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FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

May 2001

United States
Department of
Agriculture

Forest Service

Intermountain Region

Manti-La Sal
National Forest

United States
Department of the
Interior

Bureau of Land
Management

State of Utah

Cooperating Agency: Department of the Interior, Office of Surface Mining Reclamation and Enforcement

NOTE TO REVIEWER

The Figures (Maps and Drawings) referenced in the text in Chapters 1 through 4 are located in sequential order at the end of each individual chapter. Several of them are 11 by 17 inch fold-out maps that are cumbersome to fold out and review when intermixed with the text. The first number of each Figure (ex. Figure 2.3) is the chapter number. The second number, after the dot, (ex. Figure 2.3) is the number of the Figure, in sequential order. This is intended to help the reviewer easily find them for reference.

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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

FLAT CANYON FEDERAL COAL LEASE TRACT (UTU-77114)

MANTI-LA SAL NATIONAL FOREST
FERRON-PRICE RANGER DISTRICT
SANPETE AND EMERY COUNTIES, UTAH

Joint Lead Agencies:

USDA Forest Service (FS)
Intermountain Region
Manti-La Sal National Forest

USDI Bureau of Land Management (BLM)
Utah State Office

Responsible Officials:

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ABSTRACT:

This Draft Environmental Impact Statement (DEIS) was written in response to an application to lease the Flat Canyon Coal Lease Tract by Canyon Fuel Company, LLC. The purpose of the application is to potentially add adjacent recoverable coal reserves to the permit area for the Skyline Mine and extend the mine life for an estimated 9-12 years. The proposed action is to offer the tract for competitive leasing with special coal lease stipulations needed to protect natural resources. The DEIS evaluates the potential effects of leasing the tract by BLM and the potential effects of mining, based on a reasonably foreseeable development scenario (RFDS). The RFDS projects underground coal mining within the tract and adjacent private lands, including some minor surface developments consisting of two ventilation shafts and 10 coal exploration drill holes (development drilling). Based on the analysis, the responsible agency officials must decide whether or not to offer the tract for competitive leasing and, if offered, what special stipulations to include in the lease for protection of the coal resource and other natural resources on the Manti-La Sal National Forest.

Comments on this Draft EIS must be submitted to the Forest Supervisor by July 2, 2001.

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A. APPENDICES

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S-1.1 INTRODUCTION

This Draft Environmental Impact Statement (DEIS) considers the environmental, social, and economic effects of offering the Flat Canyon Coal Lease Tract (UTU-77114) for leasing by the United States Department of Interior, Bureau of Land Management (BLM), with consent by the United States Department of Agriculture, Forest Service, specifically the Manti-La Sal National Forest (FS). This analysis is tiered directly to the Final Environmental Impact Statement, Manti-La Sal National Forest, 1986 and Record of Decision and Summary, November 5, 1986 as amended. The BLM and FS jointly conducted the environmental analysis for the Flat Canyon Coal Lease Tract and prepared the DEIS. The United States Department of Interior, Office of Surface Mining Reclamation and Enforcement (OSM) participated as a cooperating agency. The DEIS specifically addresses the consequences of implementing four alternatives, including the Proposed Action and "No Action" Alternative that involves taking no further action to evaluate or offer the tract for leasing. The analysis was initiated by the agencies in response to an application to lease the Flat Canyon Tract by Canyon Fuel Company, LLC, submitted to the BLM, Utah State Office.

Decisions to be made, authorizing actions, and a description of the Federal coal leasing process are further discussed in Sections 1.3 and 1.4.

S-1.2 PROPOSED ACTION

The proposed action is for BLM to offer the Flat Canyon Coal Lease Tract (UTU-77114) for competitive leasing in response to Canyon Fuel's application for leasing under the Lease-on-Application process contained in Federal Regulations 43 CFR 3425. The Forest Service would consent to leasing by BLM. The Tract would be offered with BLM's standard terms and conditions contained on Lease Form 3400-12 and special coal lease stipulations identified by BLM and the Forest Service for the protection of natural resources consistent with applicable laws, Forest Service and BLM policies, and the Land and Resource Management Plan, Manti-La Sal National Forest. In order to meet Canyon Fuel's need to move into the tract with underground workings in late 2001 or early 2002, the proposed lease sale would need to take place around November 2001.

The tract was delineated by an Interagency Tract Delineation Team to assure that it is reasonable and meets requirements of the responsible agencies. The Flat Canyon Tract encompasses 2,692.16 acres of Federal coal reserves of the Wasatch Plateau Coal Field on National Forest System lands within the Manti-La Sal National Forest in Sanpete County, Utah. This area is described in the DEIS as the "Tract Area" as follows (Figures 1.1 and 1.2):

T. 13 S., R. 6 E., SLM,

Section 21, lots 1-4, E1/2E1/2;
Section 28, lots 1-8, S1/2NW1/4, SW1/4;

Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R. 6 E., SLM,

Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2.

Additional non-Federal lands with non-Federal coal (both in private ownership) adjacent to the Federal coal lease tract, referred to as the "Private Lands (approximately 1,100 acres)," could be mined as a result of this lease action. They are described below:

T. 13 S., R. 6 E., SLM,

Section 29, E1/2SE1/4, SE1/4NE1/4, S1/2NE1/4NE1/4;
Section 32, E1/2E1/2.

T. 14 S., R. 6 E., SLM,

Section 3 (portion as shown on Figure 1-2)
Section 8, N1/2N1/2;
Section 9, N1/2N1/2;
Section 10 (portion shown on Figure 1-2).

The Tract area and adjacent private lands are collectively referred to in this DEIS as the "Project Area". Therefore, the total area analyzed is approximately 3,792 acres.

S-1.3 PURPOSE AND NEED

The purpose of offering the tract for competitive leasing is to provide an opportunity to develop mineable Federal coal reserves by underground methods. This coal is needed for the generation of electricity, other industrial uses, and to maximize economic returns to the National, State and local economies, and to prevent bypassing mineable coal reserves adjacent to an existing mine that may otherwise not be mined.

The purpose of Canyon Fuel's application is to obtain the right to mine known Federal coal reserves in the Flat Canyon Tract, immediately to the west of the current permit area for their Skyline Mine. If leased, Canyon Fuel would extend their underground coal workings to the west into the Flat Canyon Tract and beyond into private (fee) coal reserves. Two coal seams could be mined over the majority of the project area (Flat Canyon Tract and adjacent non-Federal lands). Recoverable coal reserves in the tract and adjacent area are estimated at approximately 36 million tons. At an annual production rate of 3 to 4 million tons, the proposal could extend the life of the Skyline Mine by 9-12 years.

A review of the Forest Plan showed that the proposed lease tract area is available for further consideration for coal leasing through application of the Unsuitability Criteria (43 CFR 3464) and an appropriate environmental analysis (Letter to the Utah State Director of BLM from the Forest Supervisor, Manti-La Sal National Forest 2820-4, January 21, 2000).

If the tract is not leased within the approximate proposed time frame, it is likely that the mineable Federal coal reserves in the tract would be bypassed and not mined in the foreseeable future.

S-1.4 DECISIONS TO BE MADE, AUTHORITIES, AND PERMITS

The USDI, Bureau of Land Management (BLM) is the leasing authority for all Federal coal reserves under the Mineral Leasing Act of 1920, as amended. The BLM Utah State Director must decide:

- whether or not to offer the Flat Canyon Tract for competitive leasing.
- what terms, conditions, and stipulations are needed on the lease to ensure compliance with the Mineral Leasing Act of 1920, as amended.

The USDA, Forest Service is the Surface Management Agency. The Forest Supervisor, Manti-La Sal National Forest, must decide:

- whether or not to consent to leasing by BLM, under authority of the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1975.
- what special coal lease stipulations are needed for the protection of non-mineral resources.

If consent to leasing is given, the Forest Supervisor is also consenting to underground mining and subsidence of the land surface consistent with the lease stipulations imposed for the protection of National Forest resources.

Before any mining can take place on a Federal coal lease, a mine permit must be obtained by the lessee or operator.

The Surface Mining Control and Reclamation Act of 1977, as amended (SMCRA) gives the Office of Surface Mining Reclamation and Enforcement (OSM) primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations in the United States. Pursuant to Section 503 of SMCRA, the Utah Division of Oil, Gas, and Mining (DOGM) developed, and the Secretary of the Interior approved, Utah's permanent regulatory program authorizing Utah DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on private and State lands within the State of Utah. In March 1987, pursuant to Section 523(c) of SMCRA, Utah DOGM entered into a cooperative agreement with the Secretary of the Interior authorizing Utah DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on Federal lands within the State.

Pursuant to the cooperative agreement, Federal coal lease holders in Utah must submit a permit application package (PAP) to OSM and Utah DOGM for proposed mining and reclamation operations on Federal lands in the State. Utah DOGM reviews the PAP to ensure that it complies with the approved Utah State permanent program and other statutes. If it does comply, Utah DOGM issues the applicant a permit to conduct coal mining operations. OSM and other Federal agencies review the PAP to ensure that it contains the necessary information for compliance with the coal lease, the Mineral Leasing Act of 1920, as amended (MLA), the National Environmental Policy Act of 1969, as amended (NEPA), and other applicable Federal laws and their attendant regulations. OSM recommends to the Assistant Secretary of the Interior, Land and Minerals Management: (1) approval of the MLA mining plan, (2) approval of the MLA mining plan with conditions, or (3) disapproval of the MLA mining plan. Before making a recommendation on the mining plan, OSM obtains input from certain other Federal agencies, including the surface management agency.

The BLM is responsible for monitoring and enforcement of lease terms, conditions, and special stipulations, including required mitigations. The Forest Service cooperates with BLM by conducting field inspections of lease areas and operations.

Utah DOGM enforces the performance standards and permit requirements during the mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility of this enforcement. The surface management agency has authority in emergency situations in which Utah DOGM or OSM inspectors cannot act before environmental harm or damage occurs. UDOGM conducts frequent inspections of operations for compliance. The Forest Service cooperates with them regarding enforcement.

Resource monitoring, including subsidence, water monitoring, and vegetation monitoring is conducted by the lessee/operator in compliance with the mine permit and other permits issued for operations. The regulatory agencies take periodic samples to verify the lessee/operator monitoring data.

S-1.5 REASONABLY FORESEEABLE DEVELOPMENT

The Reasonably Foreseeable Development/Mining Scenario (RFDS) has been developed by the BLM in consultation with Canyon Fuel and Norwest Mine Services, Inc. NorWest Mine Services, Inc. prepared the scenario, predicted the location and amount of mining-induced subsidence and seismicity, conducted an analysis of the physical effects of mining to the geology, topography, and facilities/structures in and adjacent to the project area, and prepared Technical Reports under the direction of the agencies. The NorWest Technical Reports are referenced throughout the DEIS. The following is a summarized description of the Reasonably Foreseeable Mining Scenario. A detailed description of the predicted development of the proposed tract area and adjacent private lands and mineral estates are contained in the Technical Reports prepared by Norwest Mine Services, Inc. (Project File).

The RFDS is conceptual in nature and was developed for the purpose of determining the effects of leasing and subsequent mining. It presents the most likely mining scenario based on current information available from the Skyline Mine, but it is recognized that changes to locations of main entry systems and panels could be necessary based on actual conditions encountered underground. In order to adequately evaluate potential effects, with the knowledge that some aspects could change, the RFDS and effects analysis assume that the scenario with the most surface effect could occur.

