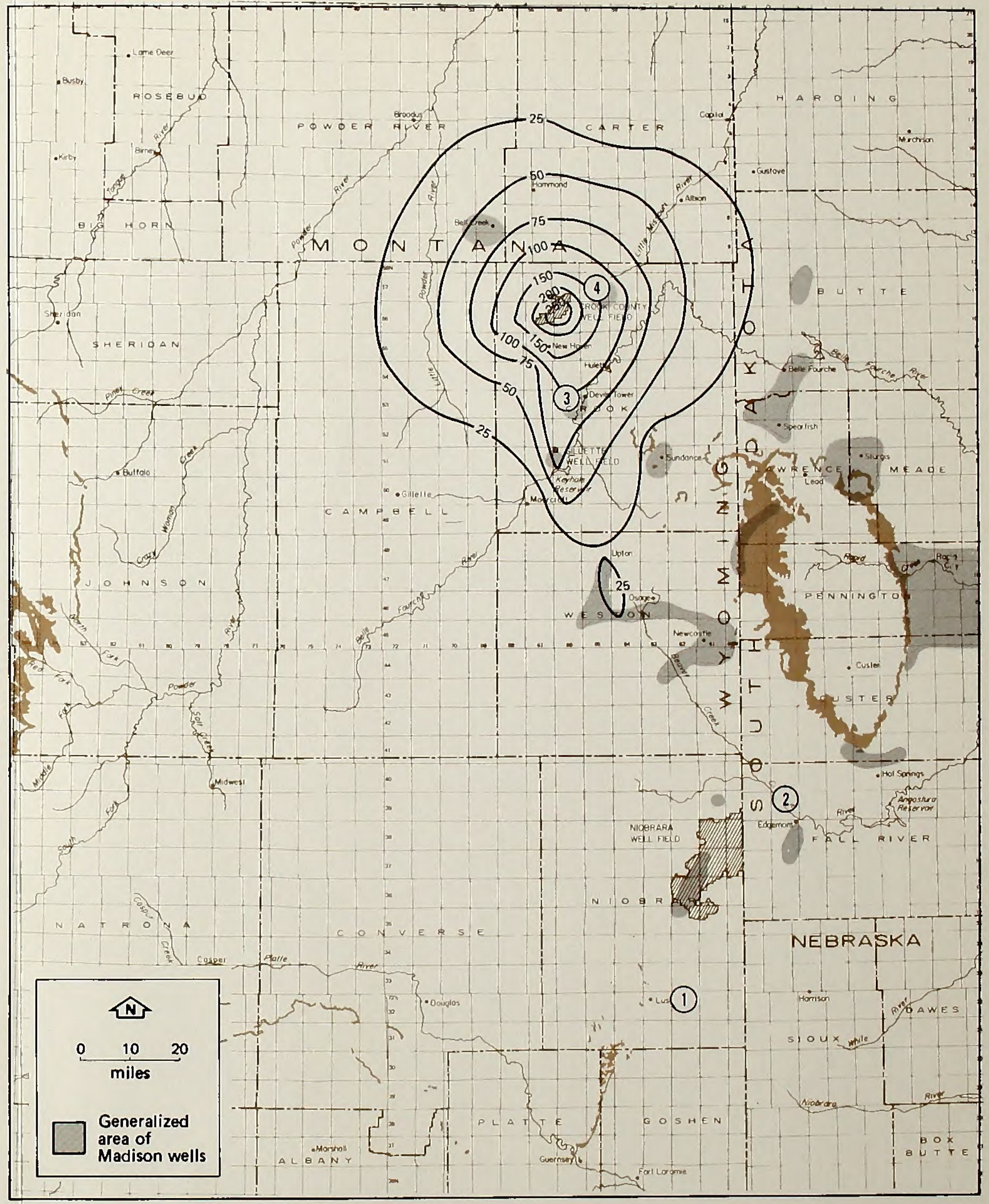
Inyan Kara water levels were calculated to decline by less than 25 feet as a result of Madison ground-water withdrawals, except in the Crook County well field, where Inyan Kara drawdowns were calculated to be about 25 feet (Table 5-7).

Ten years after ETSI would begin pumping from the Crook County well field, the cone of depression in the Madison aquifer caused by ETSI's and Gillette's pumping would enlarge (Table 5-7). Madison water levels would have declined by about 25 feet in the Upton-Osage area. Madison wells affected by more than 25 feet of drawdown would include those at Bell Creek (65 feet), Devils Tower (80 feet), Hulett (90 feet), and the Gillette well field (80 feet). At USGS test well No. 1, Madison water levels were calculated to decline by about 125 feet.

INYAN KARA

MADISON





Inyan Kara outcrop

Madison outcrop

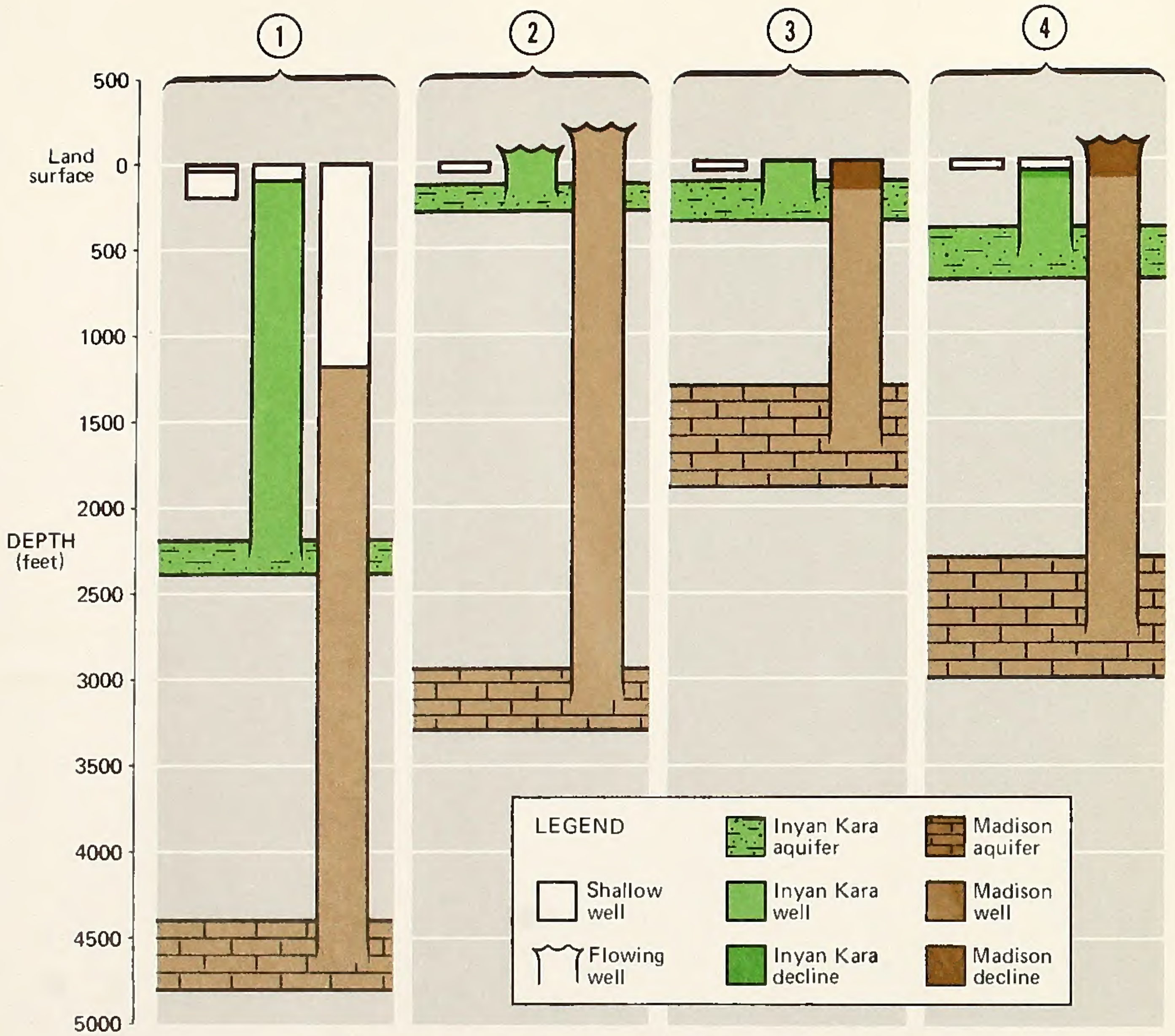
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 3 — ETSI pumping from Crook County well field only

Map 5-12. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 10 YEARS, PLAN 3, CUMULATIVE CASE



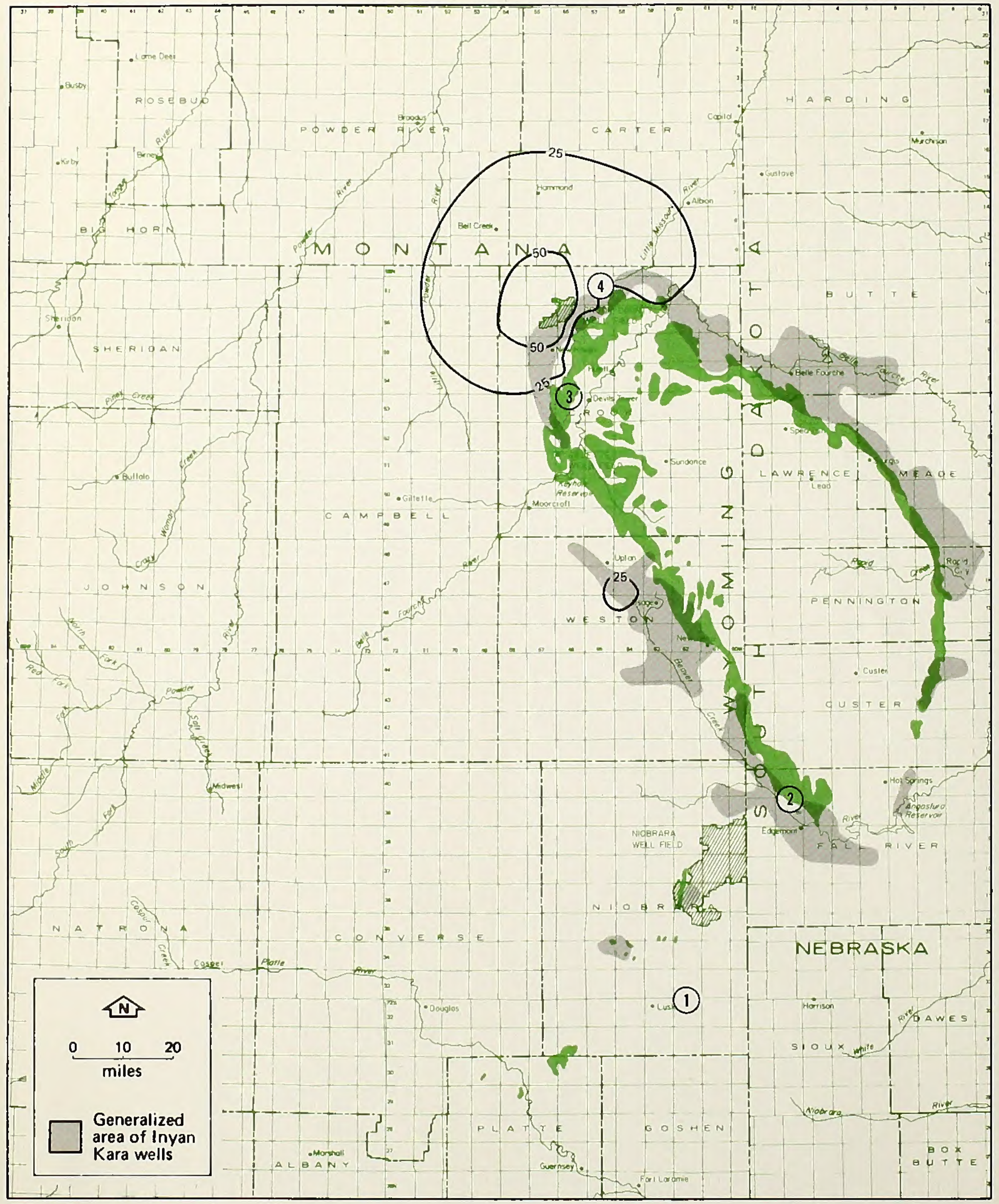
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

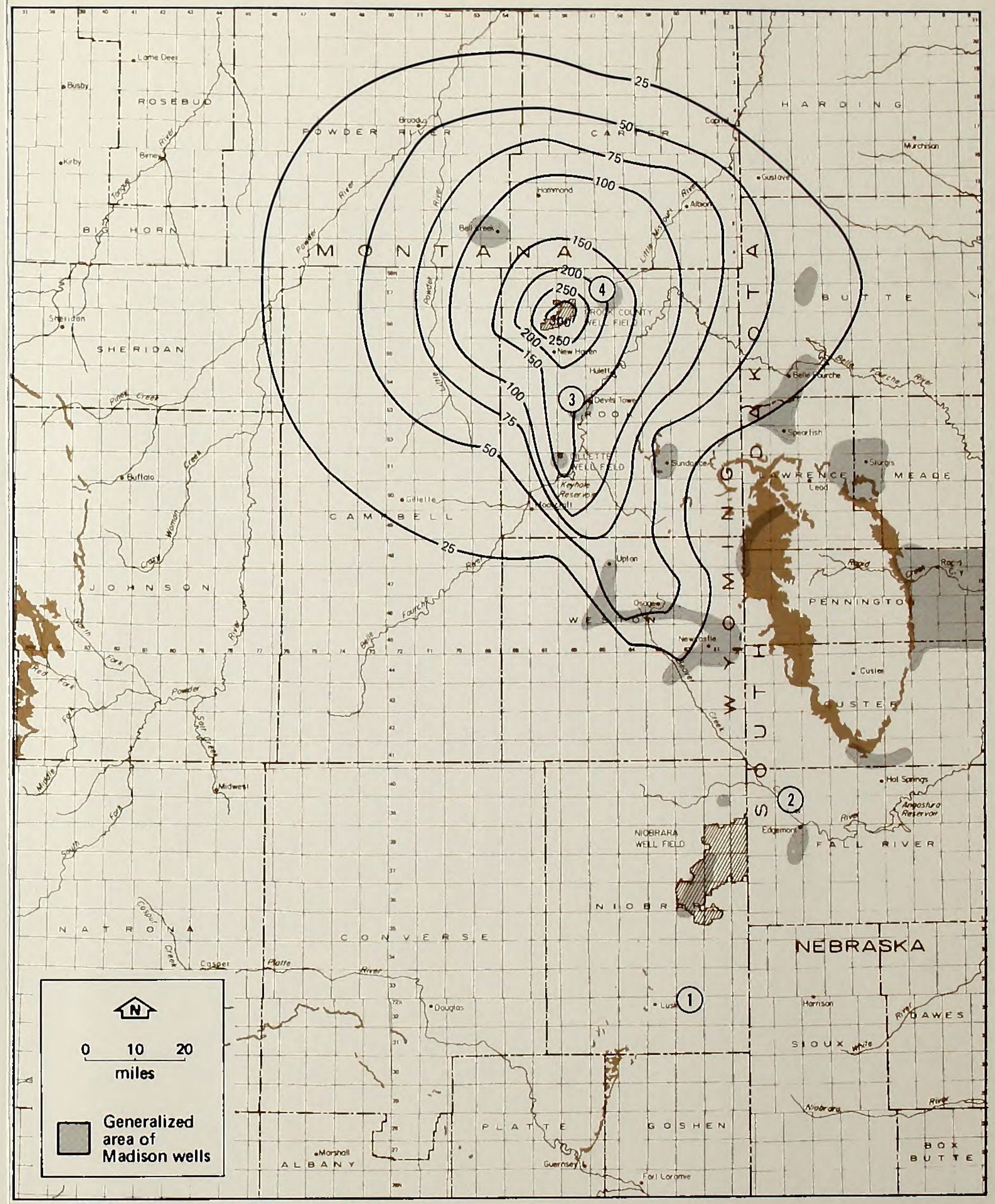
Wells in confined parts of the Inyan Kara aquifer and within about 25 miles south and east of the Crook County well field were calculated to have from about 25 to 60 feet of water-level declines 25 years after ETSI would begin pumping from the Crook County well field (Table 5-7). Twenty to 25 feet of decline was calculated to occur in the Inyan Kara near Upton and Osage where Black Hills Power and Light would be pumping large amounts of Madison ground water. Other areas with Inyan Kara wells were calculated to have less than 25 feet of drawdown as a result of Madison ground-water withdrawals.

INYAN KARA

The area affected by more than 25 feet of Madison water-level declines would increase from the area described for 10 years (Map 5-12) to include several other areas of Madison wells (Table 5-7). Those areas and their calculated Madison water-level declines were Bell Creek (110 feet), Devils Tower (140 feet), Hulett (150 feet), the Gillette well field (170 feet), the Upton-Osage area (about 70 feet), Sundance (about 40 feet), and western South Dakota (about 30 feet). All other Madison water wells currently under production were calculated to have less than 25 feet of water-level declines.

MADISON





Inyan Kara outcrop

Madison outcrop

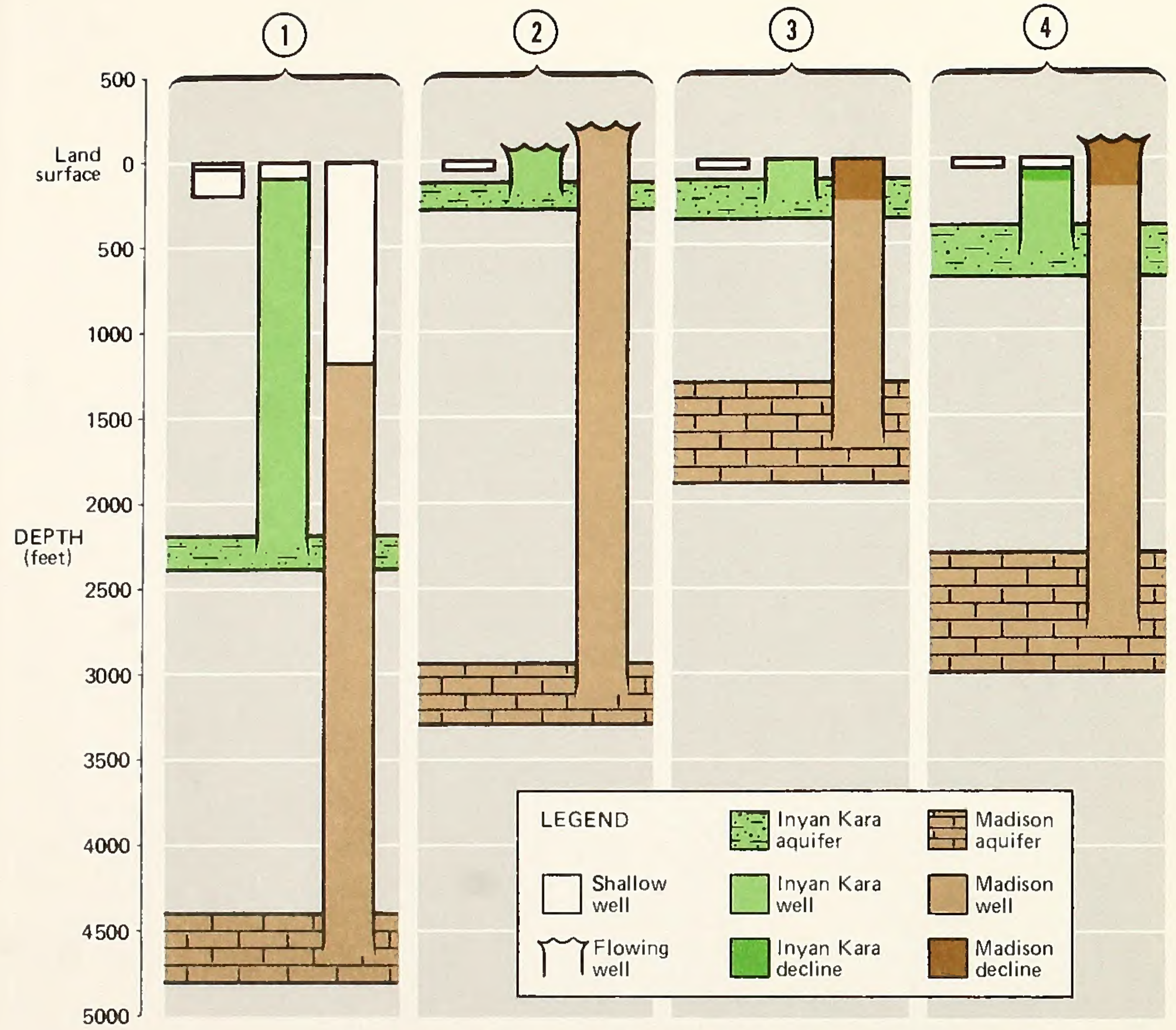
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 3 — ETSI pumping from Crook County well field only

Map 5-13. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 25 YEARS, PLAN 3, CUMULATIVE CASE