The geologic conditions predicted in the Tract indicate that mining conditions would be relatively similar to those that have been experienced in the Skyline Mines, except that the reserves become progressively deeper towards the West. All mining would be done by underground methods with surface disturbance being limited to ancillary facilities. No surface mining methods would be used and the existing portal and support facilities in Eccles Canyon would be used. The RFDS for future mining in the Tract has been developed on the assumption that longwall mining would be carried out on a similar basis to that successfully employed at Skyline. Several northeast-southwest trending faults occur within the project area. The vertical offset of each fault is not specifically known at this time but it is conceivable that the offset could be large enough to influence the mining scenario. Due to the uncertainties, the RFDS was developed assuming that they would not change the mining scenario, but their existence and potential to influence mining is recognized.

The main underground mining access to the Tract is planned in the Lower O'Connor B Seam by the westerly extension of the current main development entries in the Skyline Mine. To provide sufficient capacity for ventilation, access, escape, and haulage, it is probable that all of the six entries in the existing mains would be developed into the new area (Figure 1.2).

For Maximum Economic Recovery (MER), it has been assumed that a Main Development Corridor would be located below or under the west canyon slope of Upper Huntington Creek, as this would afford protection of this perennial drainage from subsidence, while allowing efficient recovery. A corridor about 1,600 feet wide has been identified where the mains would be located that allows for a sufficient number of entries and pillars with adequate dimensions to ensure long-term stability.

The main development system would be connected to ventilation shaft(s). Sub-mains would also be needed for access to production areas. Mining of the majority of the project area would generally be at greater depths than in the current permit area, varying from about 1,000 feet to over 2,000 feet.

Access to the Flat Canyon and Lower O'Connor 'A' Seams would be from underground, by developing rock entries at a slope to access mains in the lower seam. The lower main development entries and pillars would be driven underneath those in the upper seam and pillars would be vertically aligned to minimize adverse stress interactions and optimize coal recovery.

Production is planned by longwall methods similar to those currently being used in the Skyline Mine. It is expected that panels would be about 800 feet wide and their length would vary from about 3,000 to 15,000 feet, depending upon selected mine layout and both geological and operational constraints.

The most likely orientation of longwall panels would be approximately E-W, which has been shown to be successful at Skyline. Previous mining experience has also shown that an orientation approximately N-S could also be acceptable. Other geological and operational constraints, such as the location and offset of faults, may influence the final choice of panel orientation. Protection of surface structures and resources could also provide additional constraints on the location, orientation, and sequence of longwall extraction.

Mine production is planned from a single longwall section, in conjunction with production from continuous miners driving development entries. Additional production may come from room-and-pillar extraction, although a depth limitation of 1,800 feet for this method has been assumed. There are two mineable seams over the majority of the area and the upper coal bed (Lower O' Connor B Seam) would be mined first, followed by the lower coal bed (Flat Canyon Seam). The areas that could be potentially mined in the Lower O'Connor B Seam (Upper Seam Mining Zone) are shown on Figure 1.3. The potential mining area for the Flat Canyon Seam (Lower Seam Mining Zone) is shown on Figure 1.4.

The BLM has identified in the Tract Delineation Report longwall mining reserves of about 36 million tons. At an estimated annual production rate of three to four million tons, this would extend the life of the Skyline Mine from nine to twelve years.

Reasonable equipment constraints for the definition of the minimum and maximum extraction heights for full extraction longwall mining have been assumed for evaluation of impacts due to subsidence. For the upper seam, an operational height range from 7.5 to 12.5 feet is reasonable (BLM). The lower seam is thinner and longwall equipment with a height range from 6 ft. to 10 ft. is reasonable (BLM). These are not definitive height restrictions and it is possible that longwall mining of the two seams, based upon variations in geologic conditions and proper equipment selection, extraction heights could range from 6 to 13 feet (BLM).

For the prediction of subsidence, it has been assumed that a three-entry gate road system would be used between longwall panels with a combination of yield and rigid pillars. This is considered to be a conservative assumption, as other options might include two or three entry gate roads with yield pillars that would be expected to produce lower differential subsidence.

Areas not amenable to longwall mining, due to their shape, size, coal thickness or surface protection requirements, have been evaluated on the assumption that they would be mined by room and pillar using full or partial extraction methods.

Access to the Flat Canyon Tract can be obtained through the coal in the western part of the Skyline Mine permit area, utilizing full support room-and-pillar first mining. This would allow for the coal within the Flat Canyon Tract to be more easily accessed and for a higher percentage of the coal to be extracted (mains/submains and barrier pillars would be within the present active leases). It would also allow coal from a fee lease that adjoins the southern portion of the tract to be potentially mined past the western boundary of Electric Lake. The access under Huntington Canyon would be with full-support room-and-pillar first mining.

The coal thins to the north, south, and west of the Flat Canyon Tract. The existing Skyline Mine is on the east; therefore, there are no additional tracts that can be leased from this location as a logical extension of the mine.

The mineable coal seams do not crop out or come in contact with the surface within the tract. The only alternative access to the coal reserves from the ground surface would be by construction of a shaft. The only potential site for a new mine and shaft lies on fairly level ground between Electric Lake and Boulger Reservoir. The shaft would have to be 1,200 feet deep. Surface support facilities, including a loadout, would have to be constructed. The coal would have to be trucked out. State Route 264 is not designed for coal-hauling trucks. The roads would have to be reconstructed. There is no electricity, so an electric powerline of 46 KVA would need to be built. The total cost of such a facility could exceed 100 million dollars (NorWest, 2000). The economic viability of a new mine being constructed to extract a maximum of 36 million tons of coal is highly improbable.

In order to meet Federal requirements for proper ventilation, one or two ventilation shafts (exhaust) would be necessary. A primary ventilation shaft would be located in Swens Canyon (Figure 1.2). A secondary ventilation shaft could be needed. It could be located in the upper Boulger Canyon area (Figure 1.2). Each shaft or vent hole would be 5-8 feet in diameter. Due to the blowing (positive) ventilation system at the mine, no fans would be needed and air would be exhausted from the shafts. An evase protected by a fence would be the only facilities at the surface location. A short access road of less than 1,000 feet would be constructed to each site for the drill rig. Each pad would disturb approximately less than 1 acre and each access road would disturb approximately 0.46 acre. The total disturbance for both vents would then be 2.9 acres. The roads would be reclaimed by providing necessary drainage to prevent erosion and facilitate establishment of vegetation, then closed to continued use for the life of the mine. The vents would be inspected twice a month on foot. The roads would be reopened for access to the shafts to plug and reclaim them. The access roads would then be plugged and completely recontoured and reclaimed upon abandonment.

No additional mine facilities would be needed in Eccles Canyon to mine the project area. Water encountered underground in the project area would either continue to be discharged at the mine water discharge point at the mine in Eccles Canyon or diverted to a new discharge point below the high water line of Electric Lake. Changing the point of diversion would require reclassification of Huntington Creek by the State of Utah and issuance of a new Utah Point Discharge Elimination System (UPDES) permit. Authority to allow this lies with the State of Utah. The BLM and Forest Service must be consulted for comment, but the Federal Agencies do not have direct authority to approve or disapprove this action.

The potential exists for up to 10 exploration drill holes to be drilled during the life of the tract. The total disturbance for each site is estimated at 0.92 acres (100 ft. x 200 ft. pad and 1,000 ft. x 20 ft. road disturbance per exploration site). Multiplied by 10 sites the total disturbance would be 9.2 acres.

S-1.6 ISSUES

The issues addressed in the analysis were identified through project scoping. They drive data collection and the subsequent analysis process. The issues that were determined to be significant form the foundation by which alternatives to the proposed action were developed. Other issues, not determined to be significant, are no less important but did not drive identification of alternatives to the proposed action. Both significant and non-significant issues are addressed in detail in the analysis.

S-1.6.1 Physical Changes to the Environment Caused by Mining

Leasing and subsequent mining would cause physical changes to the environment that are not issues in themselves but would cause most of the effects to resources and must be understood before the issues become clear to the reader. These changes and how they are measured (Measures) and discussed in the analysis are shown below:

- Construction of surface facilities needed to mine the project area would disturb the ground surface and cause human activities in the area.
  Measures: Activity levels, Area of disturbance (acres) by activity, Duration of activities/disturbance.

- Mining of the underground coal reserves can cause subsidence, seismicity, and cracking of the ground surface.
  Measures: Location and amount of subsidence expected (measured in feet), Maximum Credible Mining-Induced Seismic Event by range of magnitude and probability (Richter, % probability), The amount of energy transferred through rock at distance from the seismic event locations, Location and severity of cracks (primarily based on monitoring at Skyline Mine), Connection between surface and underground cracks relative

to depth of cover, Angle-of Draw, Tension and compression zones, Perception of seismic events by people.

- Water is encountered in the underground workings and discharged to the surface environment into receiving water bodies (streams/lakes).
  Measures: Amount of water discharged, location of discharge, quality of water.

- Mining equipment and materials are used and consumed in the mining process and are incorporated into the underground mine workings as permanent additions to the underground environment.
  Measures: Type of materials, Estimated amount, Purpose of the materials.

S-1.6.2 Issues

The affects analysis addresses each issue. It was necessary to determine how the issues would be measured and compared relative to the alternatives. For this purpose, evaluation criteria were developed. The issues are listed and described in this section and the evaluation criteria are identified and discussed below the issue statements. The issues are grouped by functional area and significant issue statements are underlined.

Structures and Facilities (Including Transportation)

- Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage State Highway 264 (Significant Issue) and Forest Roads (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Extension of the mine life would increase the length of time that mining related traffic volumes would occur on State Highways (Non-Significant Issue).
  Evaluation Criteria: Length of extended use, Approx. traffic volumes.

- Mining-induced subsidence and seismicity could damage facilities at the Flat Canyon Campground (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage recreation cabins and/or camp facilities and roads on adjacent private lands that are mined as a result of leasing the Flat Canyon Tract (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

Surface and Ground Water

- Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek (Existing NPDES Permit) could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Significant Issue).
  Evaluation Criteria: Potential diversions, Estimates of amount of water encountered/discharged, Amount and location of discharge to surface waters.

- A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed (Significant Issue).
  Evaluation Criteria: Change in mine water discharge to each watershed (gpm, acre-feet), Expected change in flow duration and base flows in Eccles, Muddy, and Huntington Creeks (gpm, acre-feet, %), Expected change to inflow and discharge (%, acre-feet) to/from Scofield Reservoir and Electric Lake.

- Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Changes in flow and duration, Probability

- Subsidence of perennial streams and the Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology (Significant Issue).
  Evaluation Criteria: Changes in flow by quantity and duration, Probability,

- Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Potential changes in water quality by affected parameters and duration.

- Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies (Significant Issue).
  Evaluation Criteria: Water quality of the discharge water vs. water quality standards associated with the most restrictive of the designated beneficial uses of the receiving waters (meets/does not meet), Change in receiving stream water quality (parameters with and without limits specific to beneficial use standards including TDS, RCRA metals, oil and grease, TMDL, and drinking water standards) addressed in part by estimating volume of discharge water as percentage of resulting total flows and determining whether discharge water is being diluted or receiving waters are being "contaminated", Change in lake chemistry, including water column and lake bed sediments.

- Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Description of potential changes in quality by affected parameter and duration.