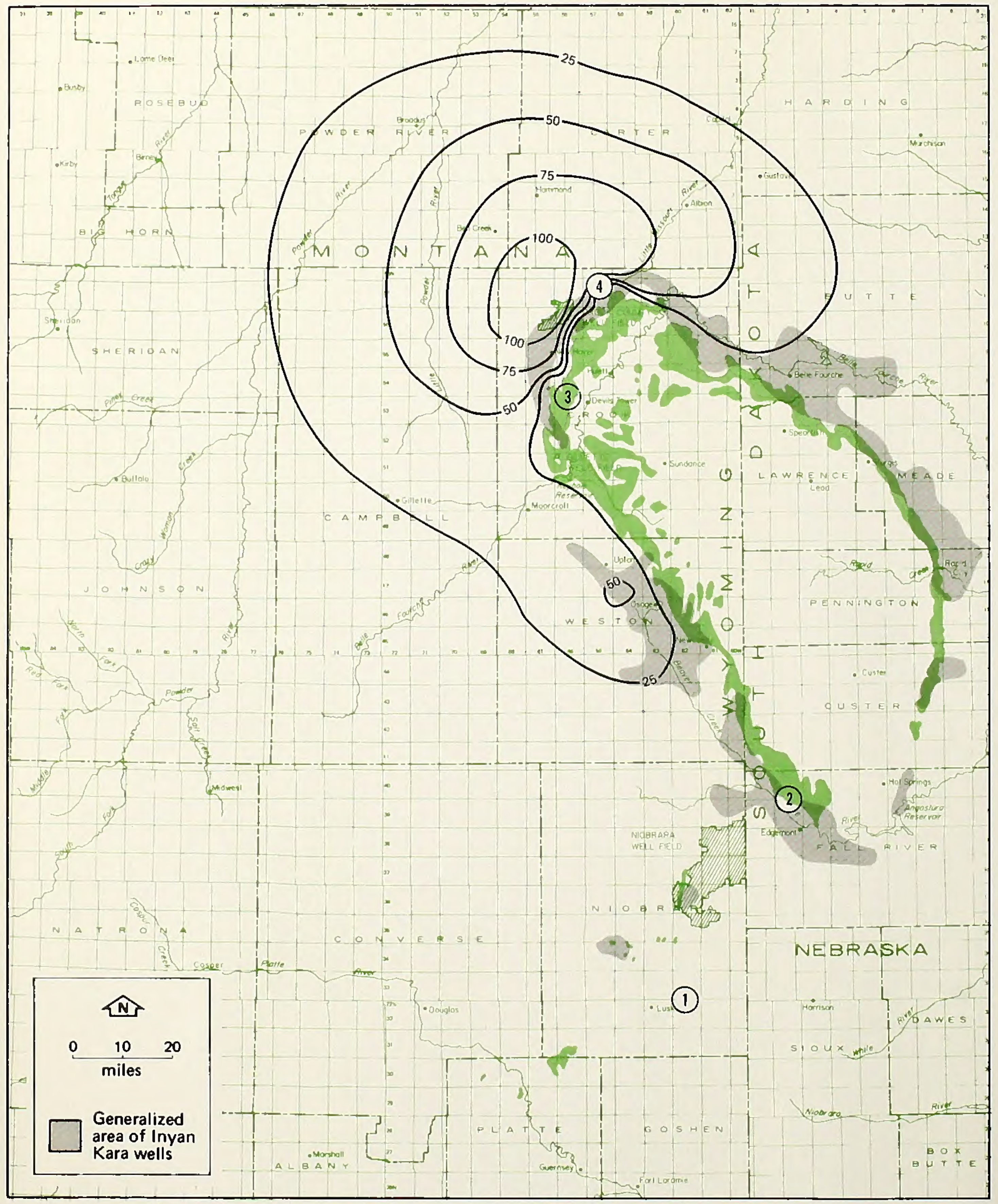
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

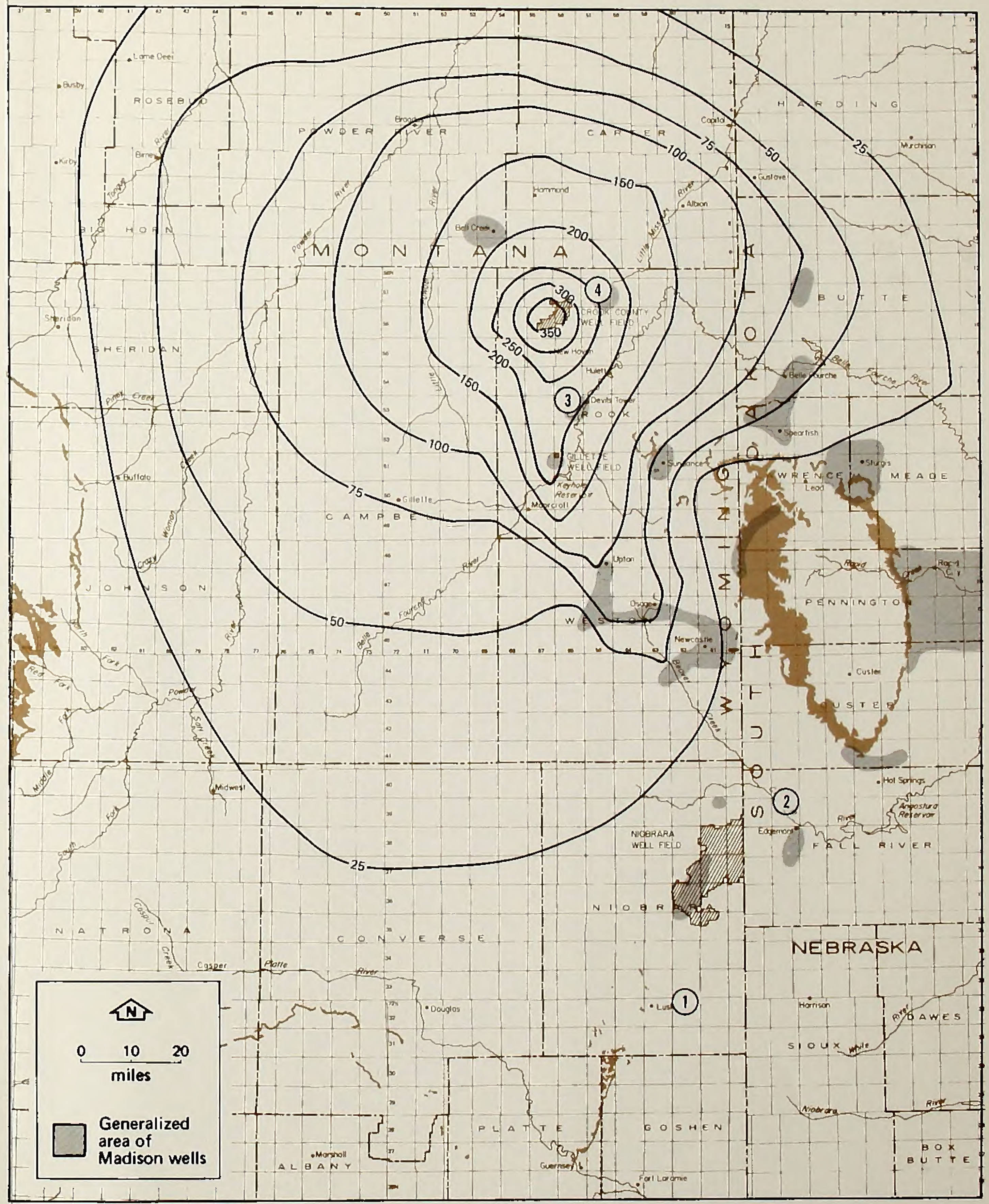
Inyan Kara wells affected by more than 25 feet of water-level declines as a result of Madison ground-water withdrawals were located in two areas: south and east of the Crook County well field, and the Upton-Osage-Newcastle area (Table 5-7). In the area near the Crook County well field and where the Inyan Kara aquifer is confined, about 25 to 100 feet of drawdown was calculated to occur. In the Upton-Osage-Newcastle area, up to 50 feet of water-level declines were calculated to occur in confined portions of the Inyan Kara aquifer. Outside these areas, drawdowns were calculated to be less than 25 feet.

INYAN KARA

Almost all Madison wells in northeastern Wyoming, southwestern Montana, and northwestern South Dakota were calculated to be affected by more than 25 feet of water-level decline (Table 5-7). The greatest declines would occur at the Crook County well field and toward the south and southeast, where large Madison ground-water withdrawals would have taken place at the Gillette well field by the city of Gillette and near Osage by Black Hills Power and Light. Madison ground-water levels were calculated to decline by 170 to 230 feet at Bell Creek, Devils Tower, Hulett, and the Gillette well field; about 100 feet at Osage and Upton; 55 to 65 feet at Belle Fourche and Sundance; and 30 to 35 feet at Newcastle and Spearfish. Other Madison wells were calculated to have less than 25 feet of water-level declines.

MADISON





Inyan Kara outcrop

Madison outcrop

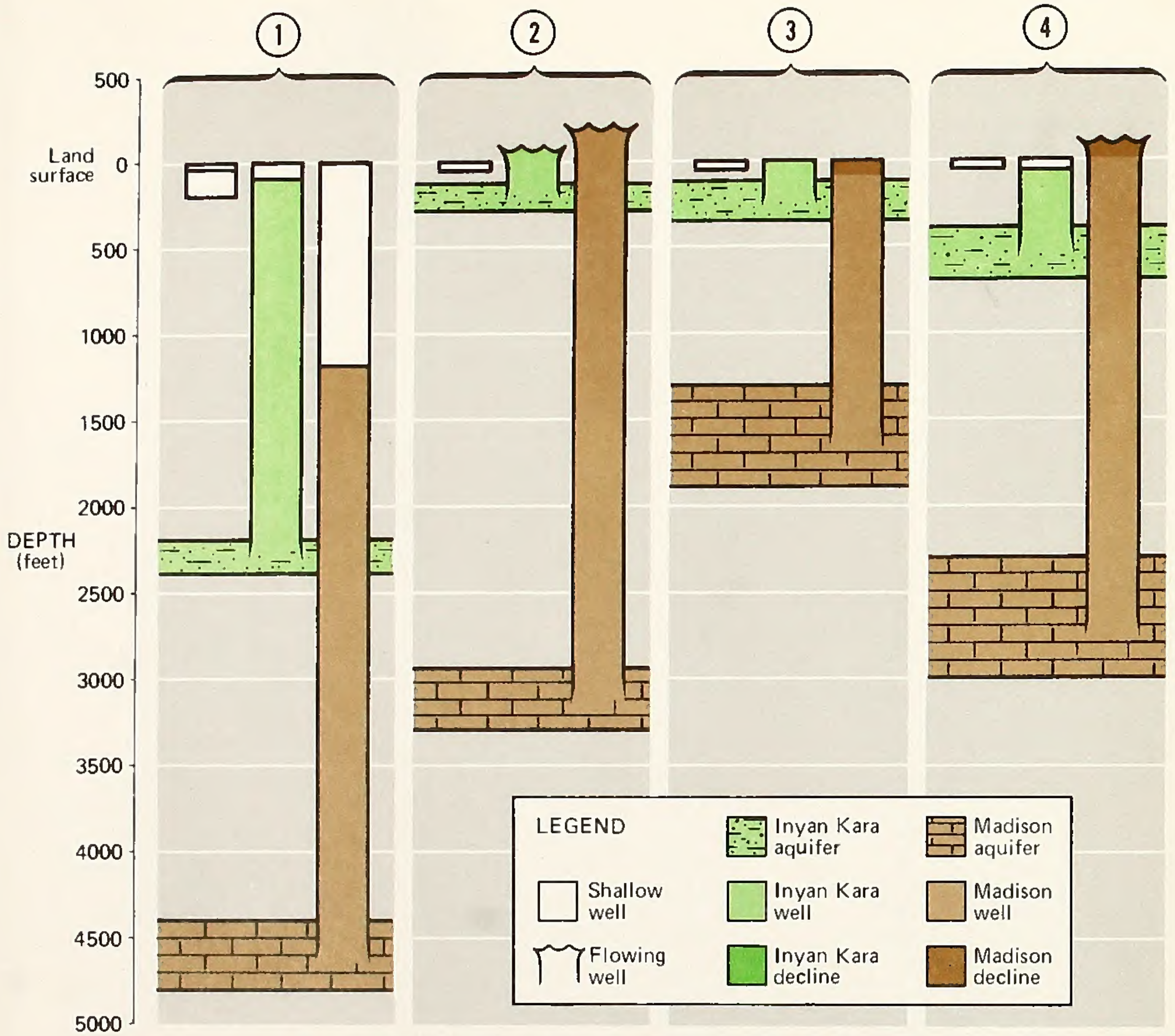
① Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 3 — ETSI pumping from Crook County well field only

Map 5-14. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 50 YEARS, PLAN 3, CUMULATIVE CASE



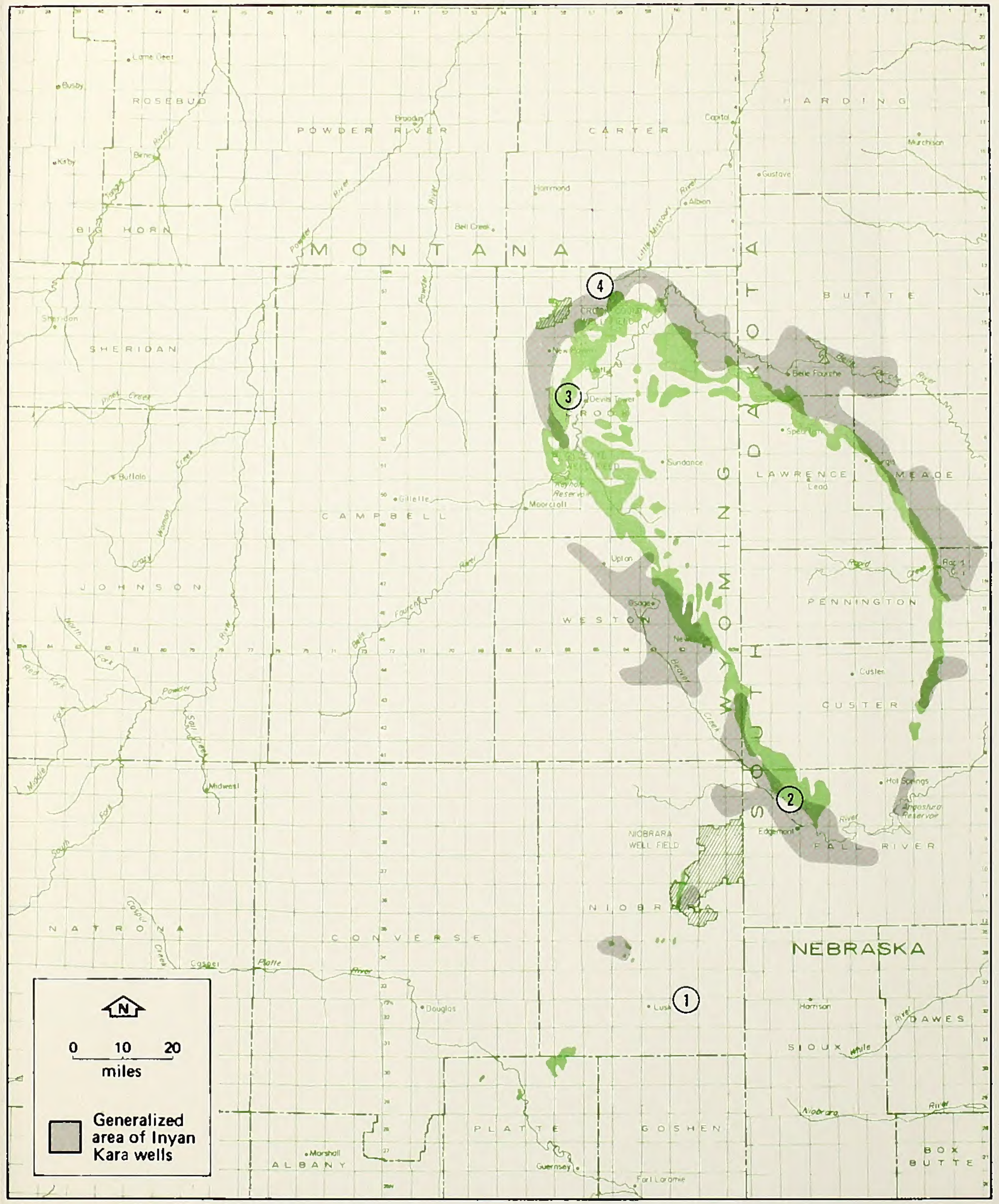
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

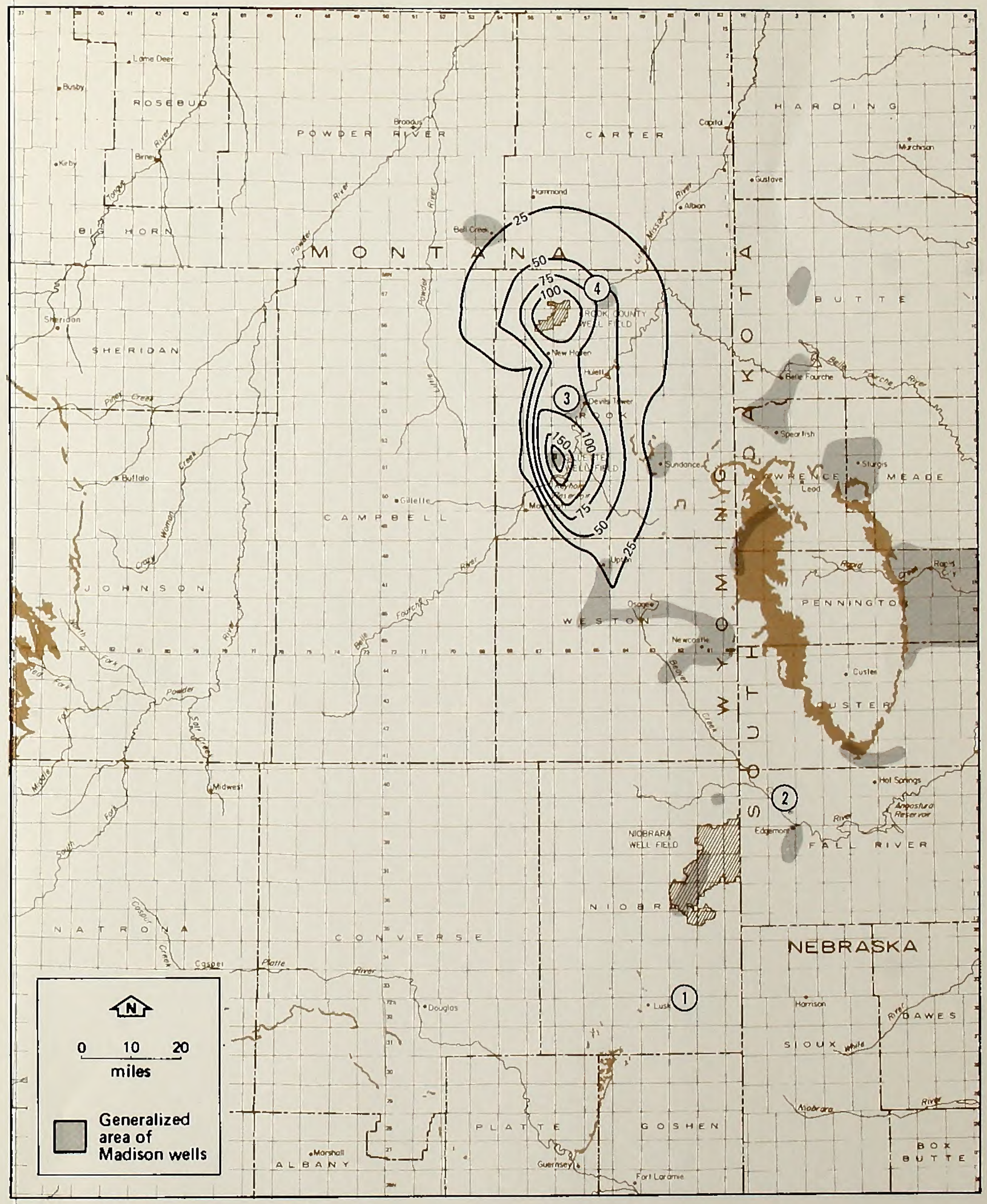
Inyan Kara water levels were calculated to decline by less than 10 feet by 1990 as a result of pumping from the Madison aquifer (Table 5-8).

Madison water-level declines were concentrated in two areas: the ETSI Crook County well field and the Gillette well field (Table 5-8). Declines were greatest in the Gillette well-field area, where Madison drawdowns were calculated to be about 220 feet. Only at Devils Tower (74 feet), Hulett (60 feet), and Upton (35 feet) did producing Madison wells have water-level declines of more than 25 feet. At the Crook County well field, where ETSI would be pumping, Madison water levels were calculated to decline by 140 feet.

INYAN KARA

MADISON





Inyan Kara outcrop

Madison outcrop

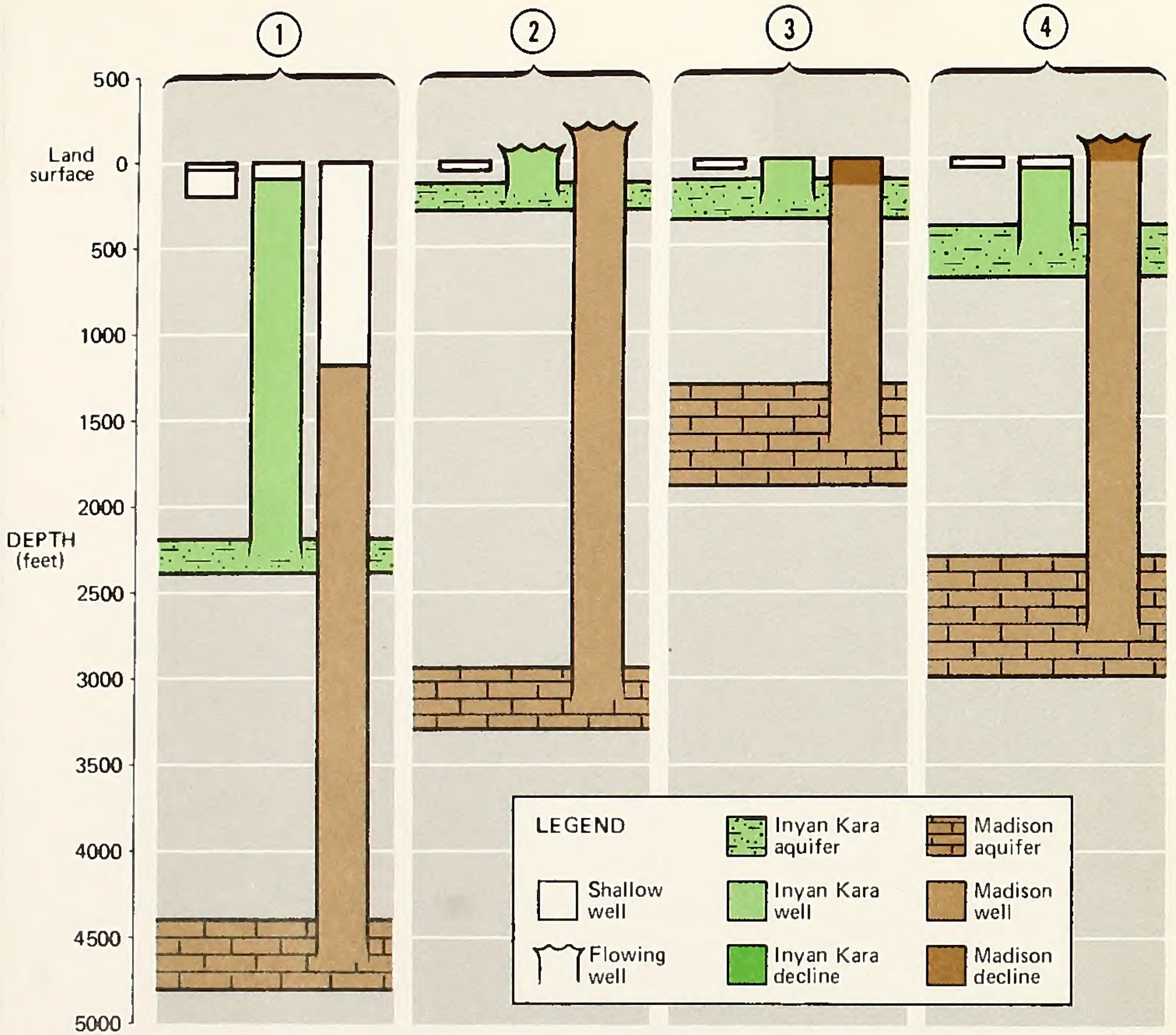
① Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 4 — ETSI pumping from Crook County and Gillette well fields

Map 5-15. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 5 YEARS, PLAN 4, CUMULATIVE CASE



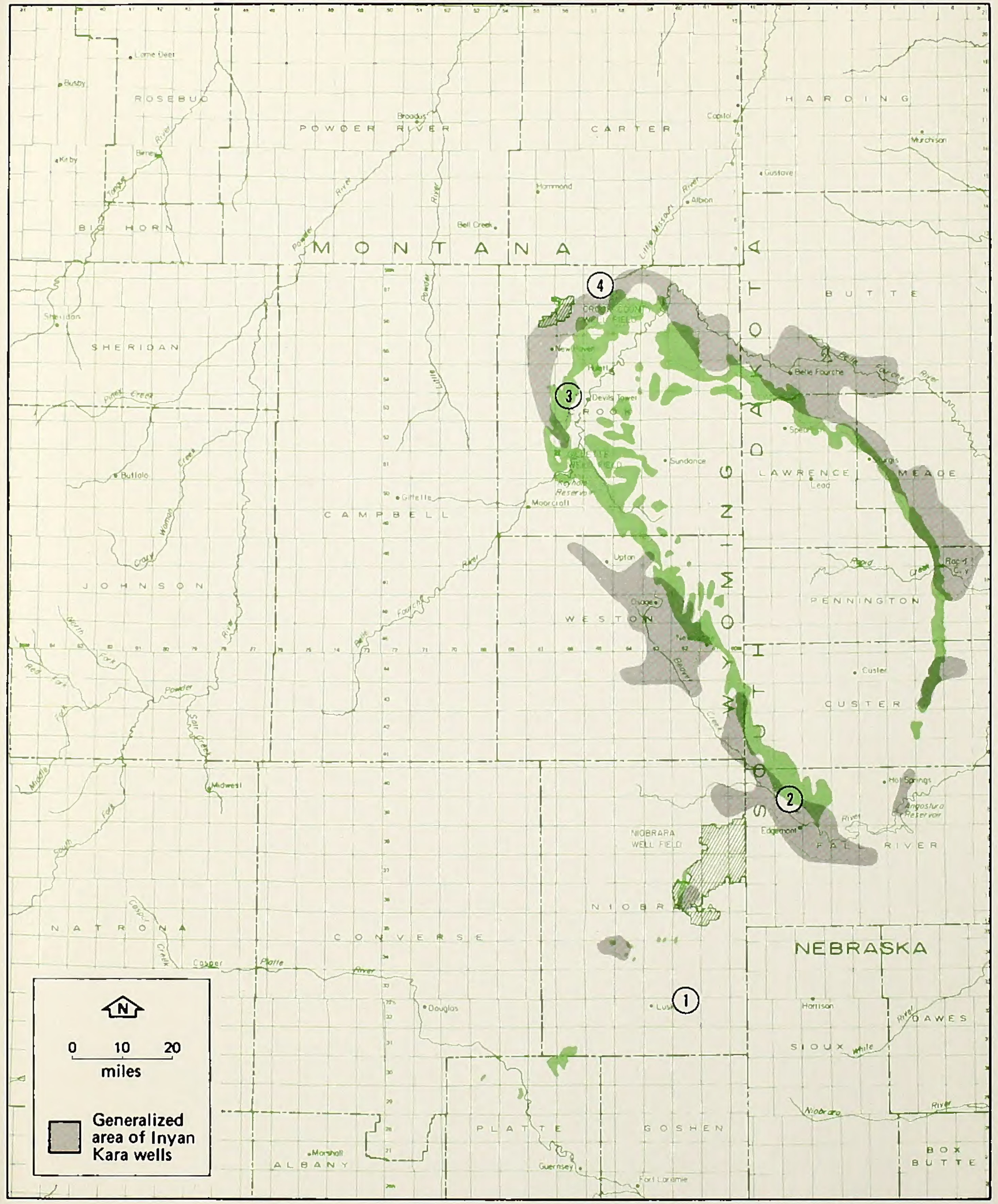
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

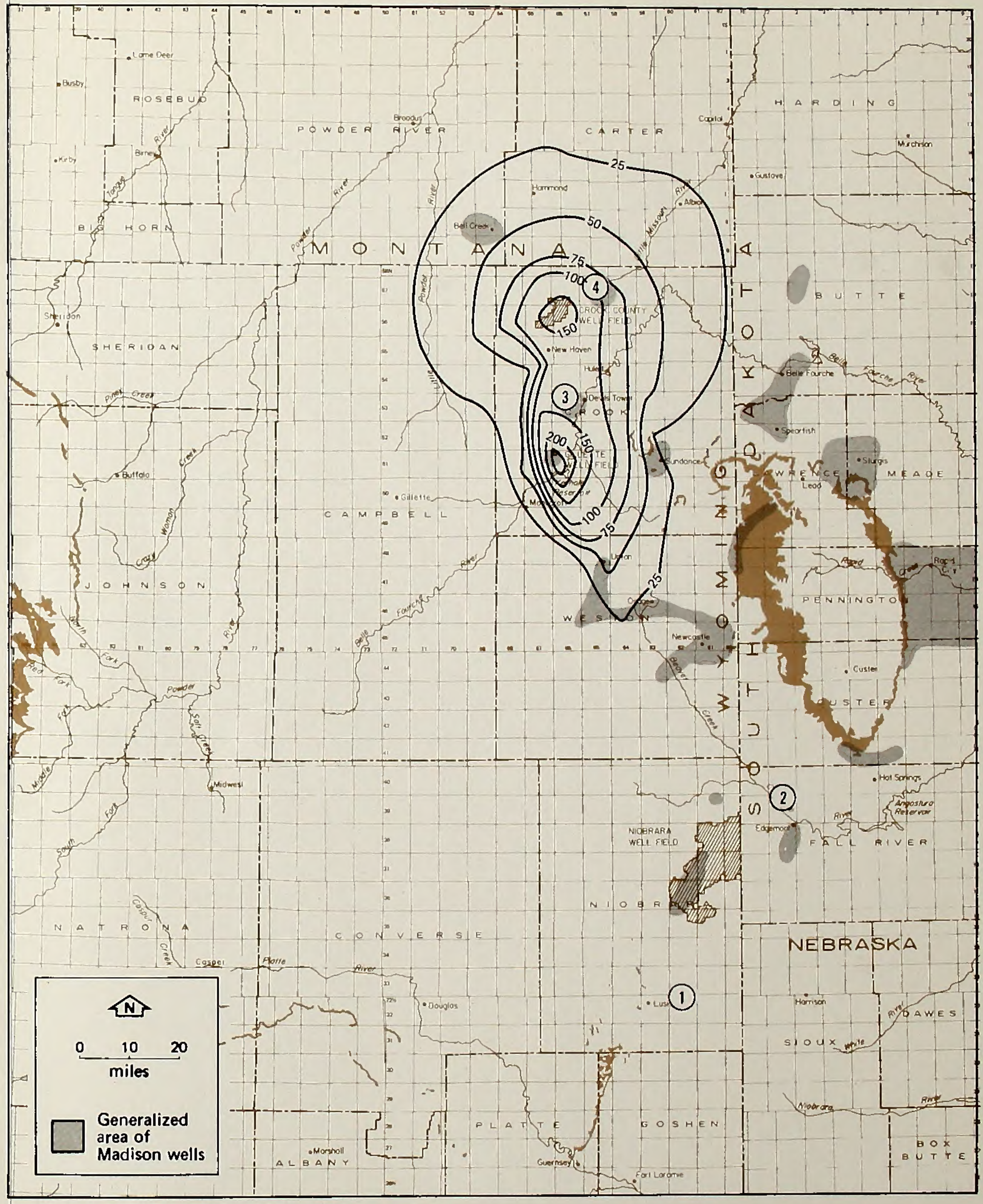
Inyan Kara water levels were calculated to decline by less than 25 feet as a result of pumping from the Madison aquifer (Table 5-8).

INYAN KARA

The areas in which Madison water-level declines of more than 25 feet were calculated to occur increased radially outward, except toward the southeast where Madison outcrops occur (Table 5-8). Water levels in Madison wells at Bell Creek, Devils Tower, Hulett, the Gillette well field, Sundance, and Upton would have declined by about 40, 120, 90, 280, 30, and 60 feet, respectively. No Madison wells in South Dakota were calculated to have more than 25 feet of water level decline.

MADISON





Inyan Kara outcrop

Madison outcrop

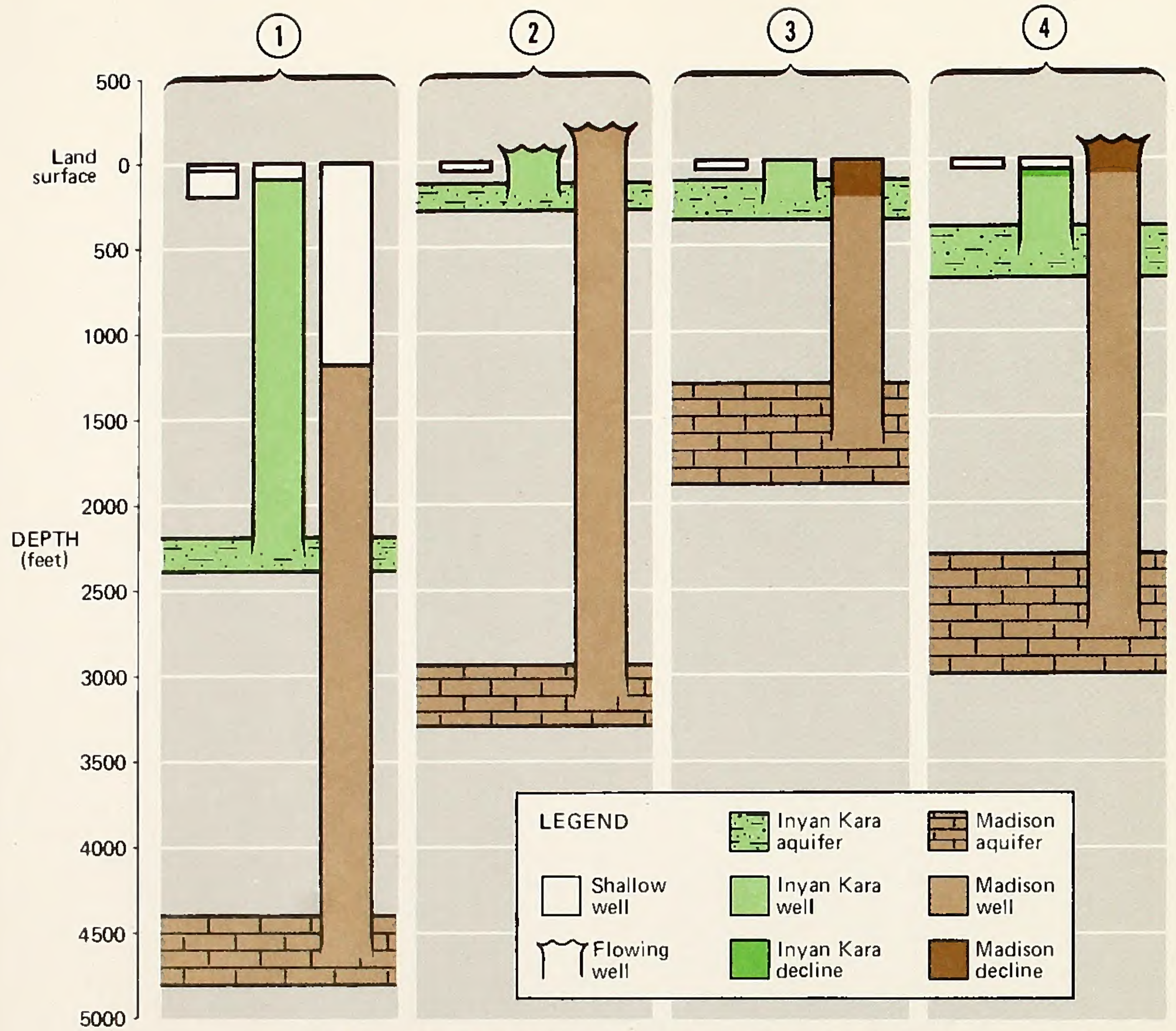
① Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 4 — ETSI pumping from Crook County and Gillette well fields

Map 5-16. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 10 YEARS, PLAN 4, CUMULATIVE CASE



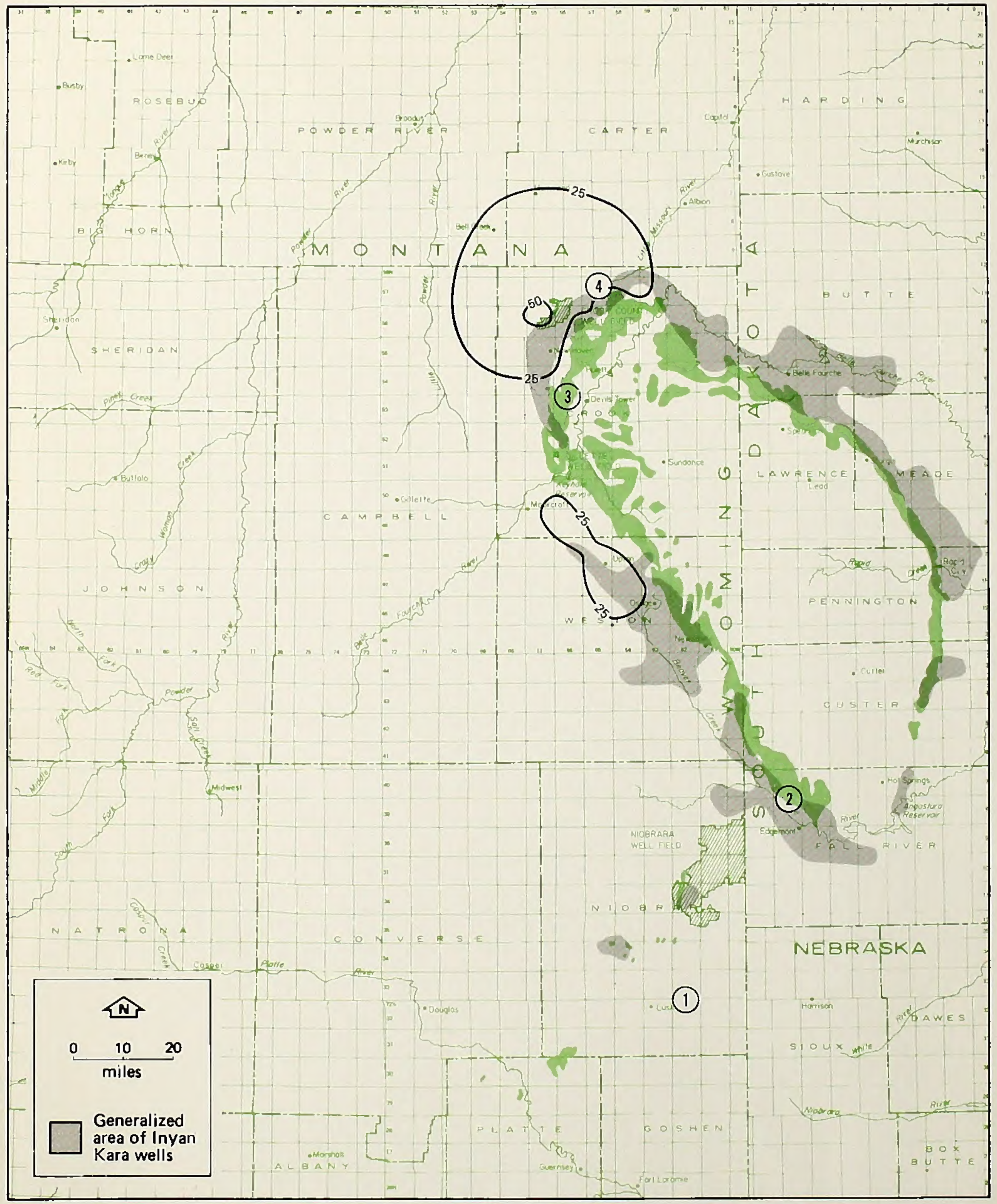
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

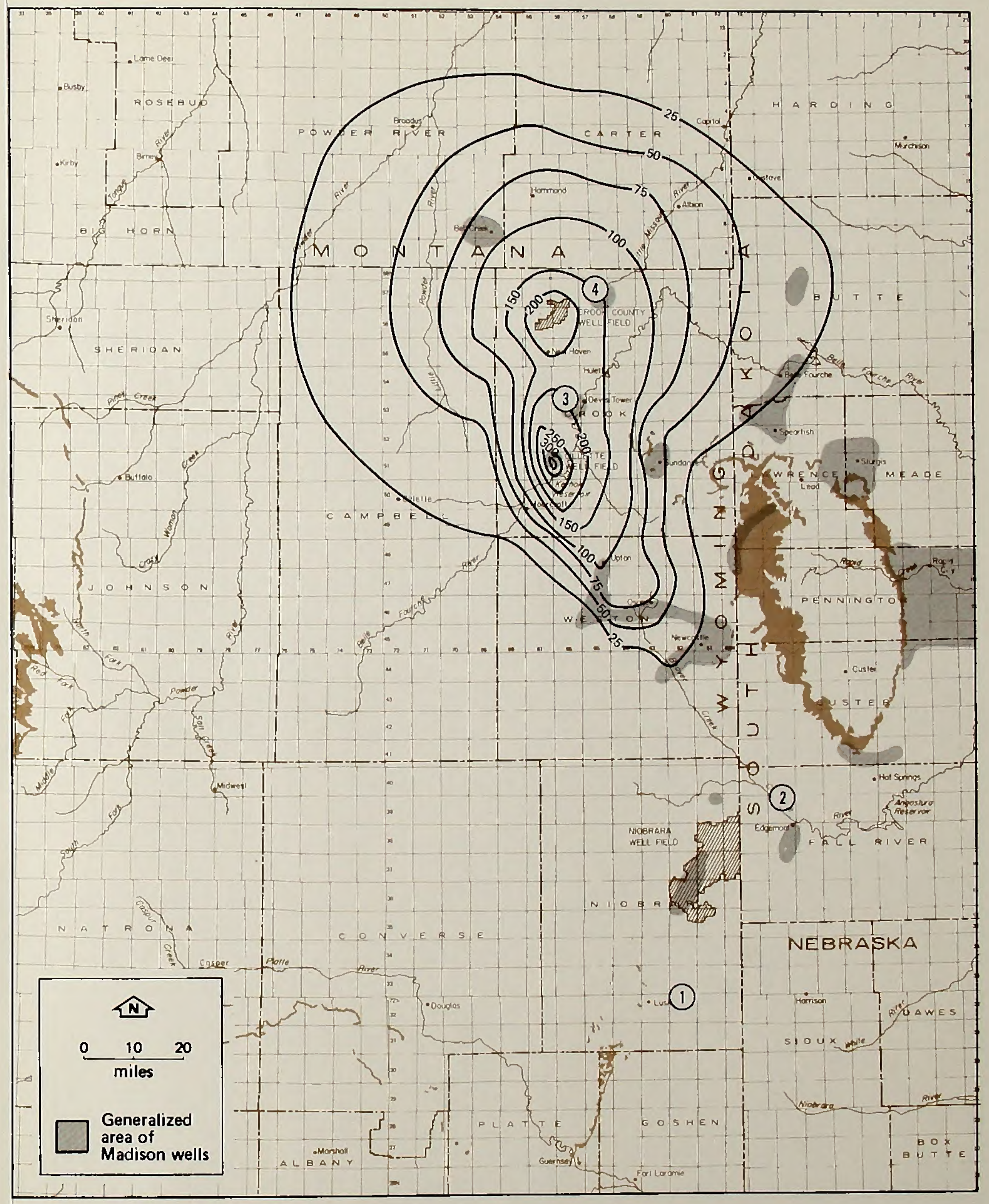
A relatively small number of Inyan Kara wells were calculated to have more than 25 feet of drawdown 25 years after ETSI would begin pumping, as a result of pumping from the Madison aquifer. South and east of the Crook County well field, and in the Upton-Osage area, Inyan Kara water levels were calculated to have between 25 and 50 feet of decline (Table 5-8).

INYAN KARA

Madison water wells in parts of northwestern South Dakota and Osage, as well as those described earlier for the 10-year interval (Map 5-16), would be affected by more than 25 feet of water-level decline (Table 5-8). Declines would be greatest at Madison wells in the Gillette well field (350 feet). Madison wells at Upton, Hulett, and Devils Tower were calculated to have water-level declines of 110, 150, and 180 feet, respectively. At Osage, Sundance, and Bell Creek, Madison water levels were calculated to decline by about 60 to 90 feet, while water levels in Madison wells in western Butte County would decline by less than about 30 feet. Madison wells outside this area, including the Spearfish and Newcastle areas, were calculated to have less than 25 feet of water-level decline 25 years after ETSI would begin pumping.