Vegetation

- Subsidence and other mining-caused changes to surface and ground water could affect vegetation, especially riparian vegetation/wetlands (Significant Issue).
  Evaluation Criteria: Riparian vegetation, wetlands, and other species and area (acres) affected, Changes in species diversity and wetland quality.

- Construction of a pipeline and/or roads in or across riparian areas and/or wetlands could destroy vegetation and related habitat and increase downstream sediment (Non-Significant Issue).
  Evaluation Criteria: Area disturbed, Duration of loss (vegetation and habitat), Estimate of sediment production.

Wildlife

- Exploration drilling, construction of mine vent holes, and reclamation activities could temporarily disrupt use of summer habitat by terrestrial species (Non-Significant Issue).
  Evaluation Criteria: Effects, Area affected (acres), Duration of effects and avoidance by affected species.

- Any changes in stream gradient/morphology, water flow, and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species. Includes changes in morphology due to flow changes and subsidence (Significant Issue).
  Evaluation Criteria: Changes to habitat, productivity, and populations, Length of stream habitat affected (miles), Duration of effects.

- Changes to flow in drainages and points of mine water discharge would affect aquatic wildlife species and habitat (Significant Issue).
  Evaluation Criteria: Water quality of discharge water vs. aquatic life standards and other published sensitivity data for both acute and chronic levels, Possible increases in contaminants to electric lake and changes to habitat quality.

Recreation

- Damage to recreation facilities and temporary closures (Boulger Dam/Reservoir, Flat Canyon Campground, Roads) could cause, displacement of recreation use to other areas, and/or loss of use during repairs/replacement and closure (Significant Issue).
  Evaluation Criteria: Duration of loss or displacement of recreation opportunity, Recreation capacity lost or displaced (Recreation Visitor Days or RVDs), Revenue lost by Concessionaire.

- Subsidence could cause surface disruption and seismic events that could cause safety hazards and disrupt the recreation experience (Non-Significant Issue).
  Evaluation Criteria: Safety hazard.

- Traffic and heavy equipment operation related to exploration drilling and drilling/construction of mine vent holes could temporarily disrupt dispersed recreation (Non-Significant Issue).
  Evaluation Criteria: Recreation Visitor Days (RVDs) affected, Duration of displaced use, Quality of recreation experience perceived by visitors.

Visual Quality

- Equipment and ground disturbance related to drilling exploration holes, construction of ventilation shafts, and reclamation would temporarily (construction phase) decrease visual quality (Non-Significant Issue).
  Evaluation Criteria: Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

- Ventilation shaft facilities, access roads, and any visible emissions (water vapor) would decrease visual quality for the life of the facilities (Non-Significant Issue).
  Evaluation Criteria: Visibility, Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

Socioeconomics

- Leasing of the tract would extend the life of the Skyline Mine, provide an important energy resource, and result in social and economic benefits (Significant Issue).
  Evaluation Criteria: Coal produced (tons), Skyline Mine life (years), Employment (person/years), Royalties/Bonus Bids.

S-1.7 ALTERNATIVES ANALYZED

Alternatives were developed to address the significant issues associated with the project and to meet the requirements of NEPA. The alternatives addressed cover both ends of the spectrum regarding the possibilities for leasing/mining. Alternative A (No Action) presents the effects of not leasing the Tract. Alternative B, at the other end of the spectrum is a leasing scenario with no special stipulations, representing the full-mining scenario where mining would be conducted to maximize efficiency and coal recovery without specific measures to protect surface resources. Alternative B' (B Prime) is a derivative of B that would result in the same mining scenario without restrictions to prevent subsidence of sensitive resource areas, but differs in that it includes Special Coal Lease Stipulations (SCLS) that would require specific monitoring and mitigations in the event that specific effects occur. Alternative C lies in between, representing a leasing scenario where SCLSs would be included in the lease and subsidence of sensitive resources and facilities/structures would not be allowed regardless of the potential level of effects to them. To provide information to the public and decision makers, so that combinations of these alternatives can be considered, each of the sensitive resources and structures/facilities are addressed individually in the analysis. All of the following alternatives will be considered in the EIS.

<u>ALTERNATIVE A</u>, NO ACTION - The no action alternative provides a baseline for estimating the effects of the action alternatives. Under this alternative the lease tract would not be offered for leasing and there would be no mining.

<u>ALTERNATIVE B</u>, OFFER THE TRACT FOR LEASING AS DELINEATED/WITHOUT SPECIAL LEASE STIPULATIONS - Under this alternative the tract would be offered for competitive leasing, as delineated by the Tract Delineation Team, with BLM standard lease terms and conditions only, as displayed in Appendix B. No special coal lease stipulations would be included in the lease to be offered. Longwall (full-extraction) mining would be allowed throughout the tract resulting in subsidence of perennial drainages, Boulger Dam and Reservoir, Flat Canyon Campground, State Route 264 (other than along Upper Huntington Creek), and structures on private lands within the project area. It would be analyzed as the basis for comparison with other action alternatives that would include special stipulations needed to protect non-mineral resources and uses.

This alternative does not specifically meet Forest Plan requirements because it does not include any of the 17 Special Coal Lease Stipulations (SCLSs) prescribed for coal leases on National Forest System lands, on an as needed basis (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4). Special stipulations were not included for the purpose of disclosing the effects of not including them

<u>ALTERNATIVE B' (B PRIME)</u>, OFFER THE TRACT AS DELINEATED WITH SPECIAL COAL LEASE STIPULATIONS BUT WITHOUT RESTRICTIONS ON MINING THAT WOULD CAUSE SUBSIDENCE OF SENSITIVE SURFACE RESOURCES - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. The mining scenario would be the same as Alternative B, without restrictions on subsiding sensitive resources, but would include lease stipulations that require mitigation of effects. In some cases, the opportunity exists to include similar requirement in the mine permit during the mining plan review and permitting process. For the purposes if this analysis, it is assumed that similar measures not specifically required by law or regulation would not be applied.

This Alternative B' would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

<u>ALTERNATIVE C</u>, OFFER THE TRACT FOR LEASING AS DELINEATED/WITH SPECIAL LEASE STIPULATIONS (Do Not Allow Subsidence of Perennial Drainages, Boulger Dam and Reservoir, or Flat Canyon Campground) - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. Subsidence of perennial drainages, Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground would not be allowed. Subsidence of structures on private lands within the project area could occur, if the lessee/operator obtains permission from private coal estate owner(s), under agreement with the private surface estate owner(s).

This alternative would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

OTHER ACTION ALTERNATIVES – Alternatives B and C define the most and least restrictive action alternatives regarding leasing/mining and resource protection. Other alternatives can be considered in the decisions, as needed, to address significant social and environmental issues or opportunities. In formulating other alternatives for consideration in the EIS, the Forest Service and BLM can look at the tract boundary and potential restrictions on underground mining and surface occupancy needed to protect non-mineral resources and uses. Sensitive resource areas were specifically and individually evaluated under Alternative B and C sufficient to select another potential alternative.

If selected, this alternative would contain Special Coal Lease Stipulations (SCLSs) consistent with Forest Plan direction and would not require Forest Plan amendments.

S-1.8 AFFECTED ENVIRONMENT AND EFFECTS OF IMPLEMENTATION

The effects of mining would involve surface disturbance related to the construction and operation of exploration drill holes, two ventilation shafts, the associated access roads, and surface subsidence caused by extraction of the underground coal seams. If leased, the life of the Skyline Mine would be increased by as much as 12 years, extending the effects of the existing mining operation by approximately the same length of time.

Table S.1, Comparison of Alternatives, Mining Outcomes and Direct Physical Effects of Leasing/Mining, is a table that displays the outcomes of mining and the physical changes to the environment likely to occur from leasing and mining as anticipated in the Reasonably Foreseeable Development Scenario for each alternative. These changes are not in themselves identified as issues, but would cause changes to resources and the socioeconomic setting and, therefore, form the basis for the identified issues. This information sets the stage for the next section in this Chapter, Summary Comparison of Alternatives Relative to the Issues.

Table S.1. Comparison of Alternatives, Direct Physical Changes Due to Mining

PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	**Alternatives B and B'**	**Alternative C**
MINING			
General	No mining of Federal or non-Federal coal in project area.	Two seams mined with limited room-and-pillar mining. 36 million tons recoverable. Extend mine life 9 to 12 years..	Two seams mined (mainly longwall, some partial extraction room-and pillar mining below perennial drainages) and other protected structures). 18 to 20 million tons recoverable. Extend mine life by 5 to 7 years.
Mine Discharge Water	No change. Discharge recently increased from 500 gpm to 2,600 gpm.	Possibility of changing the mine water discharge location from Eccles Creek to Electric Lake. Discharge could increase from 2,600 gpm to a maximum of 4,000 gpm.	Same as Alternatives B and B' Same as Alternatives B and B'
Vent Shafts	No effect	Two air vent shafts with temporary access roads. Temporary disturbance of 2.9 acres (2.0 acres for pads and 0.92 acres for access roads). Possibility of pumping mine water discharge from Swens Canyon Shaft to Electric Lake requiring new buried pipeline from shaft along Swens Canyon Road and SR-264.	Same as Alternative B and B'
Exploration Holes	No effect	About 10 additional boreholes with temporary surface disturbance of 9.2 acres (4.6 acres for pads and 4.6 acres for access roads)	Same as Alternatives B and B'

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PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
SUBSIDENCE			
Longwall and Room-and-Pillar Mining (other than full-support mains).	No effect	Longwall subsidence of 2 to 14 ft, generally with flexure of ground surface producing localized slope changes of up to 3% and tension fractures in zones of high differential subsidence expected to be less than 1% of the mined area.	Same as Alternatives B and B' in areas where longwall extraction is allowed and no impact in areas with full-support mining. Area of differential subsidence would be increased as compared to Alternatives B and B' because full-extraction mining would be split into three blocks separated by subsidence protection zones.
Full-support mains	Same as Alternatives B and B' since mains under Upper Huntington Creek could still be driven to access coal reserves in existing permit area.	Full-support mains would be driven across/under Upper Huntington Creek to access the Flat Canyon Tract project area then south under the west slope of Upper Huntington Canyon to set up longwall panels. Full-support mains are designed to be stable and prevent caving and subsidence. Geotechnical design/models show safety factors in excess of 1.74. Empirical data from existing mines shows mains to be stable for at least 70 years and predictions indicate that they would be stable over 200 years. In unlikely event that pillars fail, they would fail over hundreds to thousands of years. Maximum subsidence, if pillars fail over large area, would be 4.7 ft. considering two seams of stacked mains.	Same as Alternatives B and B'. Same as Alternatives B and B'. Same as Alternatives B and B'.
Natural Slopes	Subsidence in existing permit area has not caused slope instability or movement of naturally unstable areas.	No accelerated slope instability expected.	Same as Alternatives B and B'.

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PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
SEISMICITY			
General	No mining-induced seismic events generated from mining in project area. Seismic events from mining in adjacent area would continue. Maximum Credible Event (MCE) of Richter 3.45 at a rate of one event with magnitude greater than 2 every 5 days.	Longwall mining induced seismicity expected with increased potential at depths below 1500 ft. Maximum Credible Event (MCE) of Richter 3.45. Frequency of events over extended mine life expected to be about one event with magnitude greater than 2 every 5 days. Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas.	Same as Alternatives B and B'.
Natural Slopes	Same as Alternatives B and B'	No effect. Vibration levels are too low for potential impact to slope stability. Confirmed by no evidence of slope failure due to past mining at Skyline Mine.	Same as Alternatives B and B'.