MADISON





Inyan Kara outcrop

Madison outcrop

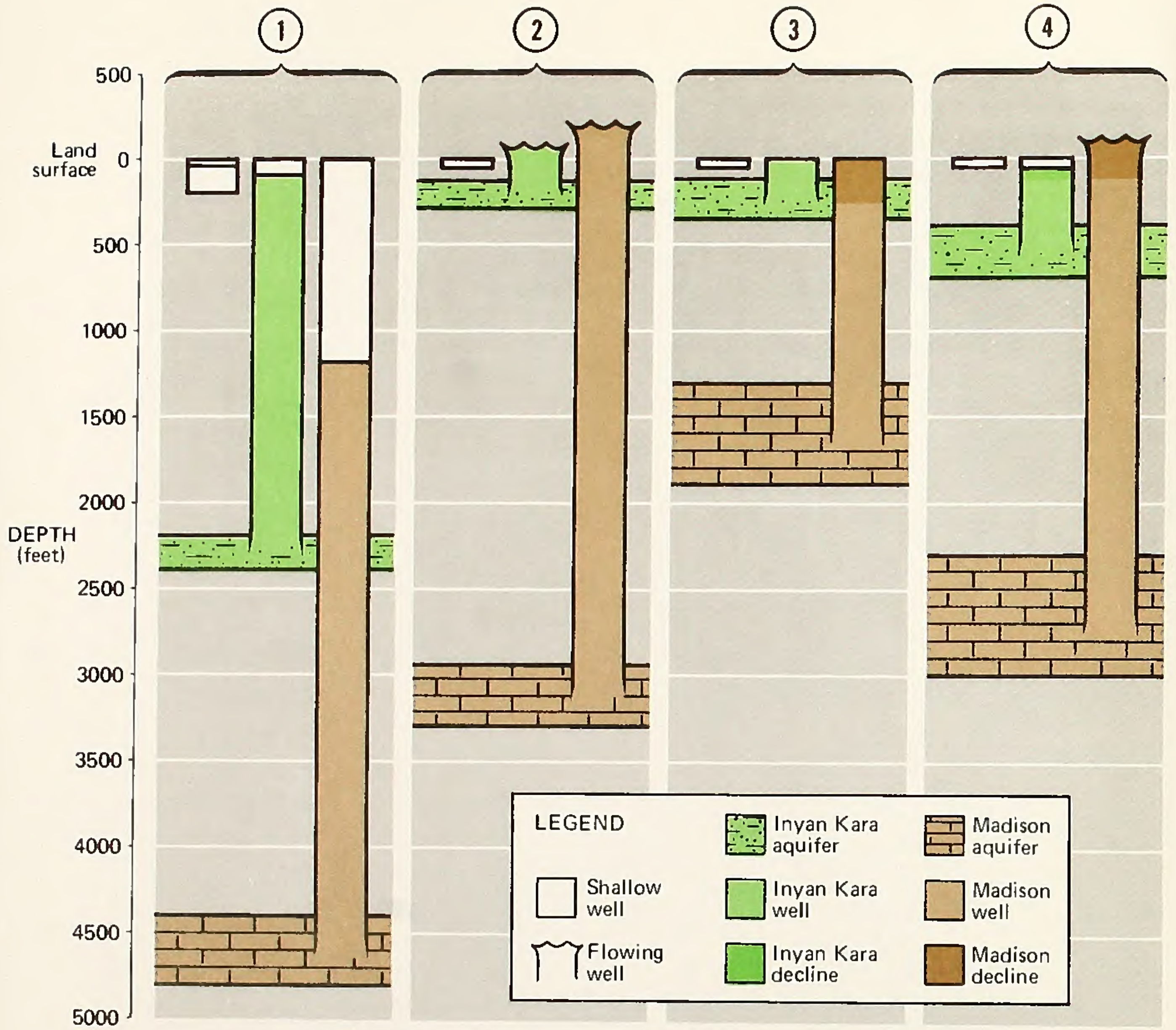
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 4 — ETSI pumping from Crook County and Gillette well fields

Map 5-17. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 25 YEARS, PLAN 4, CUMULATIVE CASE



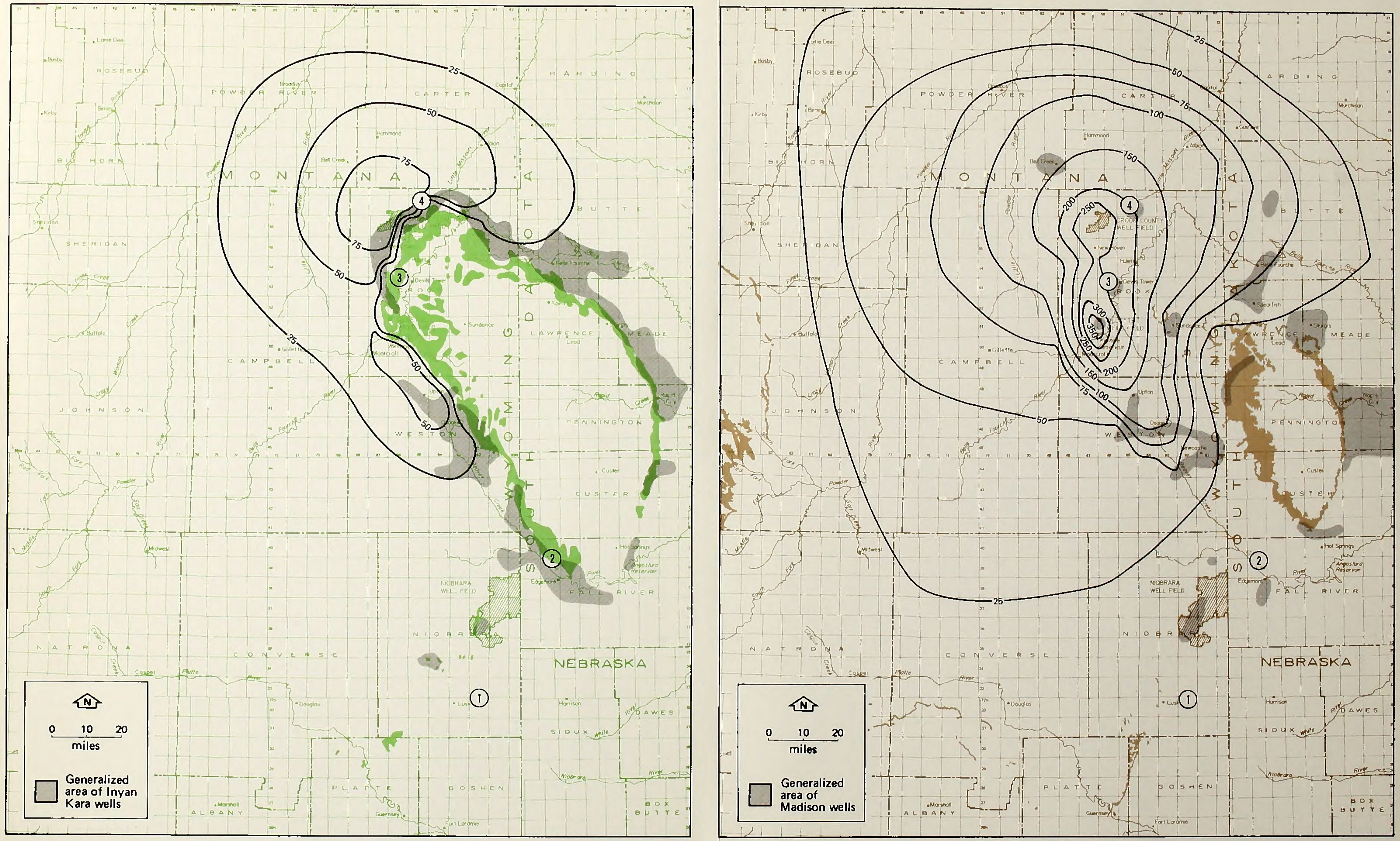
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

Inyan Kara wells south and east of the Crook County well field were calculated to have up to 80 feet of drawdown 50 years after ETSI began pumping (Table 5-8). The greatest decline would occur near the Crook County well field, with lesser declines in water levels toward the south and east. No areas of Inyan Kara wells in South Dakota would be affected by more than 25 feet of drawdown as a result of Madison ground-water withdrawals. In the Upton-Osage area, about 25 to 55 feet of drawdown was calculated to occur in Inyan Kara wells. Inyan Kara wells in and south of the Newcastle area were calculated to have less than 25 feet of water-level decline.

INYAN KARA

Madison wells affected by more than 25 feet of drawdown 50 years after ETSI would begin pumping were similar to those affected 25 years after ETSI would begin pumping (Map 5-17). Only in the Spearfish and Newcastle areas, where about 30 to 50 feet of water-level decline would occur, were additional Madison wells affected (Table 5-8). Between 40 and 90 feet of water-level decline was calculated to occur near Newcastle, Belle Fourche, and Sundance. Madison wells at Osage, Upton, and Bell Creek were calculated to have declines between 110 and 150 feet. Madison wells at Devils Tower, Hulett, and the Gillette well field were calculated to have 230, 200, and 400 feet of drawdown, respectively. Madison wells in and near Madison outcrop areas were calculated to have less than 25 feet of drawdown.

MADISON



Inyan Kara outcrop

Madison outcrop

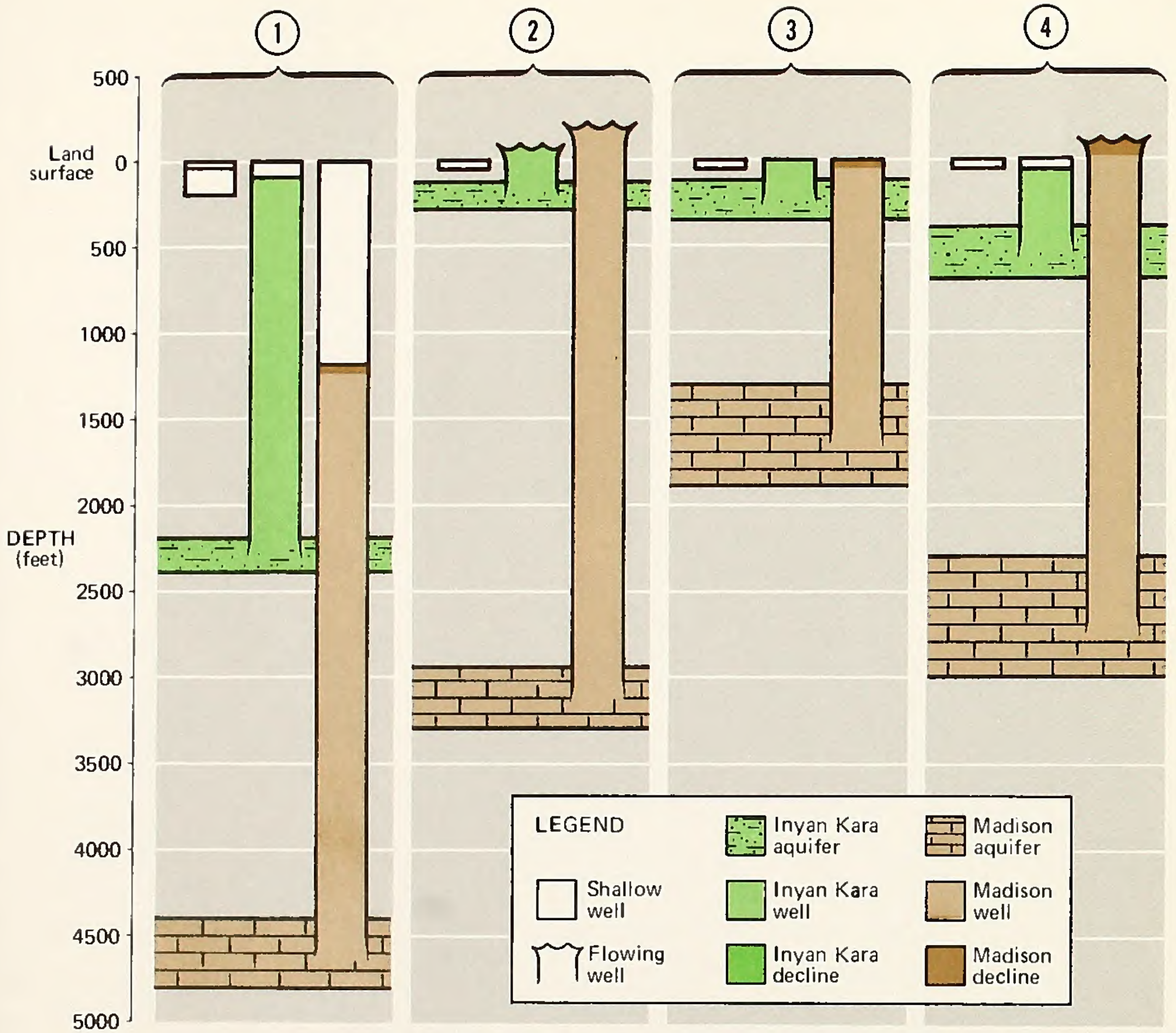
Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 5 — ETSI pumping from Niobrara and Crook County well fields

Map 5-18. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 50 YEARS, PLAN 4, CUMULATIVE CASE



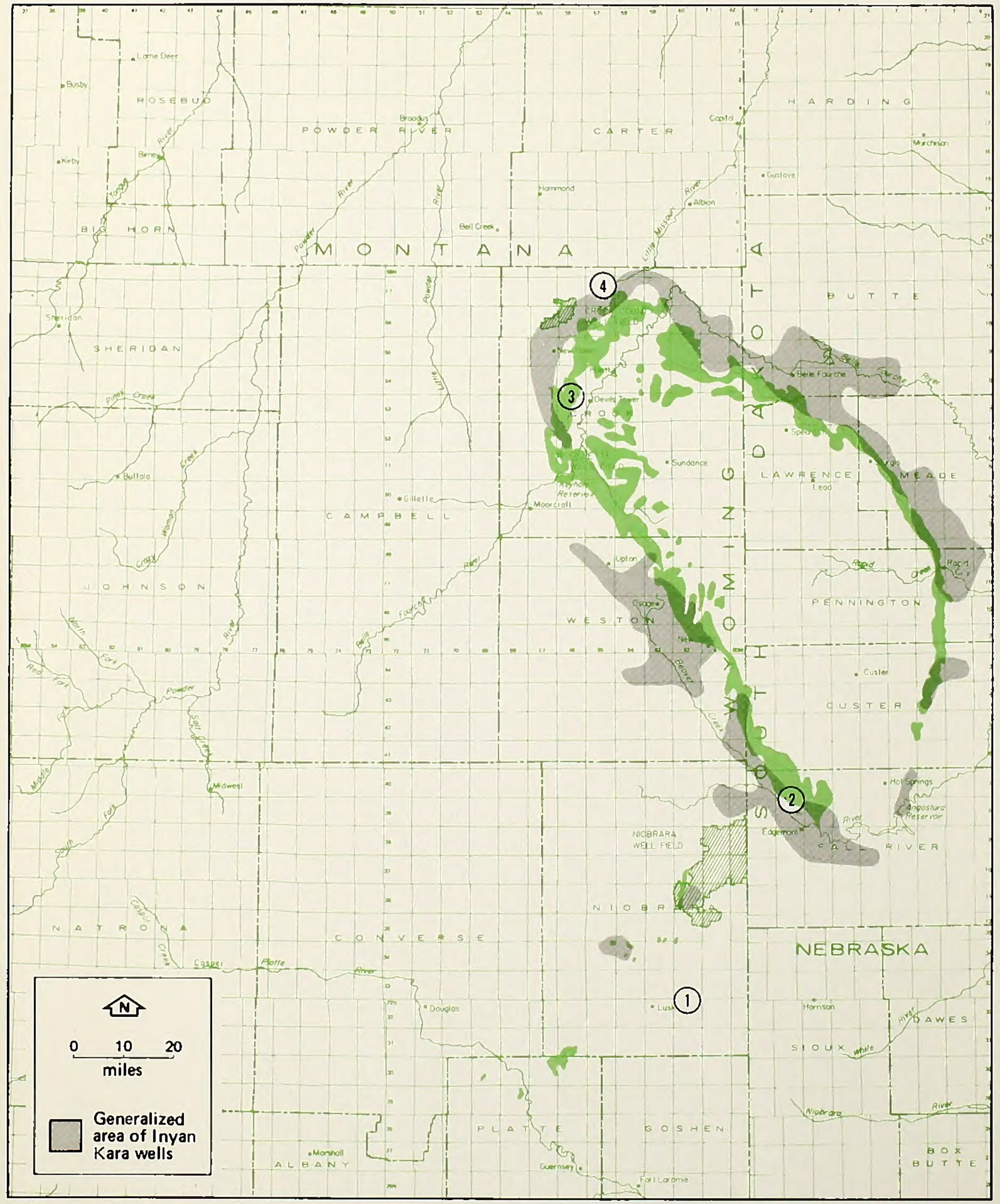
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

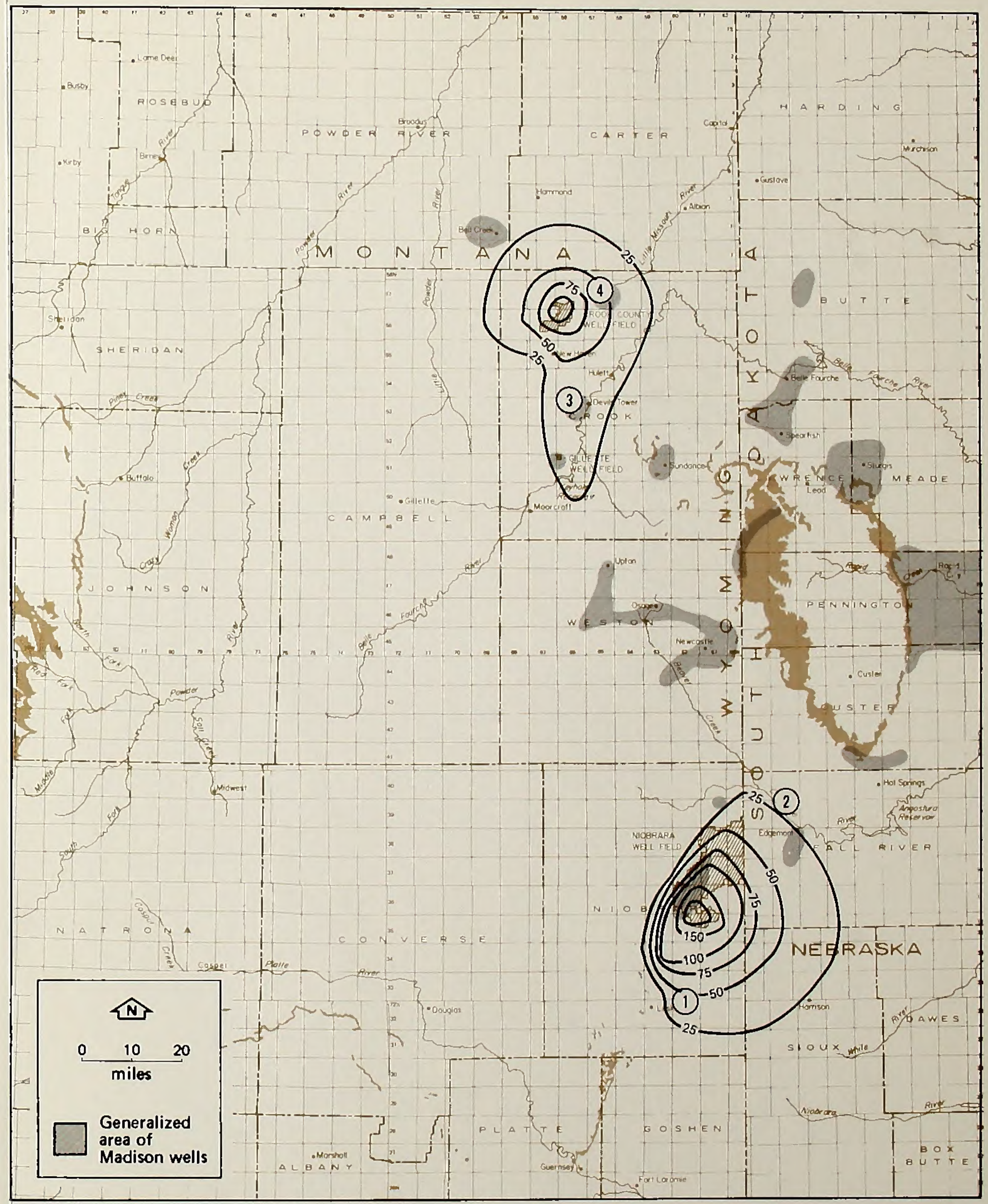
Water levels in all Inyan Kara wells were calculated to decline by less than 6 feet throughout the study area as a result of pumping from the Madison aquifer. Most of this decline was calculated to occur at the Niobrara and Crook County well fields (Table 5-9).

INYAN KARA

Except in the ETSI well fields, the Madison potentiometric surface was calculated to decline by less than 50 feet throughout the simulated area (Table 5-9). These declines were located in two general areas: in the vicinity of the Niobrara County well field, and near the Crook County and Gillette well fields. Near the Niobrara County well field, only the Edgemont-Provo area was calculated to be significantly affected, with a Madison potentiometric surface decline of about 25 to 30 feet. Near the Crook County and Gillette well fields, only the Madison wells at the Gillette well field (45 feet), Hulett (25 feet), and Devils Tower (30 feet) were calculated to be more than 25 feet. Water levels in the Madison wells at Bell Creek were calculated to decline by 18 feet. All other Madison wells would have water-level declines of less than 11 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

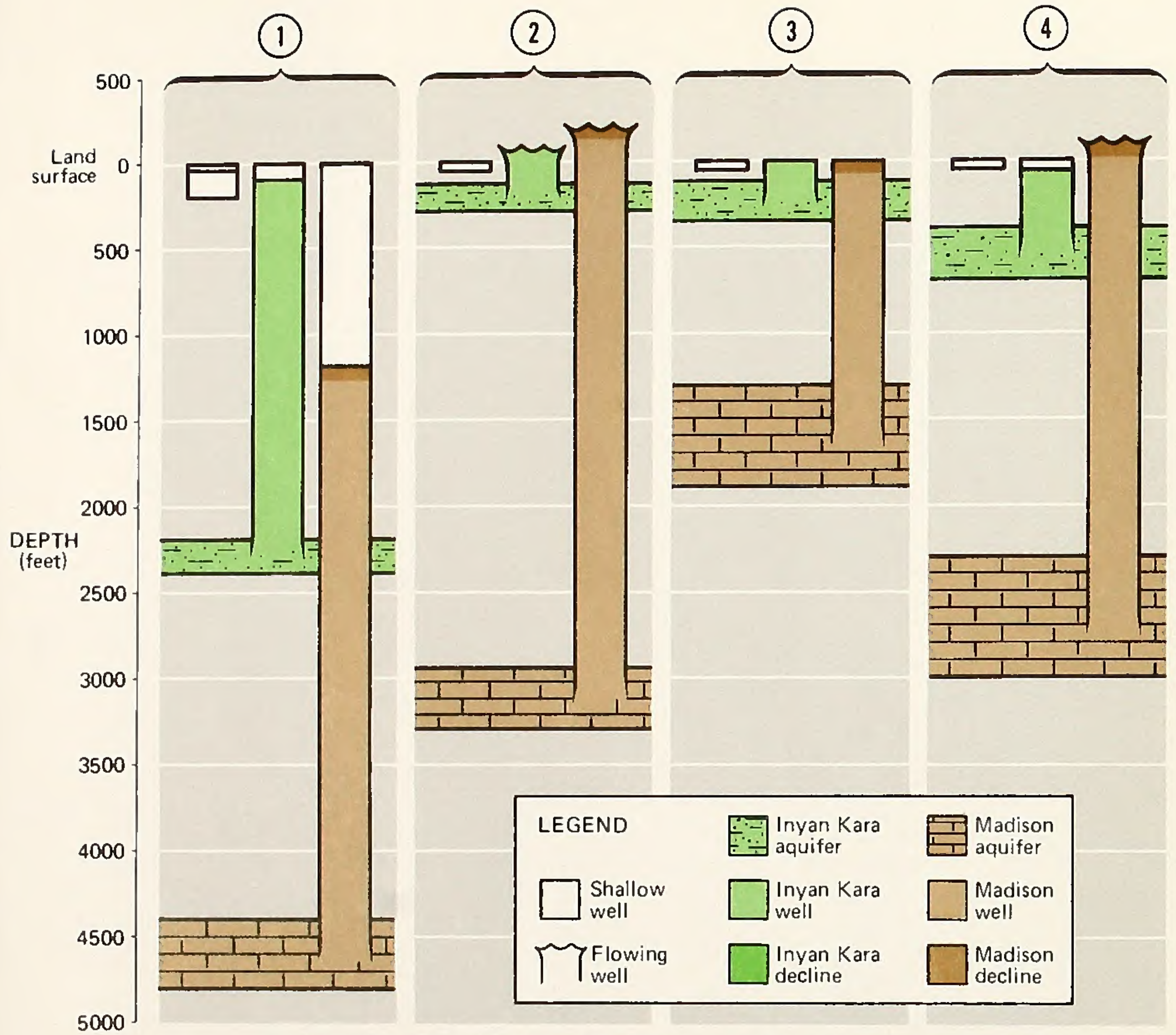
Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 5 — ETSI pumping from Niobrara and Crook County wall fields

Map 5-19. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 5 YEARS, PLAN 5, CUMULATIVE CASE



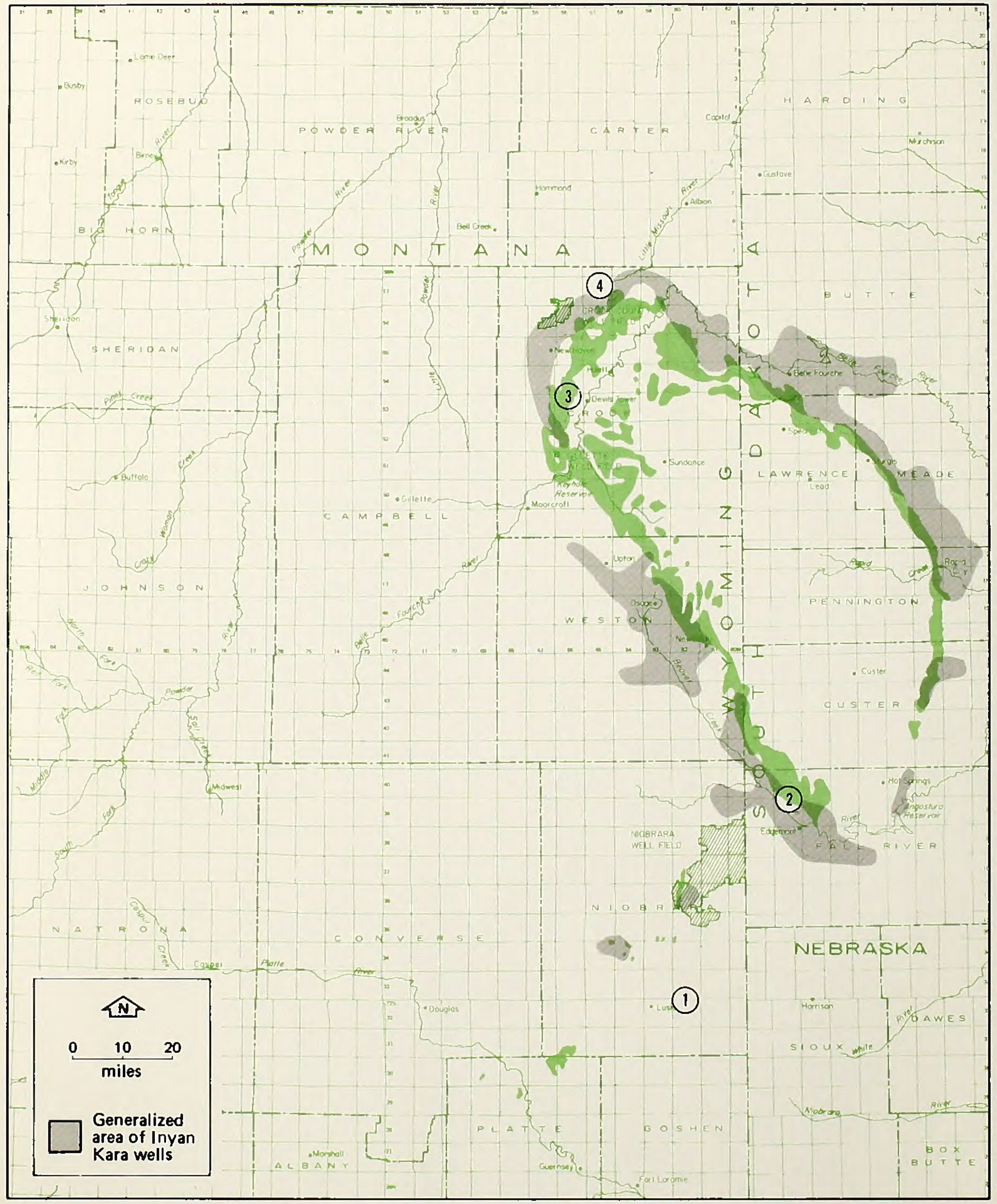
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

Water levels in Inyan Kara wells would generally not be affected in 1995 (Table 5-9). Near the Niobrara and Crook County well fields, wells in confined parts of the Inyan Kara aquifer were calculated to have up to about 23 feet of decline. Near Upton, Osage, and Provo, Inyan Kara water levels would decline by about 6 feet. Other areas would have declines of less than 6 feet.

INYAN KARA

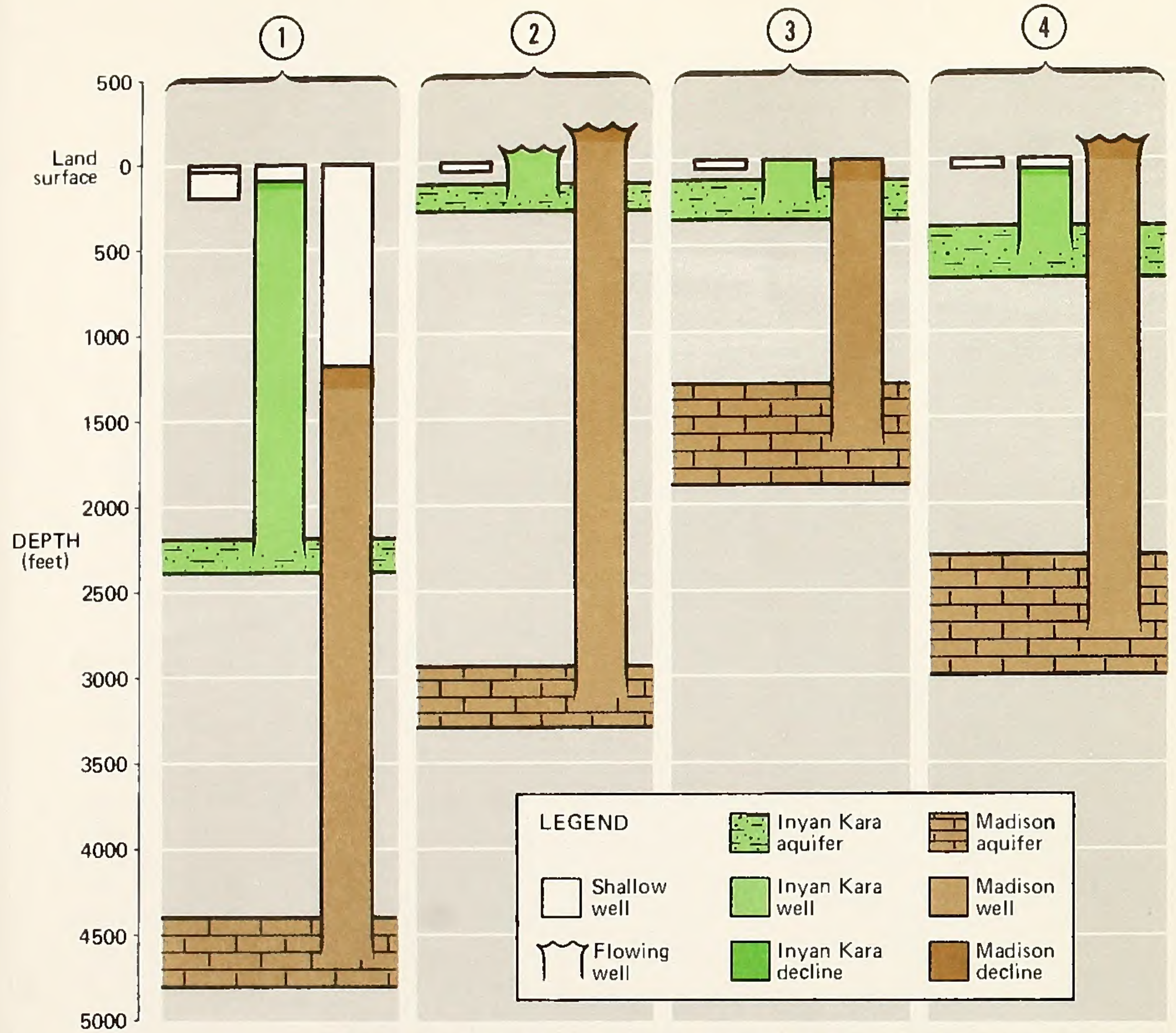
The Madison wells affected in 1995 by Madison aquifer pumping were similar to those described for Plan 5 in 1990 (Map 5-19). Madison potentiometric surface declines were less than 60 feet, except in Madison wells in the Niobrara County, Crook County, and Gillette well fields (Table 5-9). At these pumping centers, Madison water levels were calculated to decline by about 280, 140, and 64 feet, respectively. At Edgemont and Provo, declines were calculated to be about 50 to 60 feet in 1995. At Hulett, Devils Tower, and Bell Creek, Madison water levels were calculated to decline by 42, 49, and 33 feet, respectively. All other Madison wells would have less than 25 feet of water-level declines, except near Upton and Osage, where declines (due largely to pumping at these two communities) were calculated to be about 25 feet.

MADISON



Inyan Kara outcrop	① Location of typical wells of varying depths in affected aquifers	Cumulative case	Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI
Madison outcrop	25 Water-level declines (feet)	Plan 4	ETSI pumping from Crook County and Gillette well fields

Map 5-20. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 10 YEARS, PLAN 5, CUMULATIVE CASE



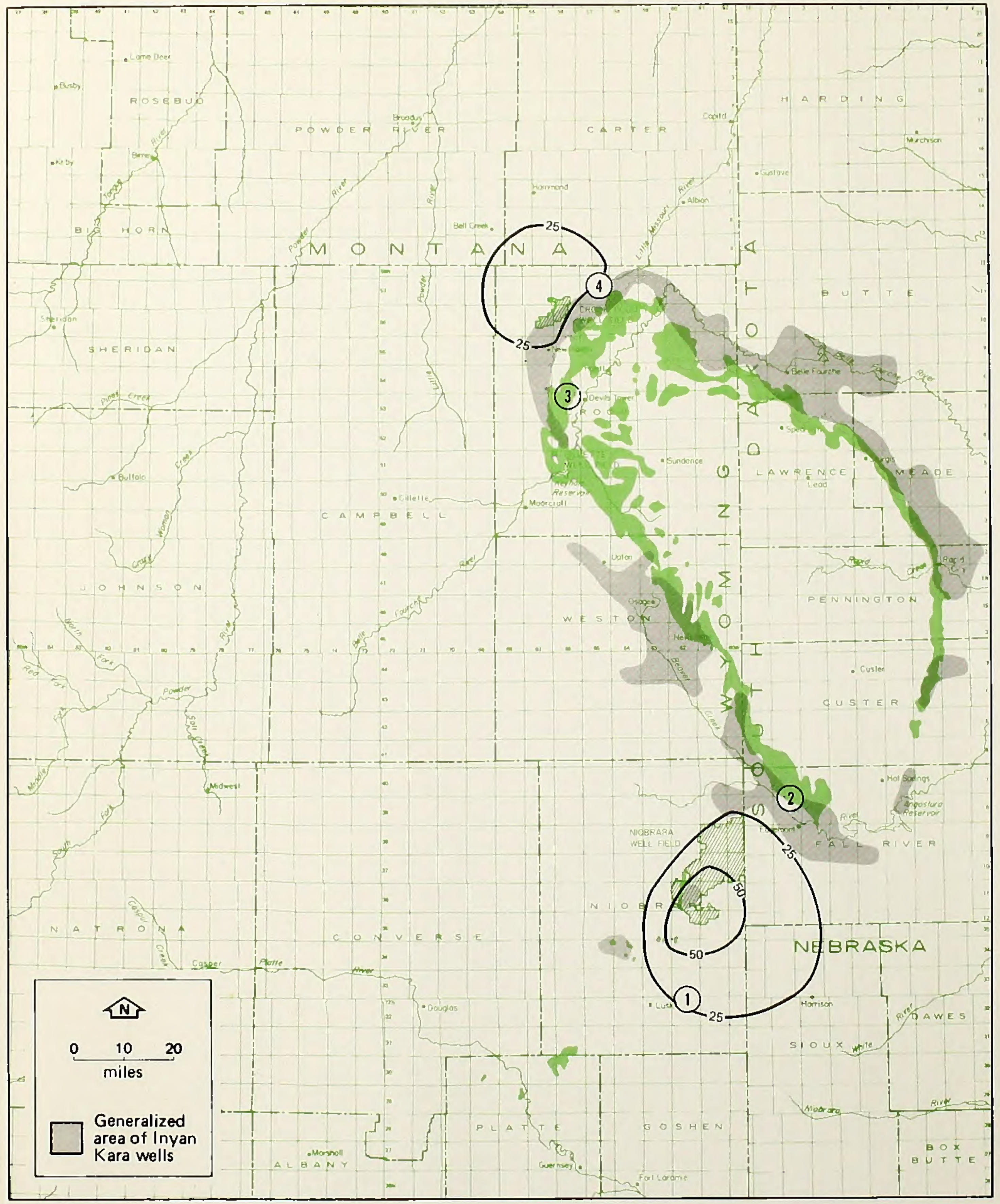
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

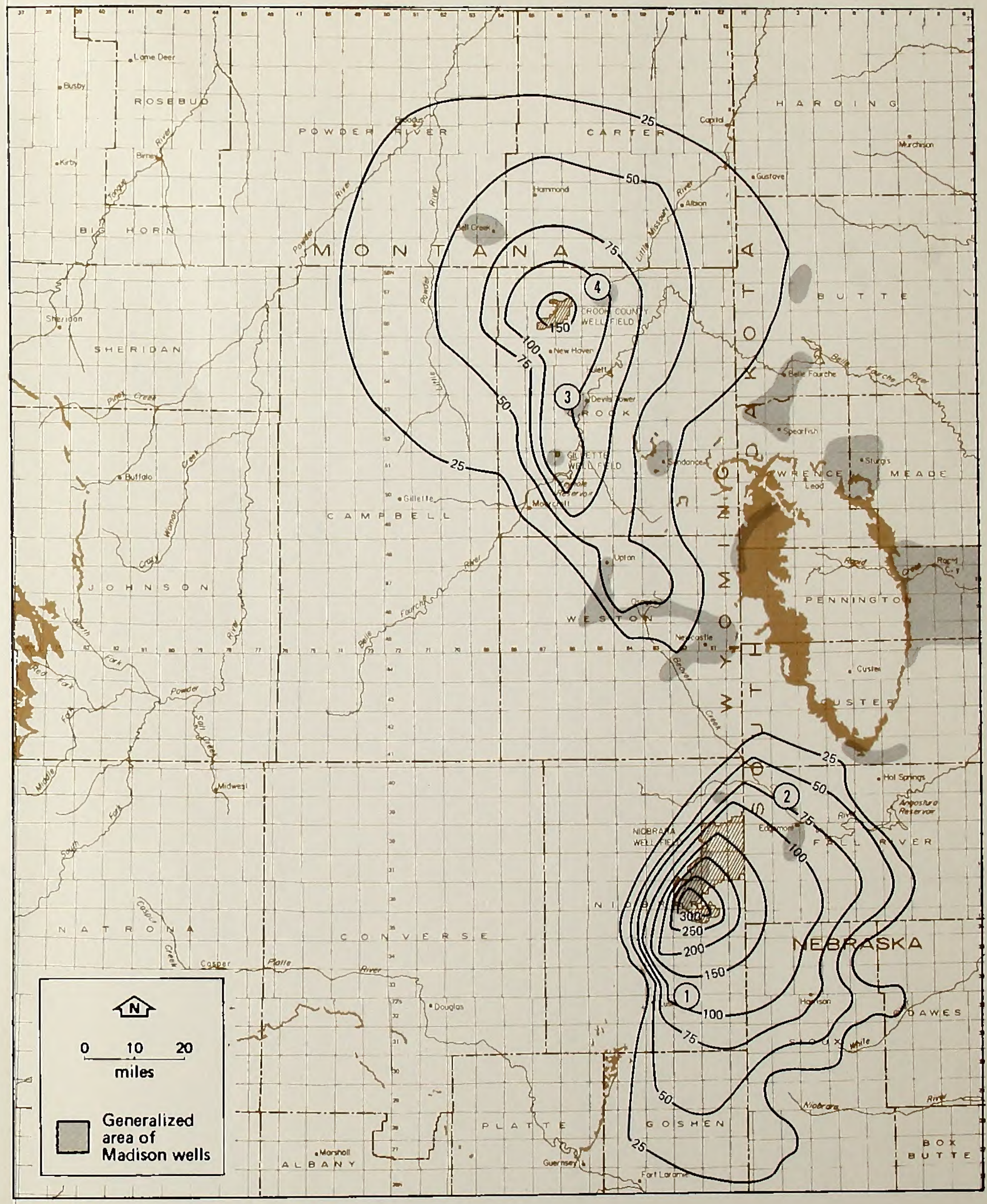
In the year 2010, 25 years after ETSI would begin pumping, only a few Inyan Kara wells near the Crook County well field, Upton-Osage, and the Niobrara County well field were calculated to be significantly affected by pumping from the Madison aquifer (Table 5-9). Water-level declines in confined portions of the Inyan Kara in these areas would be generally less than 30 feet, except in the Crook County and Niobrara well fields, where declines were calculated to be as much as 70 feet. Where the Inyan Kara aquifer is unconfined, water-level declines would be less.