This section presents a summary of effects related to the issues, most of which would result from the physical changes to the environment from mining that are expected to occur under the Reasonably Foreseeable Development Scenario if the Flat Canyon Tract is leased. The physical effects and outcomes of mining are discussed above in Section 2.7 of the DEIS and presented in Table S.1. Table S.2 displays the effects of implementing each of the three alternatives analyzed. The effects are subdivided by resource groups, addressing each issue and general aspect of each alternative needed to be able to show the differences. It is a tabular presentation of the information presented in Chapter 4, Effects of Implementation.

Table S.2 Comparison of Alternatives, Effects by Resource/Issue

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
FACILITIES				
Boulger Dam and Reservoir (Subsidence Pt. 6)				
Subsidence damage	No effect	Subsidence of up to 13 feet with high to very high differential subsidence. Dam could fail with downstream effects and potential hazard.	Subsidence of up to 13 feet with high to very high differential subsidence. Dam would be intentionally breached to prevent downstream effects and hazard.	No effect from subsidence
Seismicity damage		Based on the MCE, the dam would experience greater than 0.1g if the event occurs within 5,500 ft., and could fail with downstream effects and potential hazards.	Same as Alternative B, except downstream effects and associated hazard would be eliminated by taking the dam out of service prior to mining.	Same as Alternative B'.
Lost use		Dam would be out of service for up to 12 years. Damage estimated at about $390,000.	Dam would be taken out of service for up to 12 years, then repaired and improved by the lessee/operator at a cost of about $390,000.	Same as Alternative B', except the dam could be out of service for 5 to 8 years.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Highway SR 264 (Subsidence Pts. 5 and 6)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 14 ft., with the possibility of minor cracking of surface in some isolated areas. Two major culverts could be damaged. Damage estimated at $52,000.	Subsidence and damage to the road are the same as Alternative B. SCLS #13 would require monitoring and repair by lessee/operator. Total cost estimated at $52,000. Repairs could include filling cracks and regrading in some areas with resurfacing of road and replacement of culverts, but without long-term effects.	No effect. No longwall mining within angle-of-draw. Projected full support pillars would not cause subsidence. No cracks expected.
Safety hazard	No effect	Safety hazard exists without close monitoring and immediate repairs.	Safety hazard effectively avoided by monitoring and immediate repairs.	No effect
Seismicity damage		No effects from mining-induced seismicity.	No effects from mining-induced seismicity.	No effects from mining-induced seismicity.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Unpaved Roads (FS and pvt.)				
Subsidence damage	No effect	Small cracks 2 inches or less expected in tensile zones. Larger cracks are possible but not likely.	Subsidence and damage same as Alternative B.	Same as Alternative B'.
Safety hazard		Minor safety risk to motorists.	Monitoring required. Some repair work required in tensile zones to fill cracks and maintain slopes and drainage with temporary safety measures required. Cost of repair estimated at less than $10,000.	Same as Alternative B'.
Seismicity damage		No effect from seismicity.	No effect from seismicity.	No effect from seismicity.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Flat Canyon Campground (Subsidence Pts. 5, 6, and 8)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 14 ft. with very low to moderate differential subsidence. Minor cracking of surface expected in some areas. Water tank, water pipelines, tables, toilets, septic tank/drain field, spring collection system, and retaining wall could be damaged. Minor cracking of roads could occur. Damage costs are estimated at $150,000 by the Forest Service.	Same as Alternative B except that SCLS #13 would require monitoring and repair by the lessee/operator. Repair costs are estimated at $150,000.	No effect. Protected with no subsidence of the structures allowed. No possibility of cracks or subsidence damage to facilities provided pillar dimensions are adequate.
Seismicity damage		Longwall mining induced seismicity has the potential to vibrate structures once every 5 days at a Peak Particle Velocity (PPV) of over 1 in/sec within a range of 3,500 ft. from mining areas. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water system is expected.	Same as Alternative B, except that lessee/operator would be required to monitor and repair damage.	Same as Alternative B'.
		Some effects to recreation use at this facility are expected. See Recreation.	Some effects to recreation use at this facility are expected. See Recreation.	No effect

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Flat Canyon Cabins (Subsidence Pt. 5)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 4 ft., with very low to low differential subsidence. Potential for tensile strain and induced slope changes with the possibility of cracks. Lost use of facilities during active subsidence. Cost of repairs could reach $360,000.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Most cabins protected due to no longwall mining allowed for protection of perennial drainage. Two cabins north of canyon may be subject to tensile strains at edge of stacked pillars with some mitigation required. Repair requirements are same as Alternatives B'.
Seismicity damage	No effect	Longwall mining induced seismicity has the potential to vibrate structures once every 5 days. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water systems is expected.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Swens Canyon Cabins (Subsidence Pt. 3)				
Subsidence Damage	No effect	Longwall mining subsidence of 4 to 10 ft. with very low to high differential subsidence. Pillars at edge of longwall area could result in higher tensile strains with the possibility of damage and lost use during active subsidence. Estimated repair cost included with Flat Canyon cabins above.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Similar to Alternative B, but could be located above pillars giving rise to greater tensile zone and greater potential for damage.
Seismicity damage		Same as discussion for Flat Canyon cabins.	Same as discussion for Flat Canyon cabins.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Hunt Dam and Reservoir				
Subsidence damage	No effect	No effect from subsidence. Closest mining and subsidence would be over 1,000 ft. distance.	Same as Alternative B.	Same as Alternatives B and B'.
Seismicity damage	No effect. Nearest mining is more than 5,500 ft. away.	Mining-induced seismicity could damage the dam. If the MCE of magnitude 3.45 occurs within 5,500 ft. the dam would experience greater than 0.1g. It could potentially be taken out of service during active mining within 5,500 ft. resulting in a loss of use. If damaged, repairs would be required. Cost could reach $390,000. It is assumed that an agreement would be reached between the lessee/operator and private landowner to prevent downstream effects and make repairs.	Same as Alternative B.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Electric Lake Dam				
Subsidence damage	No effect	No effect. No mining or subsidence would occur for a distance of approximately 2 miles of the dam.	Same as Alternative B.	Same as Alternatives B and B'.
Seismicity damage	Same as Alternative B	No effect. The dam is approximately 2 miles from nearest mining. Longwall mining induced seismicity has no potential to impact this dam. A conservatively high MCE of 3.8 would result in vibrations below the Operating Basis Earthquake (OBE) of 0.1g for this dam.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
SURFACE WATER				
Prolonged and increased mine water discharge to Eccles Creek and Scofield Reservoir	Flow to Eccles Creek and Scofield Reservoir increased from 500 gpm to 2,600 gpm in 2000. Water quality and morphology affected.	Mine water discharge and flow could increase to 4,000 gpm and last 9-12 years. Stream morphology effects similar to Alternative A.	Same as Alternative B.	Same as Alternatives B and B' except that mine water discharge could occur for a shorter time (extended mine life of 5 to 7 years).
	Quality generally consistent with beneficial use standards, occasional exceedance of phenol, total phosphorous, and TDS. Some increase in sediment to Scofield Res.	Increased TDS and Phosphorous loading to Scofield Reservoir. Sediment increases to Scofield reservoir similar to Alternative A.	Same as Alternative B.	Same as Alternative B, but for a shorter time (5-7 years).

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Changing some or all of the mine water discharge from Eccles Creek to Electric Lake				
Flow	No effect	If mine water discharge is shifted to Electric Lake, flow in Eccles Creek and downstream waters would return to pre-mining flows and flow to Electric Lake would increase by a maximum of 4,000 gpm. Loss of 5.8 to 8.9 cubic feet per second (cfs) or approx. 5% Price River's annual yield. Gain of 5.8 to 8.9 cfs or approx. 7% of Huntington Creek's annual yield. Small change relative to 6,200 capacity of Scofield Reservoir and 2,300 cfs capacity of Electric Lake.	Same as Alternative B.	Same as Alternatives B and B', except that discharge would occur for a shorter time (5-7 years)..
Quality	No effect	Eccles Creek would return to near premining quality.	Same as Alternative B.	Same as Alternatives B and B'.
		Electric Lake quality decreased (TDS, Sulfate, and Phosphorus. Possible accelerated eutrophication. Water temperature increase at discharge outlet.	Same as Alternative B, but some mitigations potentially required.	Same as Alternatives B and B, but for a shorter time (5-7 years).'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence effects to springs/seeps and flow of receiving streams.	See Ground Water	See Ground Water	See Ground Water	See Ground Water
Subsidence of perennial streams and Boulger Res. could intercept water and divert it underground.	No effect	No loss of water expected due to deep overburden and sealing characteristics of clay in shales. If it should occur, state appropriated waters would be replaced by the lessee/operator's expense.	Same as Alternative B, except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	No effect because subsidence would be prevented except for the Cunningham Drainage. No loss of water expected due to deep overburden and sealing characteristics of clay in shales. In the event that loss occurs due to mining, SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
GROUND WATER				
Subsidence could change flow of springs/seeps, affecting flow of springs and receiving streams. Also water rights.	No effect	Spring locations could shift but no loss of water expected due to sealing characteristics of clay in shales. Lessee/operator required to replace state appropriated water if affected.	Same as Alternative B except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	Same as Alternative B', except that fewer springs would be subjected to subsidence.
Interception of mine water and discharge to Eccles Creek diverts water from Huntington Canyon drainage to Price River drainage (Transmountain Diversion)	No effect	Deep aquifers associated with channel sands are discontinuous. Mine water tested at 10,000 years old and transmissivity of rock layers (vertical and horizontal) is extremely slow, so any effect would not be quantifiable or perceptible	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Water Quality Effects from Equipment Left Underground	No effect	Local ground water quality could be degraded by oils and other fluids (battery acid, transmission oil, diesel fuel, lubricants, etc.) if leaked underground and slow corrosion/oxidation of metals left underground. See mine water discharge in Surface Water Section. Connection with surface waters is very slow and unlikely, therefore effects are expected to be negligible.	Same as Alternative B, but SCLS #19 would require removal of equipment unless specifically approved. Less potential for contamination because equipment and materials left underground would be limited to corrosion/oxidation resistant metals and non-polluting fluids.	Same as Alternative B'.
VEGETATI ON				
Disturbance from Surface Facilities	No effect	Temporary (3-5 yrs.) removal of 2.9 acres of vegetation for vent shafts and 9.2 acres for exploration drill holes. Long-term (12-15 years) of vegetation affected for vent shafts of less than 1 acre.	Same as Alternative B.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence disturbance.	No effect	Changes in stream morphology in Swens Canyon, Little Swens Canyon, Boulger Canyon, and Flat Canyon could result in loss of streambank riparian vegetation from scouring. Increase in pond areas could increase riparian over the long-term after all subsidence is complete (increased land/water contact area).	Same effects as Alternative B but SCLS #3 and #7 require vegetation baseline information and monitoring necessary to quantify changes.	No effect
		Spring locations could shift causing associated localized riparian vegetation to shift. Temporary loss during adjustment.	Same as Alternative B, except SCLS #3 and #7 would require vegetation baseline information and monitoring necessary to quantify changes.	Same as Alternative B', but fewer springs subjected to subsidence.
Threatened, Endangered, and Sensitive Species	No effect	No effect	No effect	No effect

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
WILDLIFE				
Terrestrial				
Disturbance from Surface Facilities	No effect	Short-term loss of habitat for exploratory drilling and construction/drilling of vent shafts due to avoidance. Sensitive bird species (individuals) could be affected during nesting season, causing abandonment.	Same as Alternative B, except SCLS #14 reduces effects to sensitive species and species of high interest by imposing appropriate timing restrictions on construction and drilling operations. Does not affect operation of vent holes, once constructed.	Same as Alternative B'.
		No effect to Threatened or Endangered Species. Activities would be postponed in critical habitat to avoid effects.	Same as Alternative B.	Same as Alternatives B and B'.
Subsidence/Seismicity	No effect	No effect	No effect	No effect
Aquatic				
Disturbance from Surface Facilities	No effect	Crossing Boulger Canyon and Swens Canyon could add minor amounts of sediment to creeks. Use of bridges or bottomless arches would reduce streambed disturbance, therefore negligible effect to habitat.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence caused changes in stream gradient/morphology/flow/ quality could affect habitat.	No effect	Stream morphology changes and sediment additions in streams could degrade habitat and productivity for aquatic species in perennial drainages with gradients of 5% or less including the majority of Boulger Creek, (4.0 miles), lower portions of Swens (0.5 mile) and Little Swens (0.5 mile) Canyons, and in Flat Canyon (1.5 miles). Individuals affected but population viability not lost. Recovery could take 10-30 years after subsidence. No flow changes expected (see Surface and Ground Water).	Same effects as Alternative B, but SCLS #3 and #7 would require monitoring to quantify effects to habitat and aquatic species and potentially require mitigations.	No effect except for Cunningham Drainage. Negligible effects because stream gradient is steeper than 5% (similar to Burnout Canyon).
Seismicity	No effect	No effect	No effect	No effect
Mine Water Discharge	Increased discharge to Eccles Creek and Scofield Reservoir from 500 gpm to 2,600 gpm not evaluated.	Discharge could increase to 4,000 gpm. Not evaluated. If discharge to Electric Lake is approved, degradation of water quality from mine water discharge into Electric Lake could degrade habitat in Electric Lake.	Same as Alternative B.	Same as Alternatives B and B', but mine water discharge would occur for a shorter time (5-7 years)..

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
LANDS AND SPECIAL-USES				
Disturbance from subsidence, seismicity, and surface facilities	No effect	Land uses and Forest Plan management emphasis remain the same, but some facilities could be impaired as discussed under Facilities.	Land uses and Forest Plan management emphasis remain the same, but facilities would be monitored and repaired. Some lost use of facilities to prevent safety hazards.	Land uses and Forest Plan emphasis remain the same. Most facilities protected from subsidence and associated effects.
RECREATION				
Disturbance from Surface Facilities	No effect	Single-season degradation of recreation experience in Boulger Canyon and Swens Canyons during construction of vent shafts.	Same as Alternative B.	Same as Alternatives B and B'.
		Single-season degradation of recreation experience for coal drilling in any specific area.	Same as Alternative B.	Same as Alternative B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES A	B	B'	C
Subsidence				
Boulger Reservoir	No effect	Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs) due to potential damage to dam. Failure of dam could cause a safety hazard to fishermen and sightseers in the stream channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B except the safety hazard would be avoided by requiring the dam to be breached prior to mining.	No effect
Flat Canyon Campground		See the facilities section for description of damages. Loss of one season of use for each of the two seams for a total of two seasons of lost use (3,000 RVDs/season for a total of 6,000 RVDs). Potential safety hazard to people using the facilities.	Same as Alternative B, except safety hazard would be avoided by closing campground during active subsidence.	No effect

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Seismicity				
Boulger Reservoir	No effect.	Dam could be damaged by seismicity (see Facilities). Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs). Potential safety hazard to fishermen and sightseers in channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B, except safety hazard avoided by requiring dam to be breached prior to mining.	Same as Alternative B'.
Flat Canyon Campground	No effect	Some minor potential for damage (see Facilities) that could cause a low safety hazard.	Safety hazard avoided because campground closed due to subsidence concerns. Campground closed for two seasons (see subsidence above).	No effect.
Dispersed recreation	Events greater than magnitude 2 could be perceived once every 5 days within 3,500 ft. of existing permit area.	Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas. Events could occur for 9 12 years.	Same as Alternative B.	Same as Alternative B' but length of time that events could occur and be felt is decreased to 5-7 years.

RESOURCE/ ISSUE	ALTERNATIVES A	B	B'	C
VISUAL QUALITY				
Disturbance from Surface Facilities	No effect	Consistent with Visual Quality Objectives. Drilling operations for coal exploration and vent shafts would be visible along SR-264 for one season for each specific hole/vent.	Same as Alternative B.	Same as Alternatives B and B'.
		Vent shafts in Swens and Boulger Canyons would be visible over the long-term (12 years) from the immediate vicinity. Both screened from view from SR-264. Water vapor plumes would be visible from SR-264 and SR-31 on infrequent occasions.	Same as Alternative B.	Same as Alternative B and B' but for less time (5-7 years).
		Drained Boulger Reservoir could be a visual detraction to visitors along SR-264 (12 years).	Same as Alternative B.	Same as Alternatives B and B' but for less time (5-7 years).
TRANSPORTATION				
Extended Mine Life	No effect	Existing mine related traffic on SR-264 and SR-31 (total of about 56 cars/trucks per day) would be extended for another 9-12 years.	Same as Alternative B.	Same as Alternatives B and B' except traffic use would be extended by 5-7 years.
Disturbance from Surface Facilities	No effect	Addition of drilling traffic for two – three seasons (one season for individual vents/hole) on SR-264, SR-31, private roads, and Forest Development Roads.	Same as Alternative B.	Same as Alternative B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence	No effect	Minor cracks could occur on SR-264 that would need repairs.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards.	Same as Alternative B'.
		Larger cracks are expected on Forest Development roads and private roads on ridge tops that could present short-term hazard.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards.	Same as Alternative B', except fewer roads would be subjected to subsidence.
		Private roads that cross Flat Canyon Creek could be flooded requiring work to raise running surface to above water levels.	Same as Alternative B.	No effect.
Seismicity	No effect	No effect.	No effect.	No effect.
SOCIO-ECONOMIC				
Lease Bonus Bid	No Bonus Bid	Bonus Bid	Same as Alternative B.	Bonus bid but less than Alternatives B and B'.
Life of Mine, Employment, and Support Services Jobs Extended	No extension. Loss of 220 jobs in 2003. This does not consider the potential for mining U 67939.	Mine life including 220 jobs extended up to 12 years.	Same as Alternative B.	Mine life including 220 jobs extended 5 to 7 years.
Coal Production	None	36 million tons	Same as Alternative B.	18-20 million tons
Value of Coal Recovered	None	$612 million	Same as Alternative B.	$306 - $340 million
Royalties	None	$49 million	Same as Alternative B.	$24 - $27 million

S-1.0 DEIS SUMMARY

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
CULTURAL AND HISTORIC RESOURCES				
Disturbance from Surface Facilities	No effect.	Site surveys required and sites would be avoided or recovered on Fed. lands. Sites on private lands subject to landowner discretion.	Same as Alternative B.	Same as Alternatives B and C.
Subsidence	No effect.	Site surveys required and sites on Federal lands would be protected, repaired or recovered. Disposition of sites on private lands subject to discretion of landowner.	Same as Alternative B. SCLS #1 serves as a notice to lessee that surveys and protection required on Federal lands.	No effect. Structures located in subsidence protection zones. For other sites, Same as Alternative B'.
		Historic log structures not likely damaged. Rock foundations could be cracked.	Same as Alternative B. Federal sites protected, repaired, or recovered.	Same As Alternative B'.
		Historic roads and trails not likely affected.	Same as Alternative B.	Same as Alternative B'.
		Lithic scatters not likely affected.	Same as Alternative B.	Same as Alternative B'.
Seismicity	No effect.	No effect.	No effect.	No effect.
PALEONTOLOGICAL RESOURCES				
Mining	No effect	Some dinosaur footprints, bone fragments, and vegetation imprints destroyed in the underground coal seam during mining.	Same as Alternative B	Same as Alternatives B and C.

S-1.0 DEIS SUMMARY

RESOURCE/ ISSUE	ALTERNATIVES			
	A	**B**	**B'**	**C**
Disturbance from Surface Facilities	No effect	Surveys would be conducted and sites would be avoided or recovered.	Same as Alternative B	Same as Alternatives B and C.
Subsidence	No effect	No effect to buried dinosaur fossils. Pleistocene mammal fossils buried in glacial materials could be displaced by subsidence. Not likely that bones would be broken.		No effect to buried dinosaur fossils. Very low potential for displacement of Pleistocene mammal fossils because high occurrence potential areas lie within subsidence protection zones.
Seismicity	No effect.	No effect.	No effect.	No effect.

This Draft Environmental Impact Statement (DEIS) considers the environmental, social, and economic effects of offering the Flat Canyon Coal Lease Tract (UTU-77114) for leasing by the United States Department of the Interior, Bureau of Land Management (BLM), with consent by the United States Department of Agriculture, Forest Service, specifically the Manti-La Sal National Forest (FS). This analysis is tiered directly to the Final Environmental Impact Statement, Manti-La Sal National Forest, 1986 and Record of Decision and Summary, November 5, 1986 as amended. The BLM and FS jointly conducted the environmental analysis for the Flat Canyon Coal Lease Tract and prepared the DEIS. The United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement (OSM) participated as a cooperating agency. The DEIS specifically addresses the consequences of implementing four alternatives, including the Proposed Action and "No Action" Alternative that involves taking no further action to evaluate or offer the tract for leasing. The analysis was initiated by the agencies in response to an application to lease the Flat Canyon Tract by Canyon Fuel Company, LLC, submitted to the BLM, Utah State Office.

Decisions to be made, authorizing actions, and a description of the Federal coal leasing process are further discussed in Sections 1.3 and 1.4.

1.1 PROPOSED ACTION

The proposed action is for BLM to offer the Flat Canyon Coal Lease Tract (UTU-77114) for competitive leasing in response to Canyon Fuel's application for leasing under the Lease-on-Application process contained in Federal Regulations 43 CFR 3425. The Forest Service would consent to leasing by BLM. The Tract would be offered with BLM's standard terms and conditions contained on Lease Form 3400-12 and special coal lease stipulations identified by BLM and the Forest Service for the protection of natural resources consistent with applicable laws, Forest Service and BLM policies, and the Land and Resource Management Plan, Manti-La Sal National Forest. In order to meet Canyon Fuel's need to move into the tract with underground workings in late 2001 or early 2002, the proposed lease sale would need to take place around November 2001.

The tract was delineated by an Interagency Tract Delineation Team to assure that it is reasonable and meets requirements of the responsible agencies. The Flat Canyon Tract encompasses 2,692.16 acres of Federal coal reserves of the Wasatch Plateau Coal Field on National Forest System lands within the Manti-La Sal National Forest in Sanpete County, Utah. This area is described in the DEIS as the "Tract Area" as follows (Figures 1.1 and 1.2):

T. 13 S., R. 6 E., SLM,

Section 21, lots 1-4, E1/2E1/2;
Section 28, lots 1-8, S1/2NW1/4, SW1/4;
Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R. 6 E., SLM,

Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2.