INYAN KARA

The area of affected Madison wells in the year 2010 included the Bell Creek area, Crook County, the Upton-Osage-Newcastle area, and the Edgemont-Provo area (Table 5-9). Madison wells in western Butte and Lawrence counties, South Dakota, were not calculated to be significantly affected. Madison water levels at Bell Creek, Upton, and Osage were calculated to decline by about 55 to 65 feet; at Sundance, by about 30 feet; at Hulett, Edgemont, and Devils Tower, by about 80 to 95 feet; and at the Gillette well field, by about 140 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

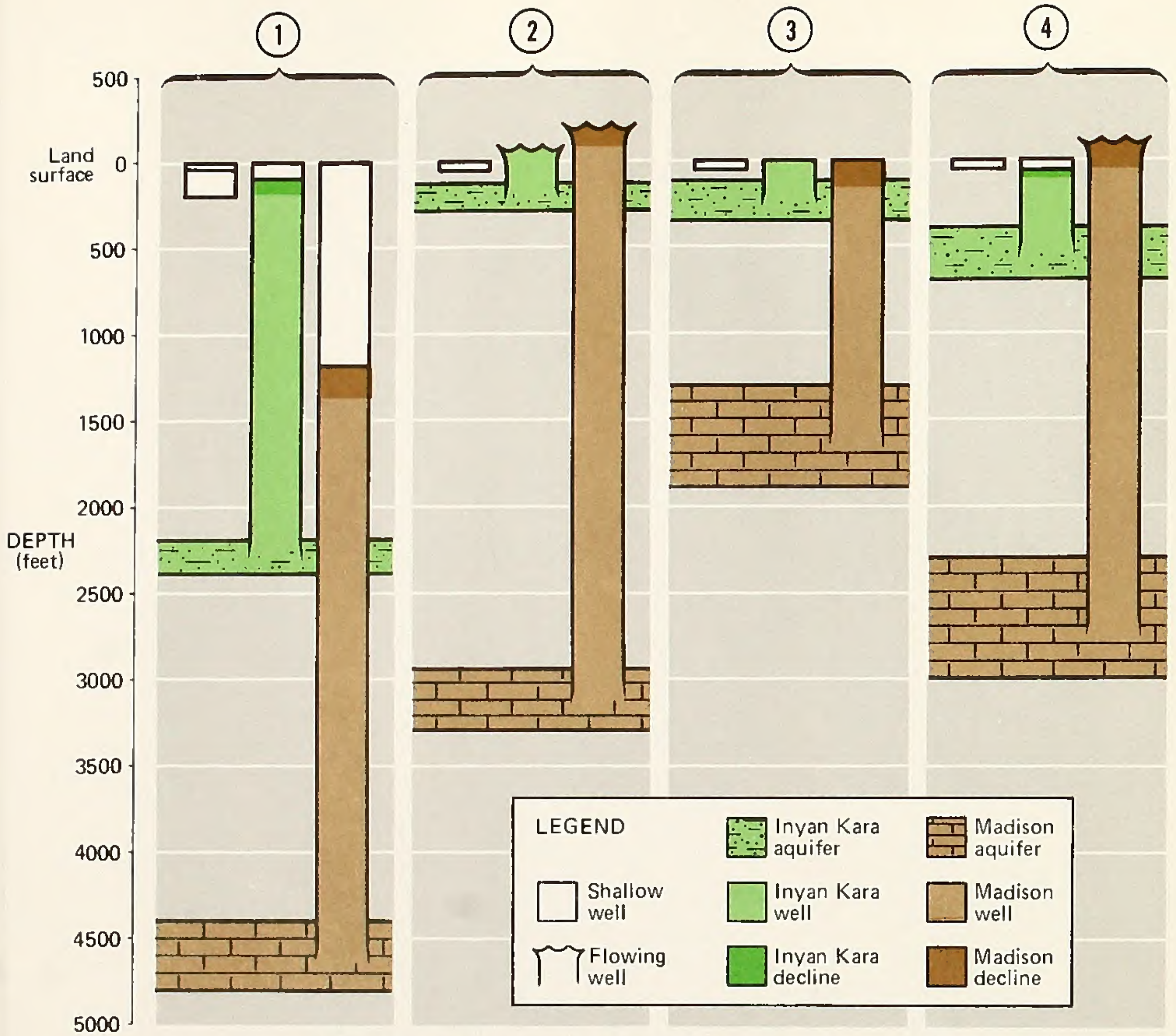
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 5 — ETSI pumping from Niobrara and Crook County well fields

Map 5-21. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 25 YEARS, PLAN 5, CUMULATIVE CASE



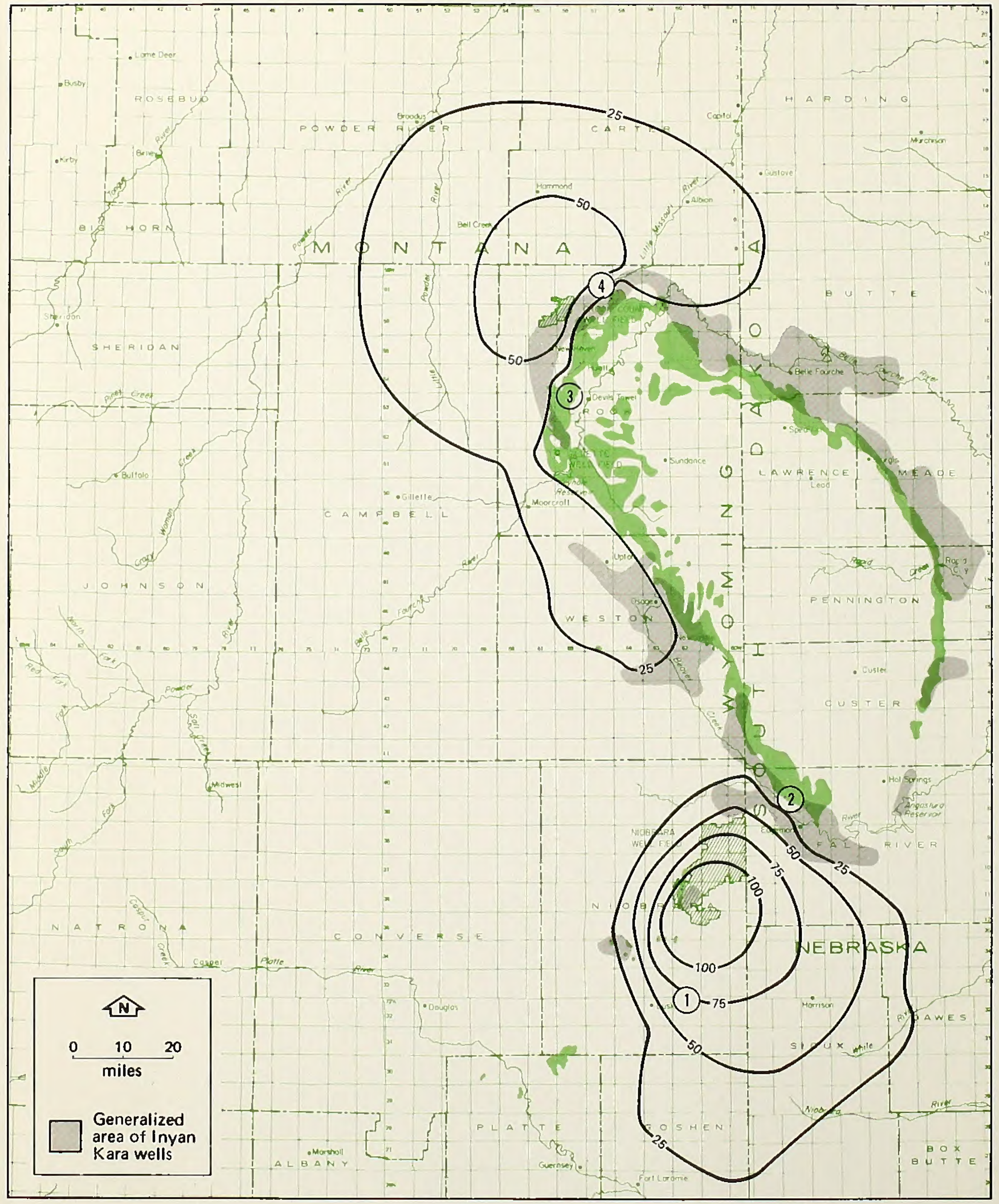
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

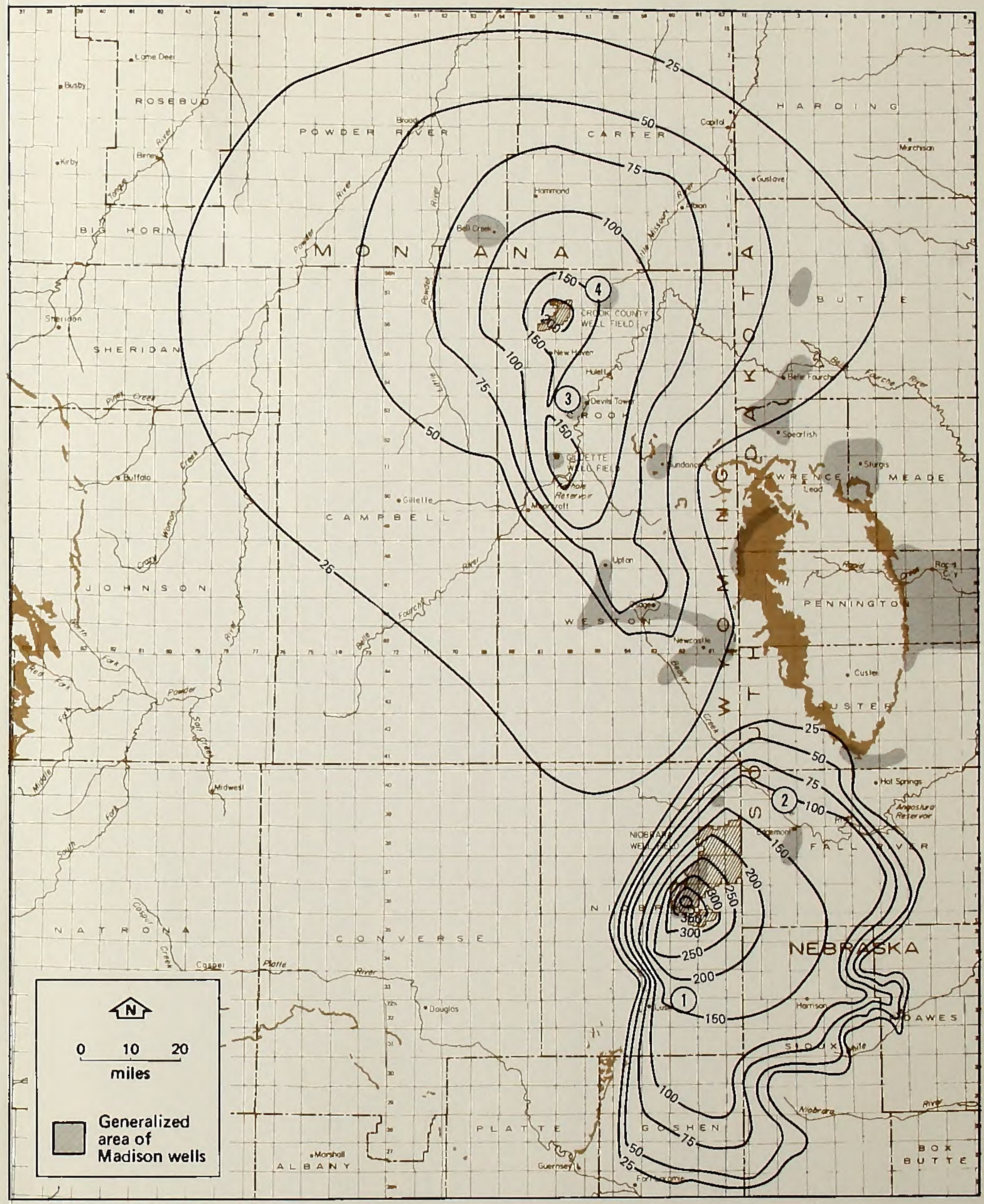
Water-level declines of more than 25 feet in Inyan Kara wells were calculated to occur in three areas: the Crook County well field, Upton-Osage, and the Niobrara County well field (Table 5-9). South and east of the Crook County well field, Inyan Kara water levels were calculated to decline by less than 55 feet. Water levels in Inyan Kara wells near Upton and Osage were calculated to decline by less than about 35 feet. South and west of the Cheyenne River and southwest of the Niobrara County well field, Inyan Kara wells were calculated to have less than about 55 feet of decline in water levels. In the Niobrara County well field and where the Inyan Kara is confined, Inyan Kara water levels were calculated to decline by as much as 130 feet. Where Inyan Kara wells in these areas are in unconfined parts of the aquifer, decline would be less than the declines shown.

INYAN KARA

Madison water levels would decline by more than 25 feet in Madison wells in southwestern Montana, northeastern Wyoming, and parts of western South Dakota (Table 5-9). Outside the ETSI well fields, Madison potentiometric surface declines would be greatest at the Gillette well field, where 190 feet of decline was calculated. At Edgemont-Provo, Devils Tower, and Hulett, calculated Madison potentiometric surface declines ranged from 110 to 160 feet. About 85 to 90 feet of decline was calculated to occur at Osage, Upton, and Bell Creek. Sundance was calculated to have a 50-foot decline in Madison water levels, while Madison wells near Newcastle and Belle Fourche were calculated to have declines of about 35 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

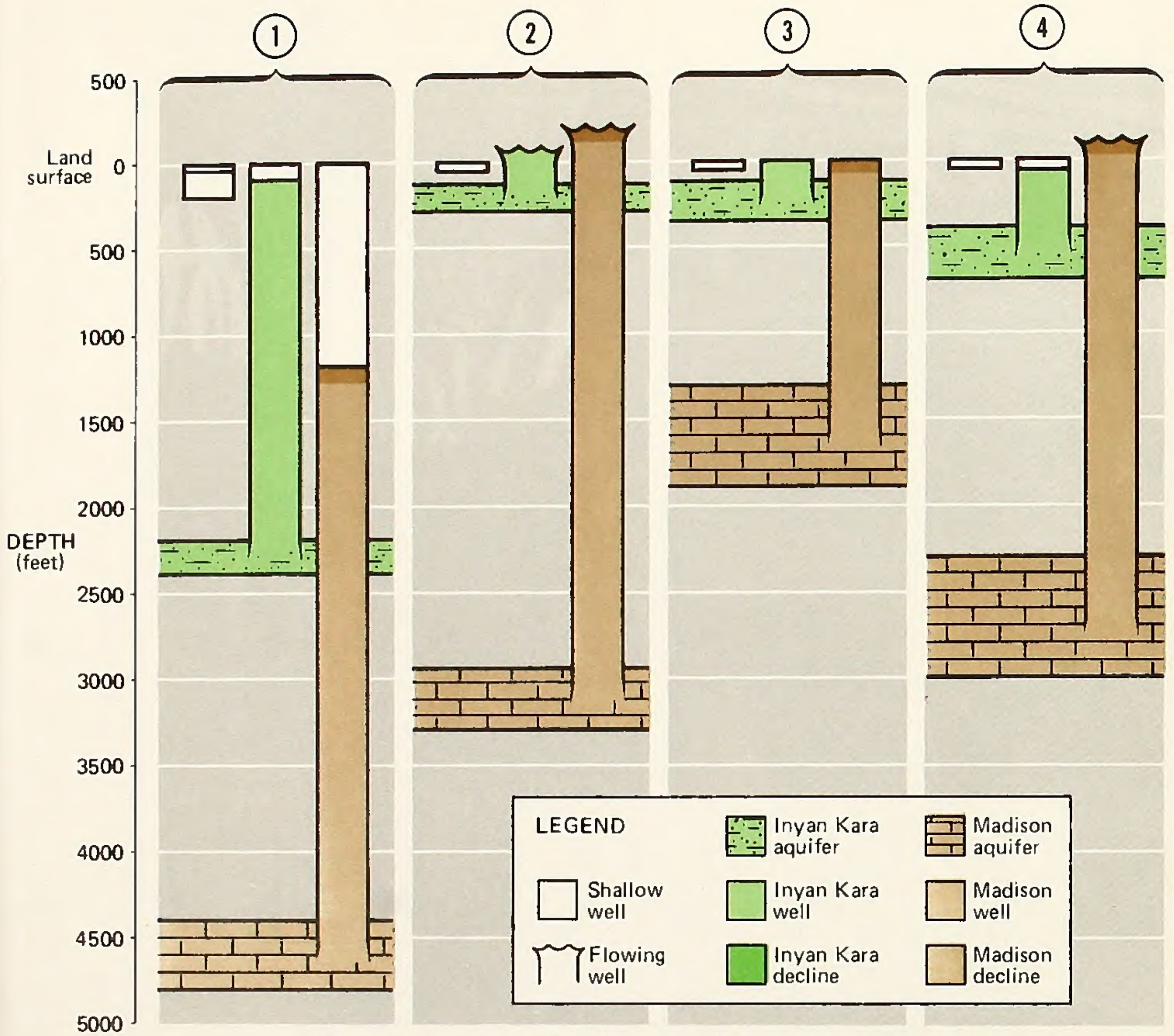
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 5 — ETSI pumping from Niobrara and Crook County well fields

Map 5-22. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 50 YEARS, PLAN 5, CUMULATIVE CASE



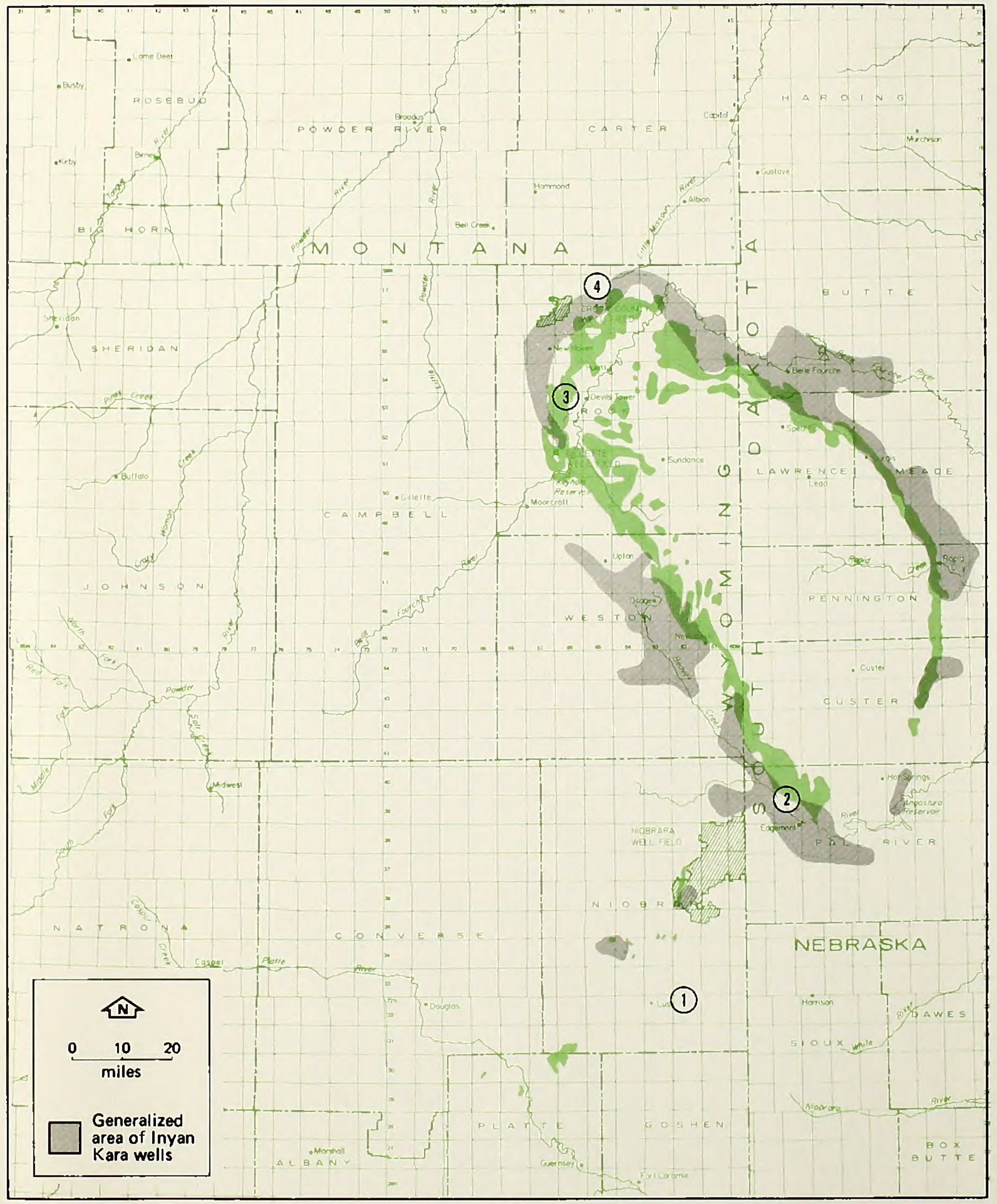
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

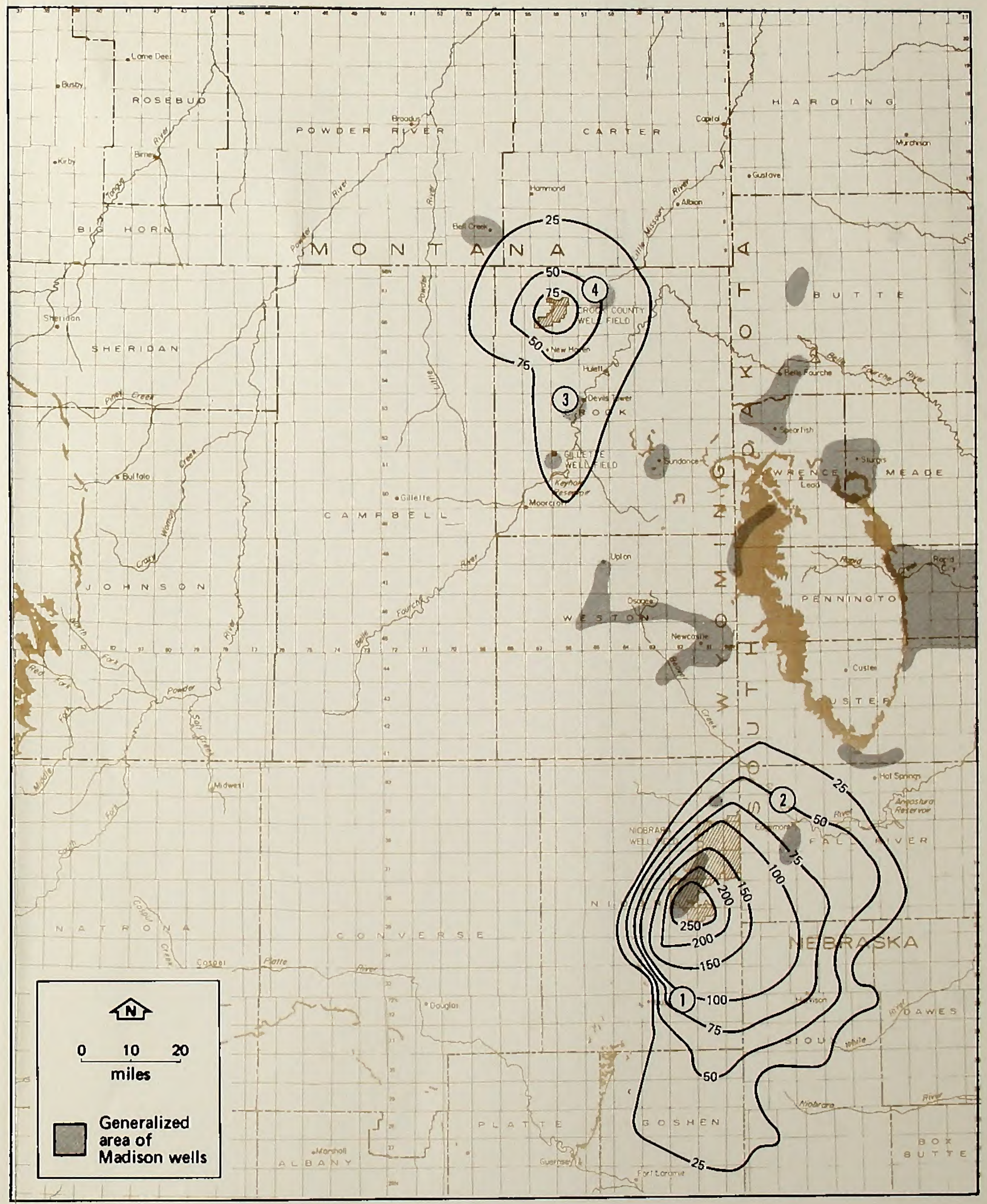
No water levels in the Inyan Kara aquifer were calculated to decline by more than 2 feet as a result of withdrawals from the Madison aquifer (Table 5-10).