Additional non-Federal lands with non-Federal coal (both in private ownership) adjacent to the Federal coal lease tract, referred to as the "Private Lands (approximately 1,100 acres)," could be mined as a result of this lease action. They are described below:

T. 13 S., R. 6 E., SLM,

Section 29, E1/2SE1/4, SE1/4NE1/4, S1/2NE1/4NE1/4;
Section 32, E1/2E1/2.

T. 14 S., R. 6 E., SLM,

Section 3 (portion as shown on Figure 1-2)
Section 8, N1/2N1/2;
Section 9, N1/2N1/2;
Section 10 (portion shown on Figure 1-2).

The Tract area and adjacent private lands are collectively referred to in this DEIS as the "Project Area". Therefore, the total area analyzed is approximately 3,792 acres.

1.2 PURPOSE AND NEED

The purpose of offering the tract for competitive leasing is to provide an opportunity to develop mineable Federal coal reserves by underground methods. This coal is needed for the generation of electricity, other industrial uses, and to maximize economic returns to the National, State and local economies, and to prevent bypassing mineable coal reserves adjacent to an existing mine that may otherwise not be mined.

The purpose of Canyon Fuel's application is to obtain the right to mine known Federal coal reserves in the Flat Canyon Tract, immediately to the west of the current permit area for their Skyline Mine. If leased, Canyon Fuel would extend their underground coal workings to the west into the Flat Canyon Tract and beyond into private (fee) coal reserves. Two coal seams could be mined over the majority of the project area (Flat Canyon Tract and adjacent non-Federal lands). Recoverable coal reserves in the tract and adjacent area are estimated at approximately 36 million tons. At an annual production rate of 3 to 4 million tons, the proposal could extend the life of the Skyline Mine by 9-12 years.

A review of the Forest Plan showed that the proposed lease tract area is available for further consideration for coal leasing through application of the Unsuitability Criteria (43 CFR 3464) and an appropriate environmental analysis (Letter to the Utah State Director of BLM from the Forest Supervisor, Manti-La Sal National Forest 2820-4, January 21, 2000).

If the tract is not leased within the approximate proposed time frame, it is likely that the mineable Federal coal reserves in the tract would be bypassed and not mined in the foreseeable future.

1.3 DECISIONS TO BE MADE, AUTHORITIES, AND PERMITS

The USDI, Bureau of Land Management (BLM) is the leasing authority for all Federal coal reserves under the Mineral Leasing Act of 1920, as amended. The BLM Utah State Director must decide:

- whether or not to offer the Flat Canyon Tract for competitive leasing.
- what terms, conditions, and stipulations are needed on the lease to ensure compliance with the Mineral Leasing Act of 1920, as amended.

The USDA, Forest Service is the Surface Management Agency. The Forest Supervisor, Manti-La Sal National Forest, must decide:

- whether or not to consent to leasing by BLM, under authority of the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1975.
- what special coal lease stipulations are needed for the protection of non-mineral resources.

If consent to leasing is given, the Forest Supervisor is also consenting to underground mining and subsidence of the land surface consistent with the lease stipulations imposed for the protection of National Forest resources.

Before any mining can take place on a Federal coal lease, a mine permit must be obtained by the lessee or operator.

The Surface Mining Control and Reclamation Act of 1977, as amended (SMCRA) gives the Office of Surface Mining Reclamation and Enforcement (OSM) primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations in the United States. Pursuant to Section 503 of SMCRA, the Utah Division of Oil, Gas, and Mining (DOGM) developed, and the Secretary of the Interior approved, Utah's permanent regulatory program authorizing Utah DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on private and State lands within the State of Utah. In March 1987, pursuant to Section 523(c) of SMCRA, Utah DOGM entered into a cooperative agreement with the Secretary of the Interior authorizing Utah

DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on Federal lands within the State.

Pursuant to the cooperative agreement, Federal coal lease holders in Utah must submit a permit application package (PAP) to OSM and Utah DOGM for proposed mining and reclamation operations on Federal lands in the State. Utah DOGM reviews the PAP to ensure that it complies with the approved Utah State permanent program and other statutes. If it does comply, Utah DOGM issues the applicant a permit to conduct coal mining operations. OSM and other Federal agencies review the PAP to ensure that it contains the necessary information for compliance with the coal lease, the Mineral Leasing Act of 1920, as amended (MLA), the National Environmental Policy Act of 1969, as amended (NEPA), and other applicable Federal laws and their attendant regulations. OSM recommends to the Assistant Secretary of the Interior, Land and Minerals Management: (1) approval of the MLA mining plan, (2) approval of the MLA mining plan with conditions, or (3) disapproval of the MLA mining plan. Before making a recommendation on the mining plan, OSM obtains input from certain other Federal agencies, including the surface management agency.

The BLM is responsible for monitoring and enforcement of lease terms, conditions, and special stipulations, including required mitigations. The Forest Service cooperates with BLM by conducting field inspections of lease areas and operations.

Utah DOGM enforces the performance standards and permit requirements during the mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility of this enforcement. The surface management agency has authority in emergency situations in which Utah DOGM or OSM inspectors cannot act before environmental harm or damage occurs. UDOGM conducts frequent inspections of operations for compliance. The Forest Service cooperates with them regarding enforcement.

Resource monitoring, including subsidence, water monitoring, and vegetation monitoring is conducted by the lessee/operator in compliance with the mine permit and other permits issued for operations. The regulatory agencies take periodic samples to verify the lessee/operator monitoring data.

1.4 INCORPORATION BY REFERENCE

To decrease the size of this document and degree of redundancy to the contents of other documents, some material tiers to or incorporates other materials by reference. Material specially cited or otherwise used in preparation of this document is hereby incorporated by reference.

Information in this document tiers to the direction contained in the Forest Plan, as amended and its Record of Decision (1986). Information in the Forest Plan Final Environmental Impact Statement is hereby incorporated by reference.

The Technical Reports prepared by NorWest Mine Services, Inc. (NorWest, 2000 and amendment (NorWest, 2000a) for this analysis under direction of the Forest Service and Bureau of Land Management are hereby incorporated by reference.

The entirety of the supporting project record on file at the Forest Supervisor's Office, Manti-La Sal National Forest, 599 West Price River Drive, Price, Utah, 84501 is hereby incorporated without further reference.

1.5 SCOPE OF THE PROJECT

The scope of the project refers to the geographic boundaries of the proposal, including any connected or cumulative actions. The scope of actions addressed in this document is limited to the specific proposal to lease the Flat Canyon Federal Coal Lease Tract.

This document does not constitute a general management plan for the area. It discloses and evaluates potential effects that could be caused by the site-specific issues associated with the proposed leasing action and reasonably foreseeable mining of the project area and includes all lands that may reasonably be affected from implementation of the alternatives.

1.6 LEASING PROCESS

The coal leasing process, lease administration, and enforcement are described in Federal Regulations 43 CFR 3400. The Flat Canyon Tract would be processed under the leasing procedures contained in 43 CFR 3425, Leasing-on-Application.

Under this process, evaluation of a coal lease tract for potential leasing is initiated by an application to lease by the coal industry. The BLM initiates evaluation of the application by prioritizing applications on record based on the date submitted, market conditions, and need by the proponents to obtain additional reserves to allow continued mining from adjacent mines.

The tract boundaries to be considered for leasing by the BLM are determined by a Tract Delineation Team consisting of representatives of the BLM, the surface management agency, and the State. In this case the surface management agency is the Forest Service. The team considers the proponent's application and other factors such as adjacent coal reserves, accessibility to reserves, geologic conditions, and environmental factors in the delineation process to ensure that the tract is in the public's interest.

Once the tract is delineated, the BLM and Surface Management Agency review market conditions, current land and resource management plans, and management direction for leasing and mining. This review is conducted to determine if the proposed lease area is available for further consideration for leasing

After it is determined that the tract is available for further consideration for leasing and consistent with general management direction, an environmental analysis is conducted. Prior to starting the analysis, adequate information regarding coal reserves and the environment must be compiled to meet data adequacy requirements set by the Uinta-Southwestern Utah Coal Region. Usually the proponent collects and compiles this data and submits it to the BLM and the surface management agency. Once data adequacy is met, the data are supplemented by agency inventories and an environmental analysis is conducted.

An environmental analysis must be completed consistent with requirements of the National Environmental Policy Act of 1969. A coal lease suitability analysis, required under Federal Regulations at 43 CFR 3461, is conducted and documented. In this case, the BLM and Forest Service jointly prepare an Environmental Impact Statement and suitability analysis. The Office of Surface Mining Reclamation and Enforcement participates as a cooperating agency.

If cleared for leasing, the BLM will hold a competitive lease sale at the BLM Utah State Office in Salt Lake City in accordance with requirements and procedures set forth in Federal Regulations 43 CFR 3420.

No mining may occur on a lease until the lessee/operator submits a complete and technically adequate Permit Application Package/Mining and Reclamation Plan and a permit to mine is issued.

1.7 CURRENT AND PAST MINING

Canyon Fuel is mining the area to the east of the tract, and east of Upper Huntington Creek and Electric Lake by underground methods, using state-of-the art longwall mining technology. This area contains five Federal coal leases that are included in the current approved permit area for Canyon Fuel's Skyline Mine. Figures 1.1 and 3.1 show the permit area. The underground workings in the permit area at the Skyline Mine are accessed through portal facilities located in Eccles Canyon, approximately 2.5 miles east of the northern portion of the Flat Canyon Tract. The main portals are located in Eccles Canyon and North Fork of Eccles Canyon. A ventilation breakout is located in the South Fork of Eccles Canyon. An overland conveyor system transfers coal from the portal facilities on National Forest System lands to coal storage and loadout facilities (truck and train) at the mouth of Eccles Canyon below the Forest boundary on privately owned lands, a distance of approximately 2.5 miles along State Route 264 (paved highway). The Skyline Mine currently produces about 3-4 million tons of coal per year. A more detailed discussion of past and current mining at the Skyline Mine is contained in Chapter 3.

1.8 REASONABLY FORESEEABLE DEVELOPMENT

The Reasonably Foreseeable Development/Mining Scenario (RFDS) has been developed by the BLM in consultation with Canyon Fuel and Norwest Mine Services, Inc. NorWest Mine Services, Inc. prepared the scenario, predicted the location and amount of mining-induced subsidence and seismicity, conducted an analysis of the physical effects of mining to the geology, topography, and facilities/structures in and adjacent to the project area, and prepared Technical Reports under the direction of the agencies. The NorWest Technical Reports are referenced throughout the DEIS. The following is a summarized description of the Reasonably Foreseeable Mining Scenario. A detailed description of the predicted development of the proposed tract area and adjacent private lands and mineral estates are contained in the Technical Reports prepared by Norwest Mine Services, Inc. (Project File).

The RFDS is conceptual in nature and was developed for the purpose of determining the effects of leasing and subsequent mining. It presents the most likely mining scenario based on current information available from the Skyline Mine, but it is recognized that changes to locations of main entry systems and panels could be necessary based on actual conditions encountered underground. In order to adequately evaluate potential effects, with the knowledge that some aspects could change, the RFDS and effects analysis assume that the scenario with the most surface effect could occur.

The geologic conditions predicted in the Tract indicate that mining conditions would be relatively similar to those that have been experienced in the Skyline Mines, except that the reserves become progressively deeper towards the West. All mining would be done by underground methods with surface disturbance being limited to ancillary facilities. No surface mining methods would be used and the existing portal and support facilities in Eccles Canyon would be used. The RFDS for future mining in the Tract has been developed on the assumption that longwall mining would be carried out on a similar basis to that successfully employed at Skyline. Several northeast-southwest trending faults occur within the project area. The vertical offset of each fault is not specifically known at this time but it is conceivable that the offset could be large enough to influence the mining scenario. Due to the uncertainties, the RFDS was developed assuming that they would not change the mining scenario, but their existence and potential to influence mining is recognized.

The main underground mining access to the Tract is planned in the Lower O'Connor B Seam by the westerly extension of the current main development entries in the Skyline Mine. To provide sufficient capacity for ventilation, access, escape, and haulage, it is probable that all of the six entries in the existing mains would be developed into the new area (Figure 1.2).

For Maximum Economic Recovery (MER), it has been assumed that a Main Development Corridor would be located below or under the west canyon slope of Upper Huntington Creek, as this would afford protection of this perennial drainage from subsidence, while allowing efficient recovery. A corridor about 1,600 feet wide has been identified where the mains would be located that allows for a sufficient number of entries and pillars with adequate dimensions to ensure long-term stability.

The main development system would be connected to ventilation shaft(s). Sub-mains would also be needed for access to production areas. Mining of the majority of the project area would generally be at greater depths than in the current permit area, varying from about 1,000 feet to over 2,000 feet.

Access to the Flat Canyon and Lower O'Connor 'A' Seams would be from underground, by developing rock entries at a slope to access mains in the lower seam. The lower main development entries and pillars would be driven underneath those in the upper seam and pillars would be vertically aligned to minimize adverse stress interactions and optimize coal recovery.

Production is planned by longwall methods similar to those currently being used in the Skyline Mine. It is expected that panels would be about 800 feet wide and their length would vary from about 3,000 to 15,000 feet, depending upon selected mine layout and both geological and operational constraints.

The most likely orientation of longwall panels would be approximately E-W, which has been shown to be successful at Skyline. Previous mining experience has also shown that an orientation approximately N-S could also be acceptable. Other geological and operational constraints, such as the location and offset of faults, may influence the final choice of panel orientation. Protection of surface structures and resources could also provide additional constraints on the location, orientation, and sequence of longwall extraction.

Mine production is planned from a single longwall section, in conjunction with production from continuous miners driving development entries. Additional production may come from room-and-pillar extraction, although a depth limitation of 1,800 feet for this method has been assumed. There are two mineable seams over the majority of the area and the upper coal bed (Lower O' Connor B Seam) would be mined first, followed by the lower coal bed (Flat Canyon Seam). The areas that could be potentially mined in the Lower O'Connor B Seam (Upper Seam Mining Zone) are shown on Figure 1.3. The potential mining area for the Flat Canyon Seam (Lower Seam Mining Zone) is shown on Figure 1.4.

The BLM has identified in the Tract Delineation Report longwall mining reserves of about 36 million tons. At an estimated annual production rate of three to four million tons, this would extend the life of the Skyline Mine from nine to twelve years.

Reasonable equipment constraints for the definition of the minimum and maximum extraction heights for full extraction longwall mining have been assumed for evaluation of impacts due to subsidence. For the upper seam, an operational height range from 7.5 to 12.5 feet is reasonable (BLM). The lower seam is thinner and longwall equipment with a height range from 6 ft. to 10 ft. is reasonable (BLM). These are not definitive height restrictions and it is possible that longwall mining of the two seams, based upon variations in geologic conditions and proper equipment selection, extraction heights could range from 6 to 13 feet (BLM).

For the prediction of subsidence, it has been assumed that a three-entry gate road system would be used between longwall panels with a combination of yield and rigid pillars. This is considered to be a conservative assumption, as other options might include two or three entry gate roads with yield pillars that would be expected to produce lower differential subsidence.

Areas not amenable to longwall mining, due to their shape, size, coal thickness or surface protection requirements, have been evaluated on the assumption that they would be mined by room and pillar using full or partial extraction methods.

Access to the Flat Canyon Tract can be obtained through the coal in the western part of the Skyline Mine permit area, utilizing full support room-and-pillar first mining. This would allow for the coal within the Flat Canyon Tract to be more easily accessed and for a higher percentage of the coal to be extracted (mains/submains and barrier pillars would be within the present active leases). It would also allow coal from a fee lease that adjoins the southern portion of the tract to be potentially mined past the western boundary of Electric Lake. The access under Huntington Canyon would be with full-support room-and-pillar first mining.

The coal thins to the north, south, and west of the Flat Canyon Tract. The existing Skyline Mine is on the east; therefore, there are no additional tracts that can be leased from this location as a logical extension of the mine.

The mineable coal seams do not crop out or come in contact with the surface within the tract. The only alternative access to the coal reserves from the ground surface would be by construction of a shaft. The only potential site for a new mine and shaft lies on fairly level ground between Electric Lake and Boulger Reservoir. The shaft would have to be 1,200 feet deep. Surface support facilities, including a loadout, would have to be constructed. The coal would have to be trucked out. State Route 264 is not designed for coal-hauling trucks. The roads would have to be reconstructed. There is no electricity, so an electric powerline of 46 KVA would need to be built. The total cost of such a facility could exceed 100 million dollars (NorWest, 2000). The economic viability of a new mine being constructed to extract a maximum of 36 million tons of coal is highly improbable.

In order to meet Federal requirements for proper ventilation, one or two ventilation shafts (exhaust) would be necessary. A primary ventilation shaft would be located in Swens Canyon (Figure 1.2). A secondary ventilation shaft could be needed. It could be located in the upper Boulger Canyon area (Figure 1.2). Each shaft or vent hole would be 5-8 feet in diameter. Due to the blowing (positive) ventilation system at the mine, no fans would be needed and air would be exhausted from the shafts. An evase protected by a fence would be the only facilities at the surface location. A short access road of less than 1,000 feet would be constructed to each site for the drill rig. Each pad would disturb approximately less than 1 acre and each access road would disturb approximately 0.46 acre. The total disturbance for both vents would then be 2.9 acres. The roads would be reclaimed by providing necessary drainage to prevent erosion and facilitate establishment of vegetation, then closed to continued use for the life of the mine. The vents would be inspected twice a month on foot. The roads would be reopened for access to the shafts to plug and reclaim them. The access roads would then be plugged and completely recontoured and reclaimed upon abandonment.

No additional mine facilities would be needed in Eccles Canyon to mine the project area. Water encountered underground in the project area would either continue to be discharged at the mine water discharge point at the mine in Eccles Canyon or diverted to a new discharge point below the high water line of Electric Lake. Changing the point of diversion would require reclassification of Huntington Creek by the State of Utah and issuance of a new Utah Point Discharge Elimination System (UPDES) permit. Authority to allow this lies with the State of Utah. The BLM and Forest Service must be consulted for comment, but the Federal Agencies do not have direct authority to approve or disapprove this action.

The potential exists for up to 10 exploration drill holes to be drilled during the life of the tract. The total disturbance for each site is estimated at 0.92 acres (100 ft. x 200 ft. pad and 1,000 ft. x 20 ft. road disturbance per exploration site). Multiplied by 10 sites the total disturbance would be 9.2 acres.

1.9 CONFORMANCE WITH LAND USE PLANS

1.9.1 Availability

The Forest Plan consistency review was completed and documented in a letter from the Forest Supervisor, Manti-La Sal National Forest, to the Utah State Director of BLM, dated January 21, 2000 (Project File). It was determined that the tract is available for further consideration for coal leasing under the Land and Resource Management Plan, Manti-La Sal National Forest, 1986 (Forest Plan) and the Record of Decision for the Forest Plan and Final Environmental Impact Statement, dated November 5, 1986.

The tract lies with the Huntington Canyon-Gentry Mountain Coal Multiple-Use Evaluation Area evaluated in the Manti-La Sal National Forest Land and Resource Management Plan, 1986 (Forest Plan). Issues and concerns that must be evaluated for tracts in this area include water quality, traffic, visual quality, and recreation thresholds. The Forest Plan states that the area is available for further lease action consideration. Further lease actions utilizing Huntington Canyon for transportation and mine development, other than supplying existing operations, would be delayed until it is determined that unacceptable impacts to existing resources would not occur.

The Flat Canyon Tract has been proposed for leasing by Canyon Fuel to provide additional coal reserves for the Skyline Mine that can be accessed from underground workings in the adjacent Skyline Mine Permit area. Additional mine developments, other than underground workings, are not anticipated.

1.9.2 Forest Plan Emphasis and Direction

The tract includes RNG (Range), DRS (Developed Recreation Sites), TBR (Timber), and WPE (Watershed Protection/Improvement) Forest Plan Management Units.

RNG Management Unit

Emphasis is on production of forage and cover for domestic livestock and wildlife. Direction states that appropriate mitigation measures must be used to assure continued livestock access and use. Those authorized to conduct development would be required to replace losses through appropriate mitigations, where site-specific development adversely affects long-term production or management.

DRS Management Unit

Management emphasis for DRS units is on developed recreation. The Flat Canyon Tract includes the Flat Canyon Campground DRS Management Unit. Mineral leasing is allowed where it is determined that stipulated methods of development and extraction would not adversely affect recreation values to any significant degree.

TBR Management Unit

Emphasis is on management for the production and use of wood-fiber for a variety of wood products. There is no specific direction for mineral activities in TBR Management Units. General policy requires mineral operators to pay the fair market value of merchantable timber removed or destroyed for mineral activities, and reclamation measures include planting to replace timber.

WPE Management Unit

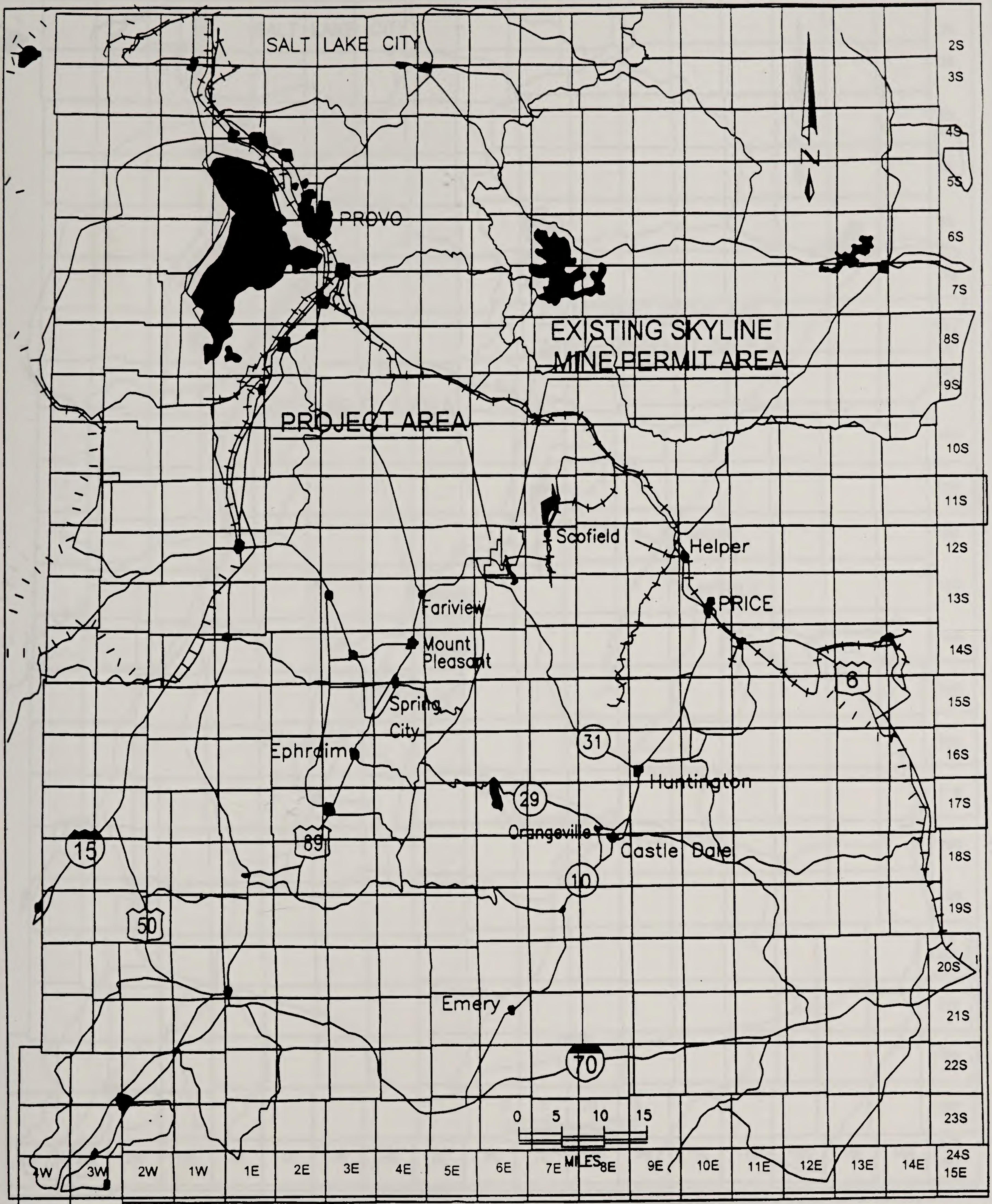
Emphasis is on watershed protection/improvement. This includes areas where watershed treatments have occurred and other resource use is limited to protect the watershed investments. Other uses can occur so long as the use or its rehabilitation does not degrade the watershed treatment.