INYAN KARA

Water level declines in the Madison aquifer were centered on the Crook County and Niobrara County well fields, with an extension south from the Crook County field over the Gillette well field (Table 5-10). Water-level declines at Devils Tower and Hulett were calculated to be about 30 feet, those at the Gillette well field and USGS test well No. 1 were calculated to be about 40 feet, and declines in the Edgemont-Provo area were calculated to be about 60 feet. No other producing Madison wells outside the ETSI well fields would have declines of more than 25 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

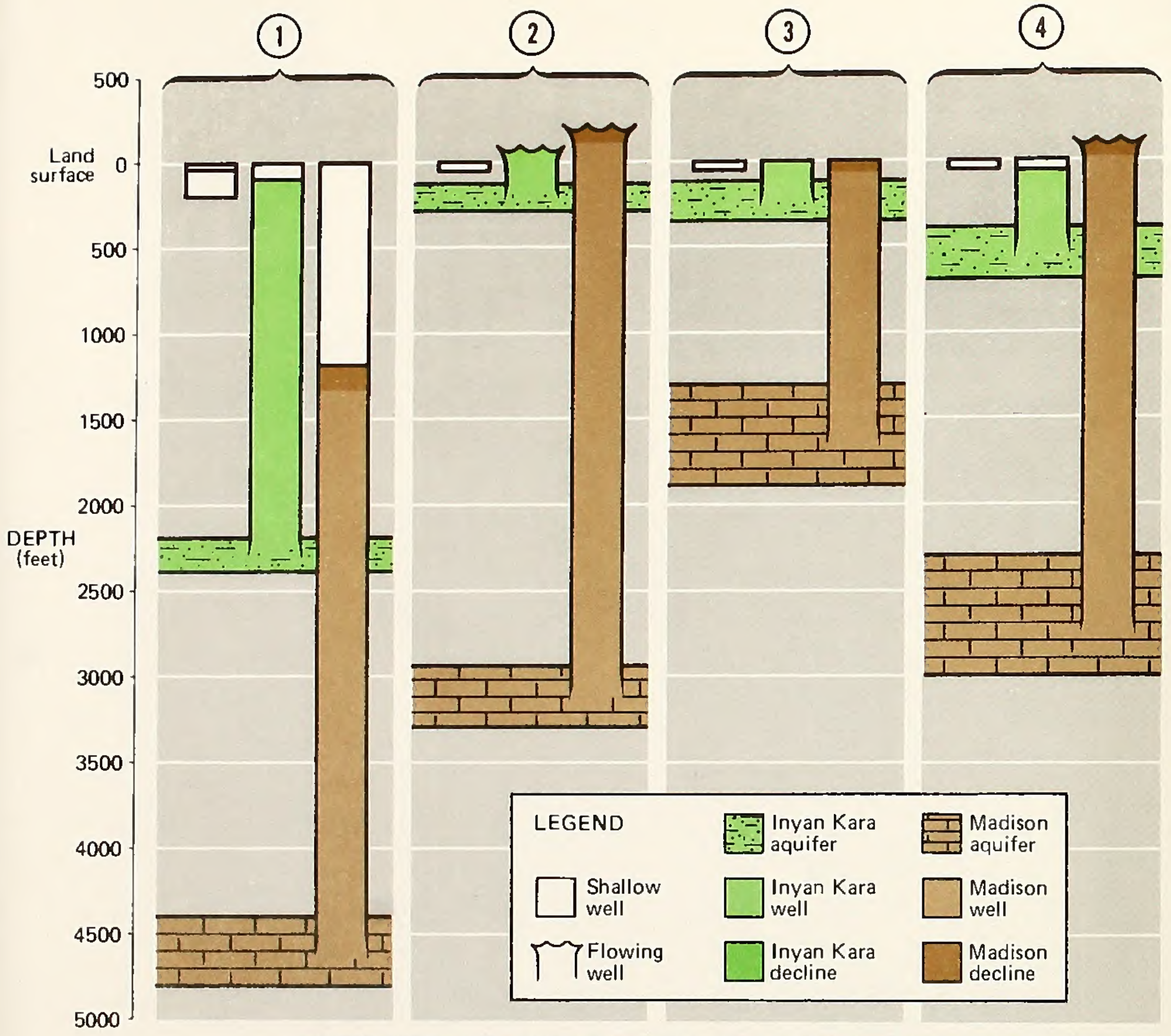
Location of typical wells of varying depths in affected aquifers

Water-leval declines (feet)

Cumulative case — Impacts shown are due to pumping by axisting and planned Madison water users as well as ETSI

Plan 6 — ETSI pumping from Niobrara and Crook County well fields (best astimate parameters used)

Map 5-23. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 5 YEARS, PLAN 6, CUMULATIVE CASE



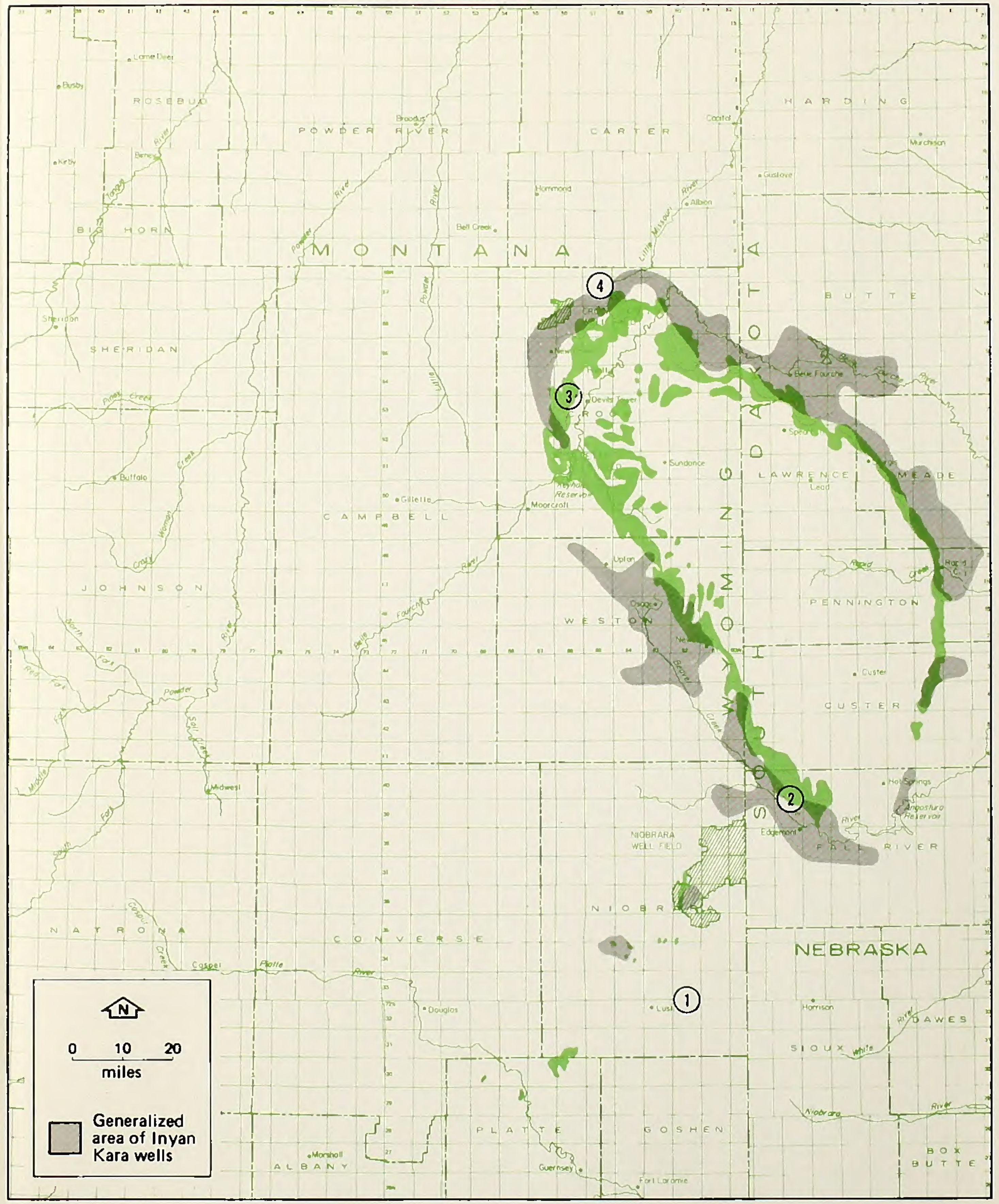
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

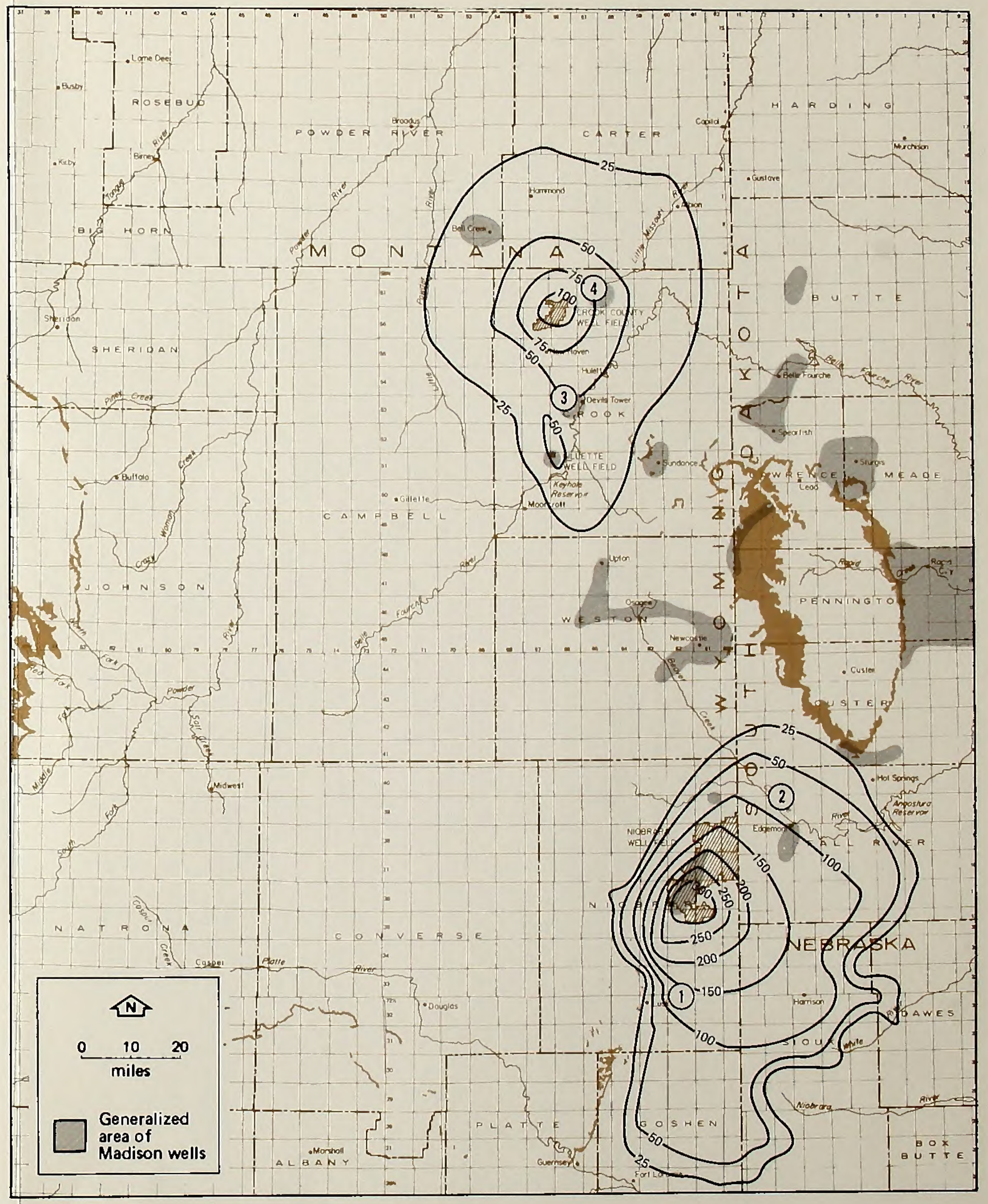
Inyan Kara wells at the Crook County well field were calculated to have water-level declines of about 6 feet in 1995 (Table 5-10). All other Inyan Kara wells would experience declines of 5 feet or less as a result of withdrawals from the Madison aquifer.

INYAN KARA

Only one additional Madison well location (Bell Creek), besides those described for the year 1990 (Map 5-23), would experience water-level declines of greater than 25 feet between 1990 and 1995. The water-level declines for Bell Creek, Devils Tower, Hulett, the Gillette well field, and USGS test well No. 1 were calculated to be about 35, 50, 45, 55, and 65 feet, respectively (Table 5-10). Declines at Edgemont-Provo were calculated to be about 90 to 110 feet. No other producing Madison wells outside the ETSI well fields would experience declines of 25 feet or more.

MADISON





Inyan Kara outcrop

Madison outcrop

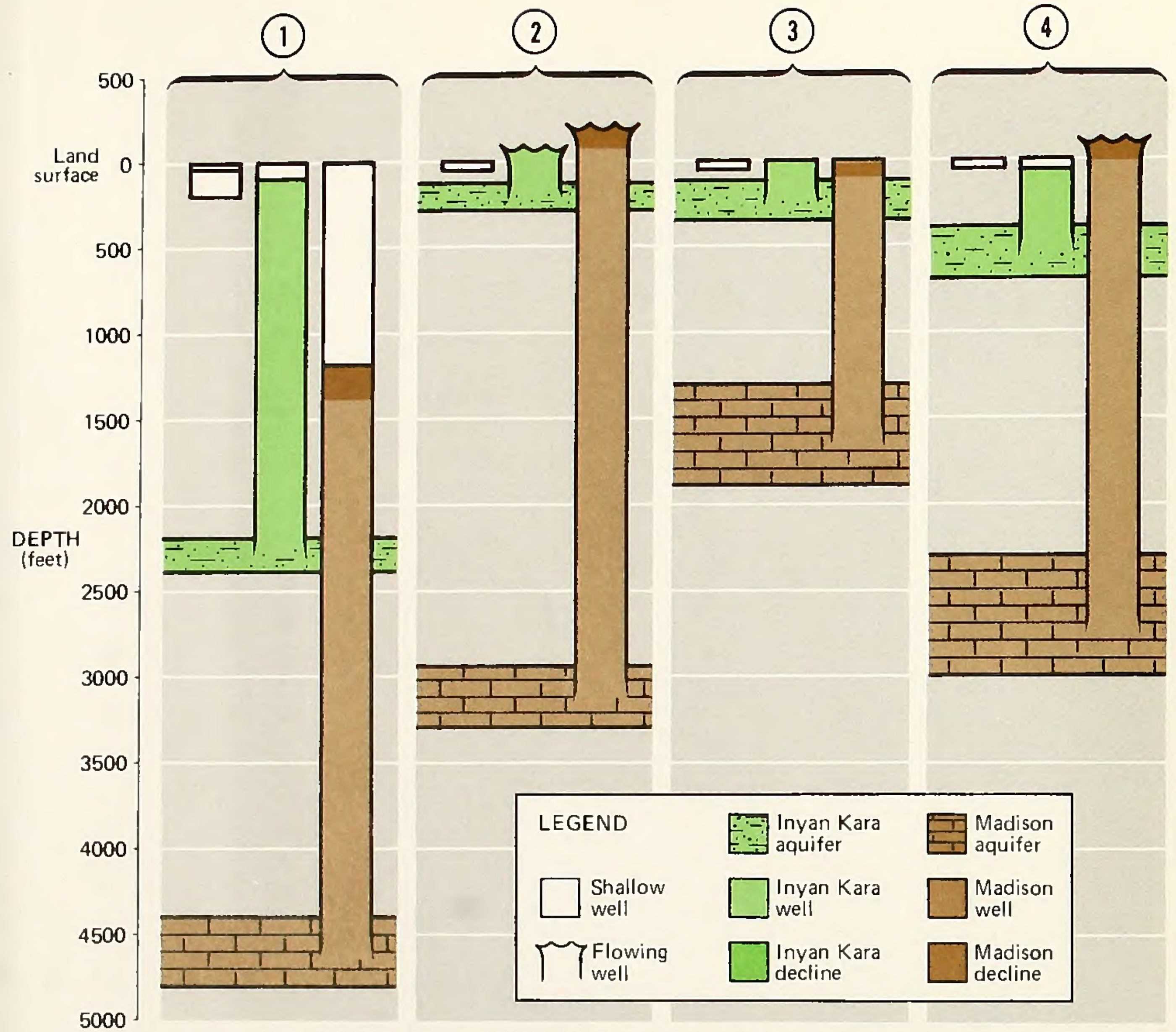
(1) Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 6 — ETSI pumping from Niobrara and Crook County well fields (best estimate parameters used)

Map 5-24. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 10 YEARS, PLAN 6, CUMULATIVE CASE



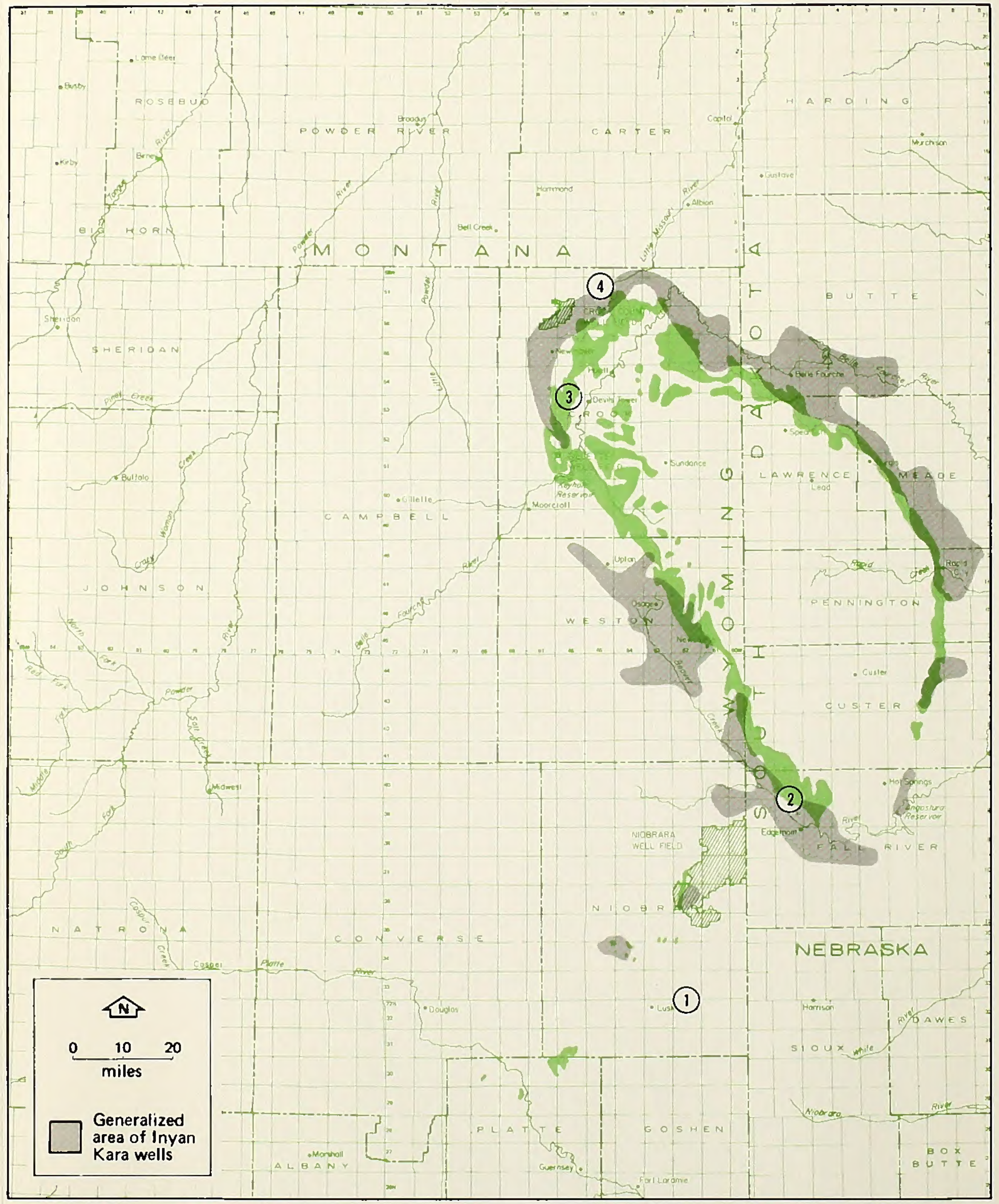
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