Land Uses

The Boulger Canyon dam, reservoir, and associated dispersed recreation area and Flat Canyon Campground lie within the tract. The lease must contain stipulations to protect or mitigate impacts to these facilities and provide for public safety.

1.10 Data Adequacy Standards

It has been determined that there is sufficient coal and environmental resource data to meet Uinta-Southwestern Utah Coal Region Data Adequacy Standards (Canyon Fuel Company, LLC Data Adequacy Submittal and Supplement, Third-Party Contractor Technical Reports).



LEGEND

RAILROAD	LAKE/RIVER	U.S. HIGHWAY
HIGHWAY	CITY	STATE HIGHWAY
ROAD	PROJECT AREA	INTERSTATE HIGHWAY

FIGURE 1.1

PROJECT LOCATION MAP

DATE: 3/19/1999

FILE: 2273F1.DWG

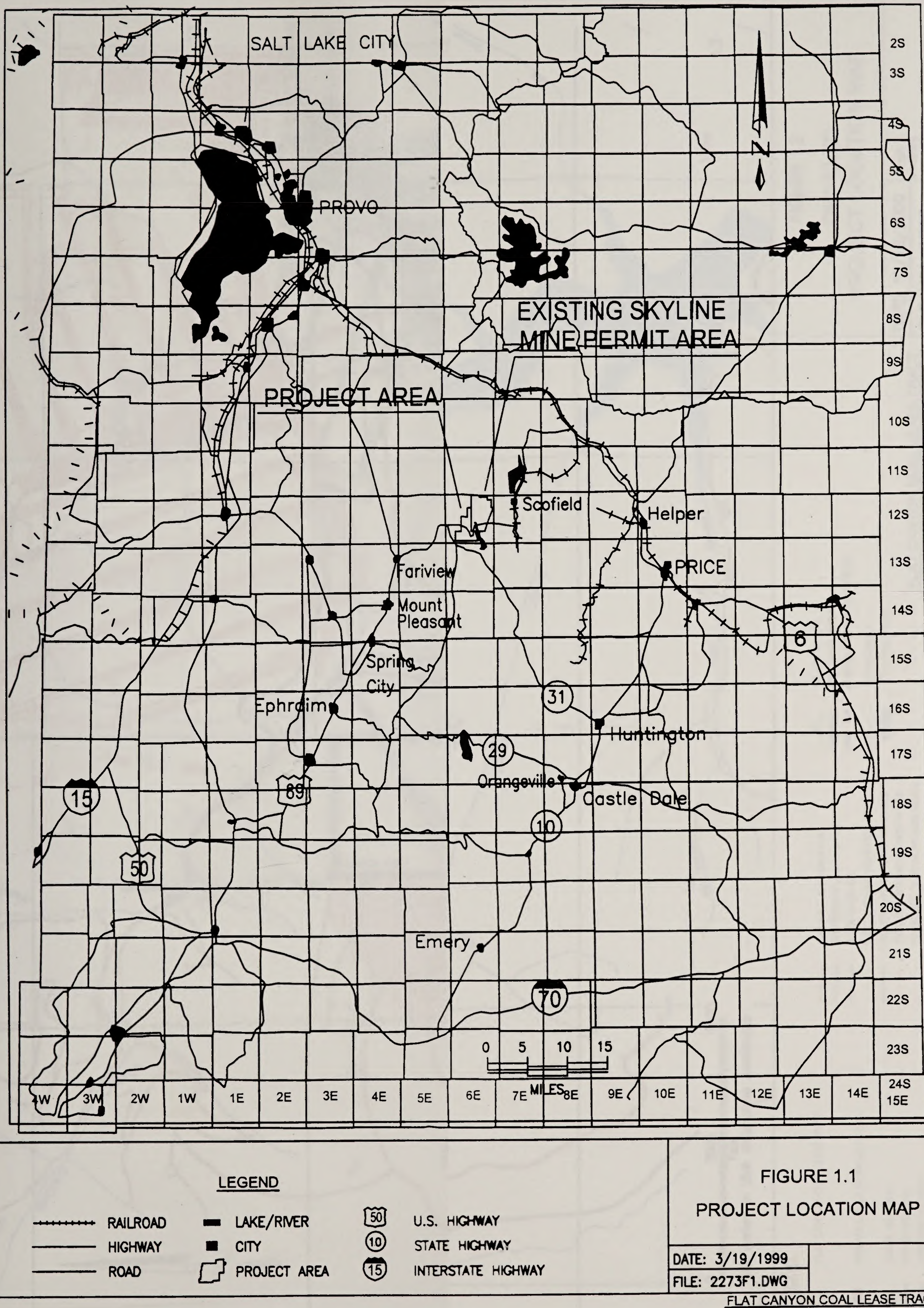


FIGURE 1.1

PROJECT LOCATION MAP

DATE: 3/19/1999

FILE: 2273F1.DWG

LEGEND

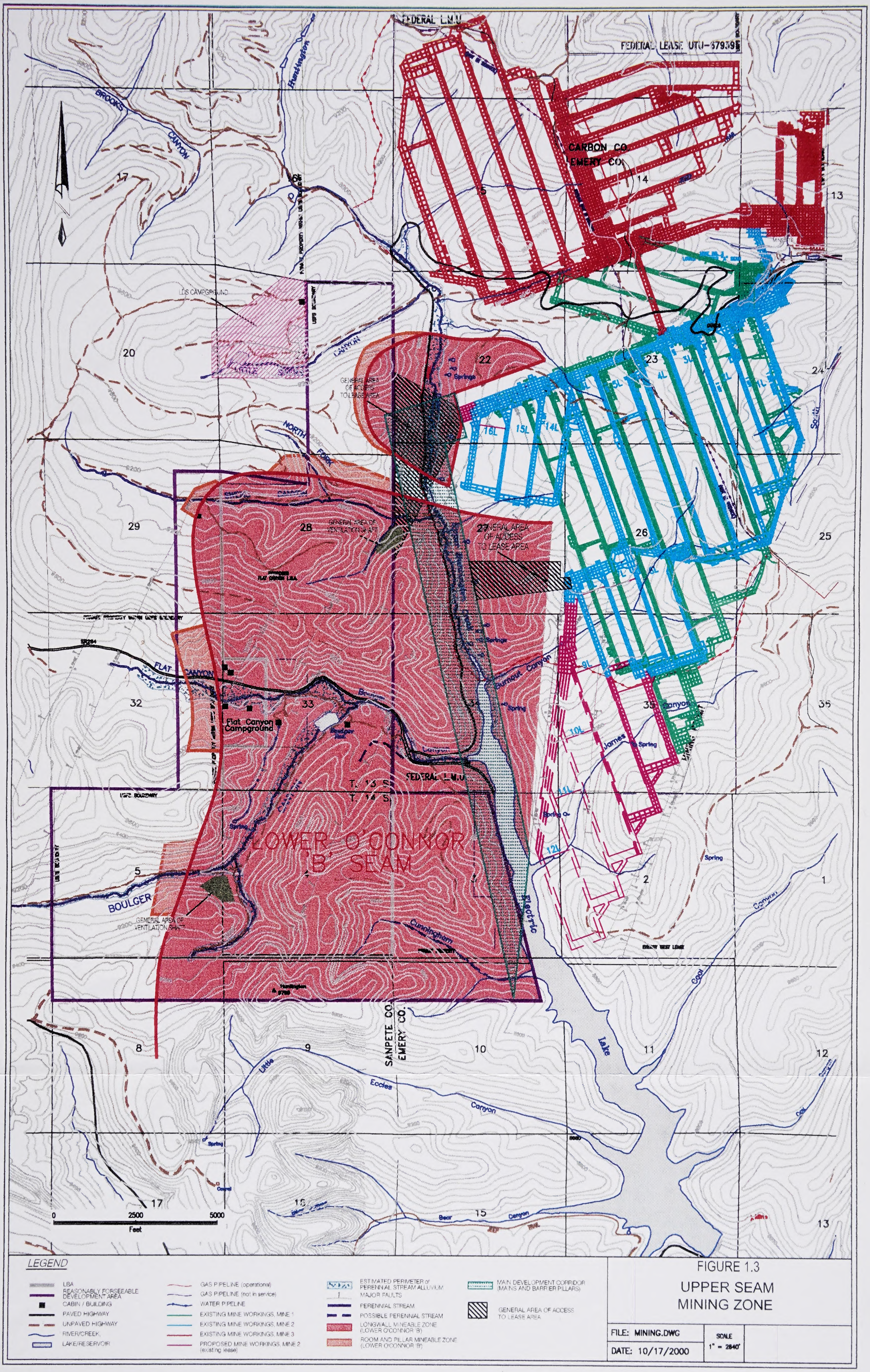
- FLAT CANYON COAL LEASE TRACT
- PRIVATE LANDS IN PROJECT AREA
- CABIN / BUILDING
- PAVED HIGHWAY
- UNPAVED HIGHWAY
- GAS PIPELINE (operational)
- GAS PIPELINE (not in service)
- WATER PIPELINE
- EXISTING MINE WORKINGS, MINE 1
- EXISTING MINE WORKINGS, MINE 2
- EXISTING MINE WORKINGS, MINE 3
- PROPOSED MINE WORKINGS, MINE 2 (existing lease)
- MAJOR FAULTS
- PERENNIAL STREAM
- POSSIBLE PERENNIAL STREAM
- RIVER/CREEK
- LAKE/RESERVOIR

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