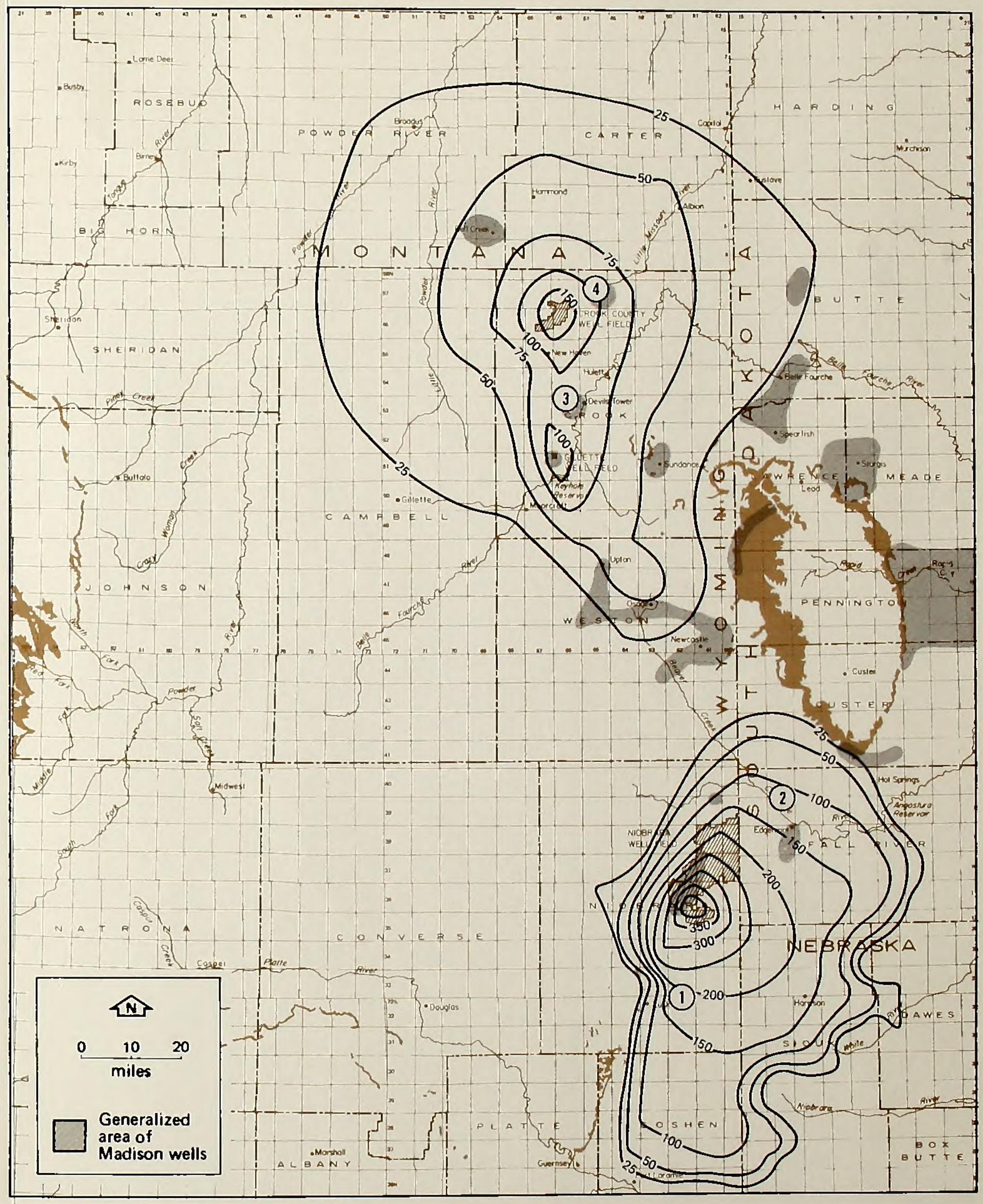
No Inyan Kara wells would experience water-level declines of more than 20 feet as a result of ground-water withdrawals from Madison wells (Table 5-10).

INYAN KARA

The area of the Madison aquifer affected by withdrawals from the Madison aquifer would spread outward considerably between 1995 and 2010, especially around the Crook County well field (Table 5-10). Water-level declines in Madison wells near Sundance were calculated to be about 40 feet, declines in the Upton-Osage area were calculated to be about 55 to 60 feet, and those near Bell Creek were calculated to be about 60 feet. Devils Tower, Hulett, and USGS test well No. 1 would all experience about 75 to 90 feet of decline. The Gillette well field would experience water-level declines of about 120 feet, and water levels in the Edgemont-Provo area were calculated to decline by about 140 to 160 feet. Declines of 25 to 30 feet were calculated for Madison wells in western Butte County. No other non-ETSI producing wells in the Madison aquifer would have water-level declines of 25 feet or more.

MADISON





Inyan Kara outcrop

Madison outcrop

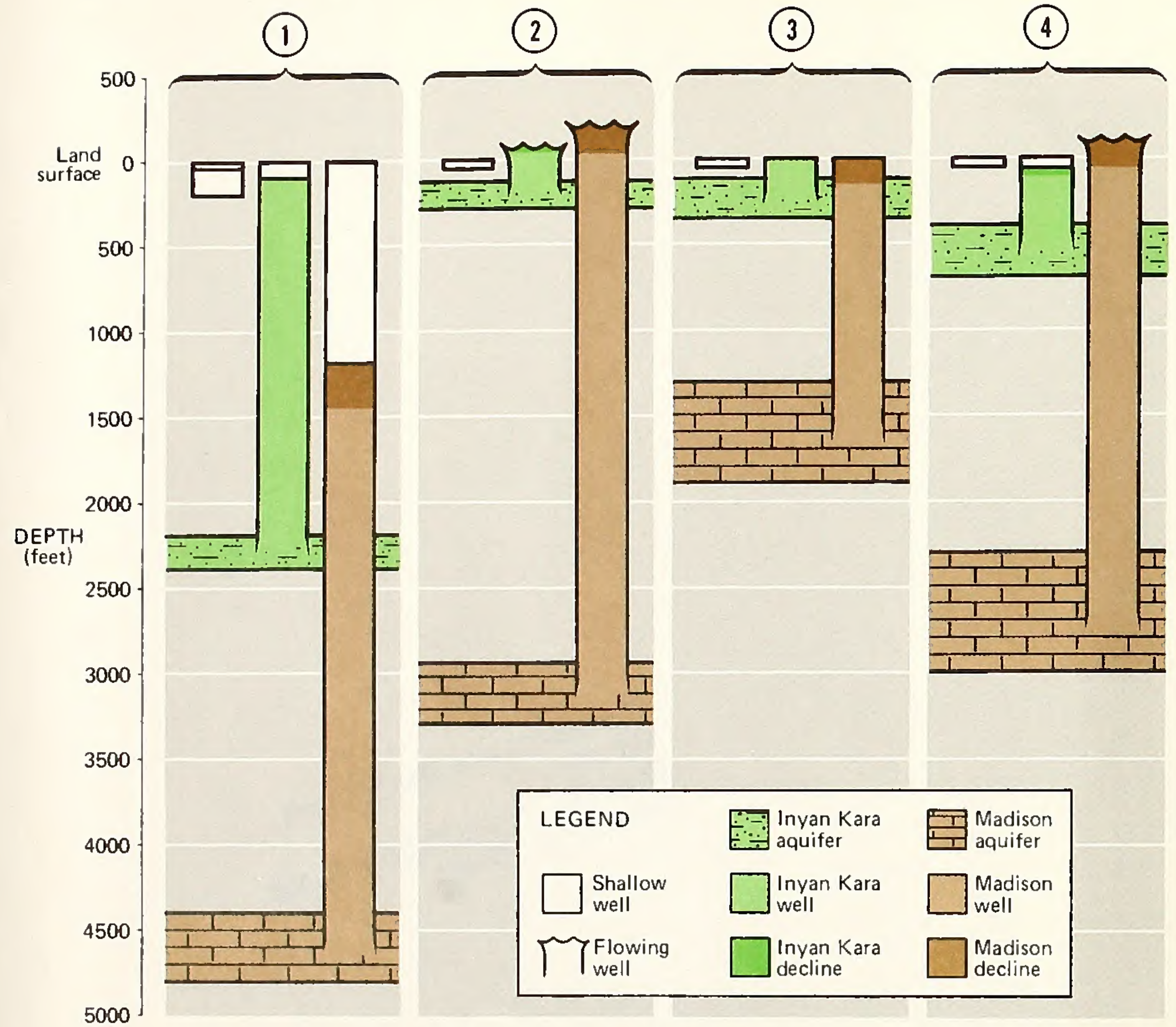
Location of typical wells of varying depths in affected aquifers

Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 6 — ETSI pumping from Niobrara and Crook County well fields (best estimate parameters used)

Map 5-25. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 25 YEARS, PLAN 6, CUMULATIVE CASE



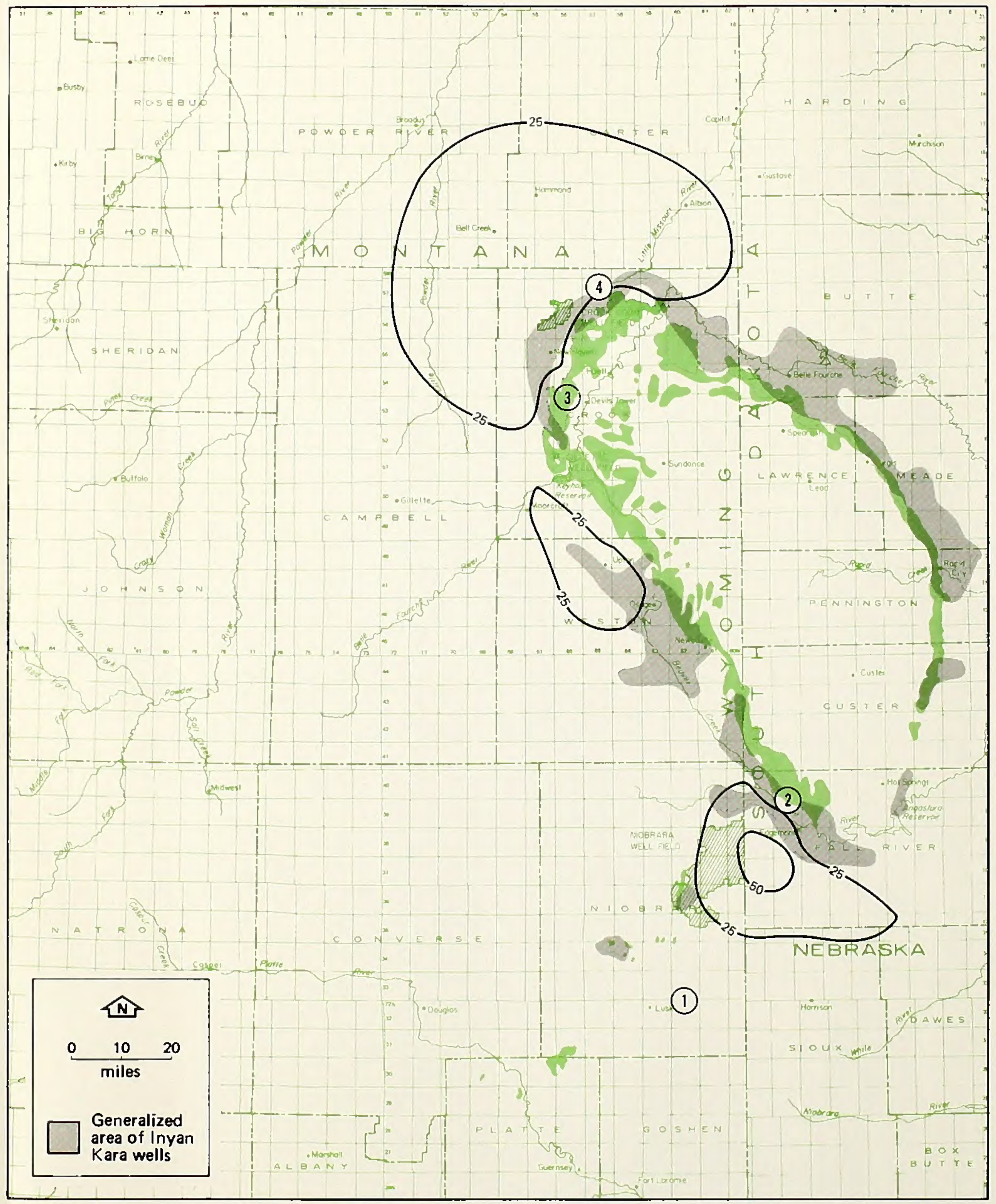
WATER-LEVEL DECLINES IN TYPICAL WELLS AT REPRESENTATIVE LOCATIONS

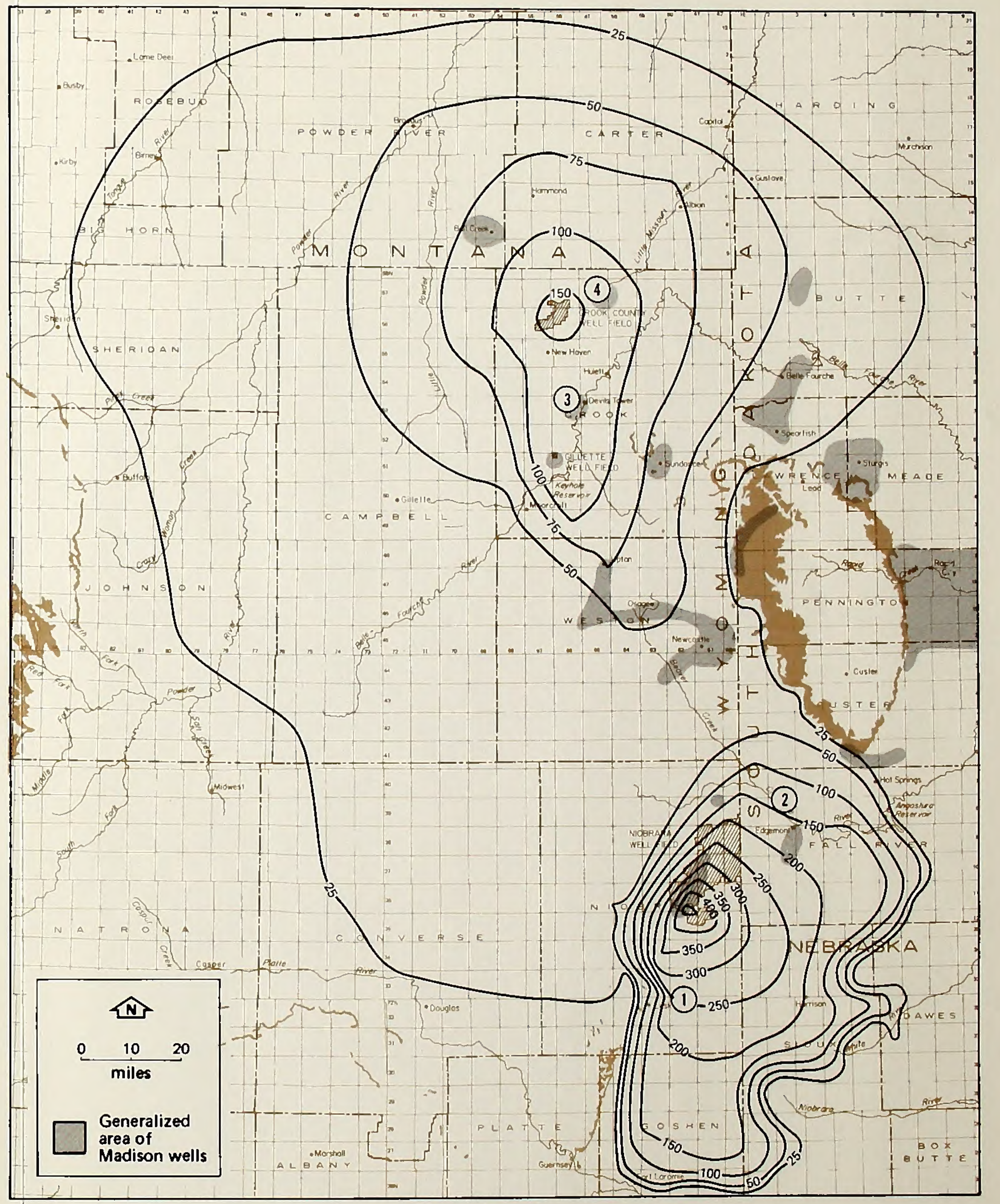
Inyan Kara wells southwest of the Cheyenne River, in the Osage-Upton area, and toward the south and east of the Crook County well field were calculated to have declines of about 25 to 50 feet as a result of withdrawals from the Madison aquifer (Table 5-10). Water-level declines for all other Inyan Kara wells were computed to be less than 25 feet.

INYAN KARA

By 2035, Madison water-level declines were calculated to have spread outward so that all Madison wells in northeastern Wyoming, extreme southern Montana, and extreme western South Dakota would have declines of at least 25 feet (Table 5-10). Newcastle, Wyoming, and Spearfish, South Dakota, would each have declines of about 25 to 30 feet.. Belle Fourche and Sundance would have declines of 40 to 60 feet. Calculated declines for Osage, Upton, and Bell Creek would be about 75 to B5 feet. Declines for Hulett, Devils Tower, and USGS test well No. 1 were calculated to be about 100 to 120 feet. Madison wells in the Edgemont-Provo area and in the Gillette well field were calculated to have declines of about 170 to 200 feet.

MADISON





Inyan Kara outcrop

Madison outcrop

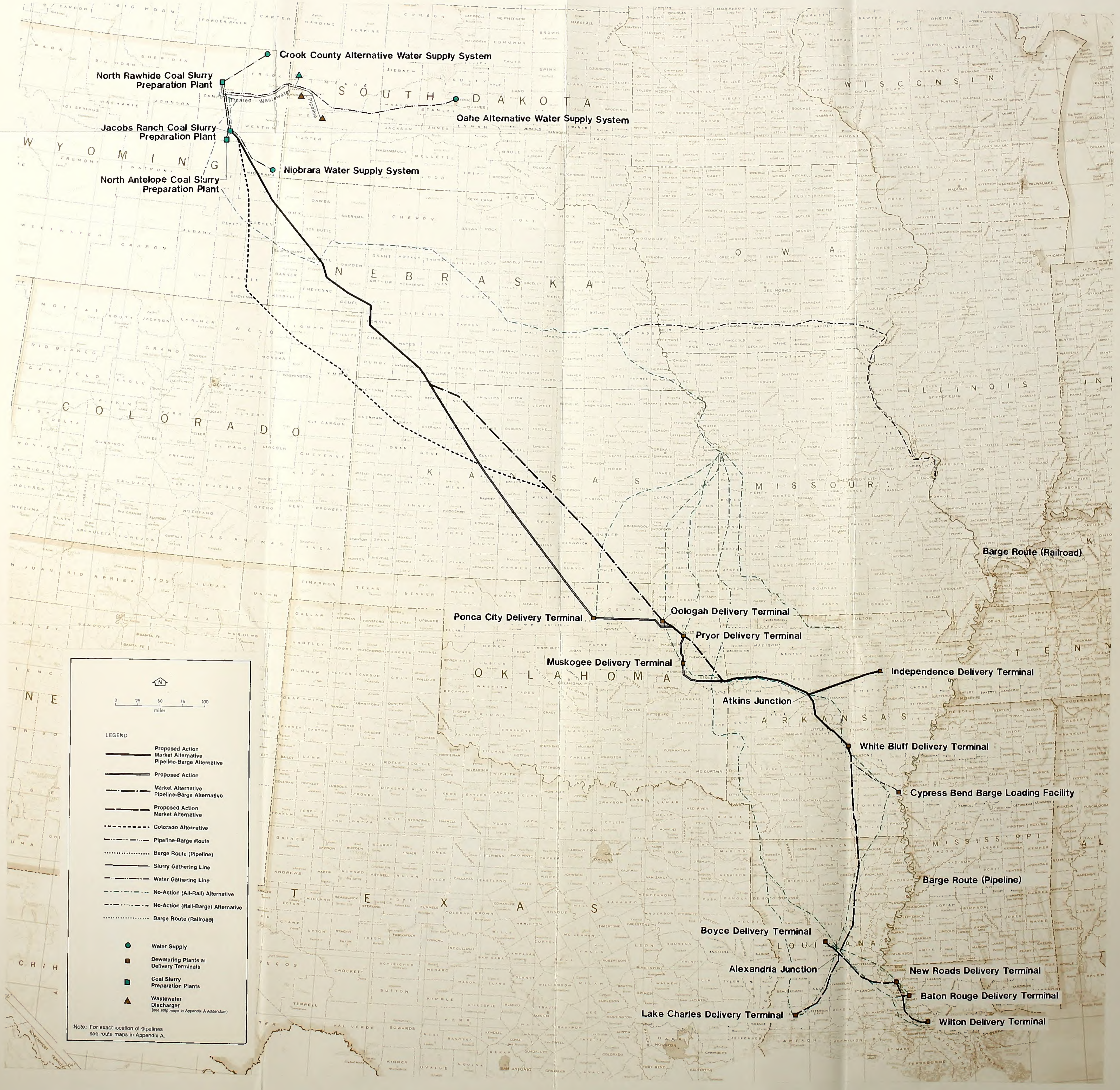
(1) Location of typical wells of varying depths in affected aquifers

25 Water-level declines (feet)

Cumulative case — Impacts shown are due to pumping by existing and planned Madison water users as well as ETSI

Plan 6 — ETSI pumping from Niobrara and Crook County well fields (best estimate parameters used)

Map 5-26. CALCULATED WATER LEVEL DECLINES IN THE MADISON AND INYAN KARA AQUIFERS IN 50 YEARS, PLAN 6, CUMULATIVE CASE



Map A-1. - LOCATION AND GENERAL ARRANGEMENT OF PROPOSED COAL SLURRY PIPELINE SYSTEM AND ALTERNATIVES

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT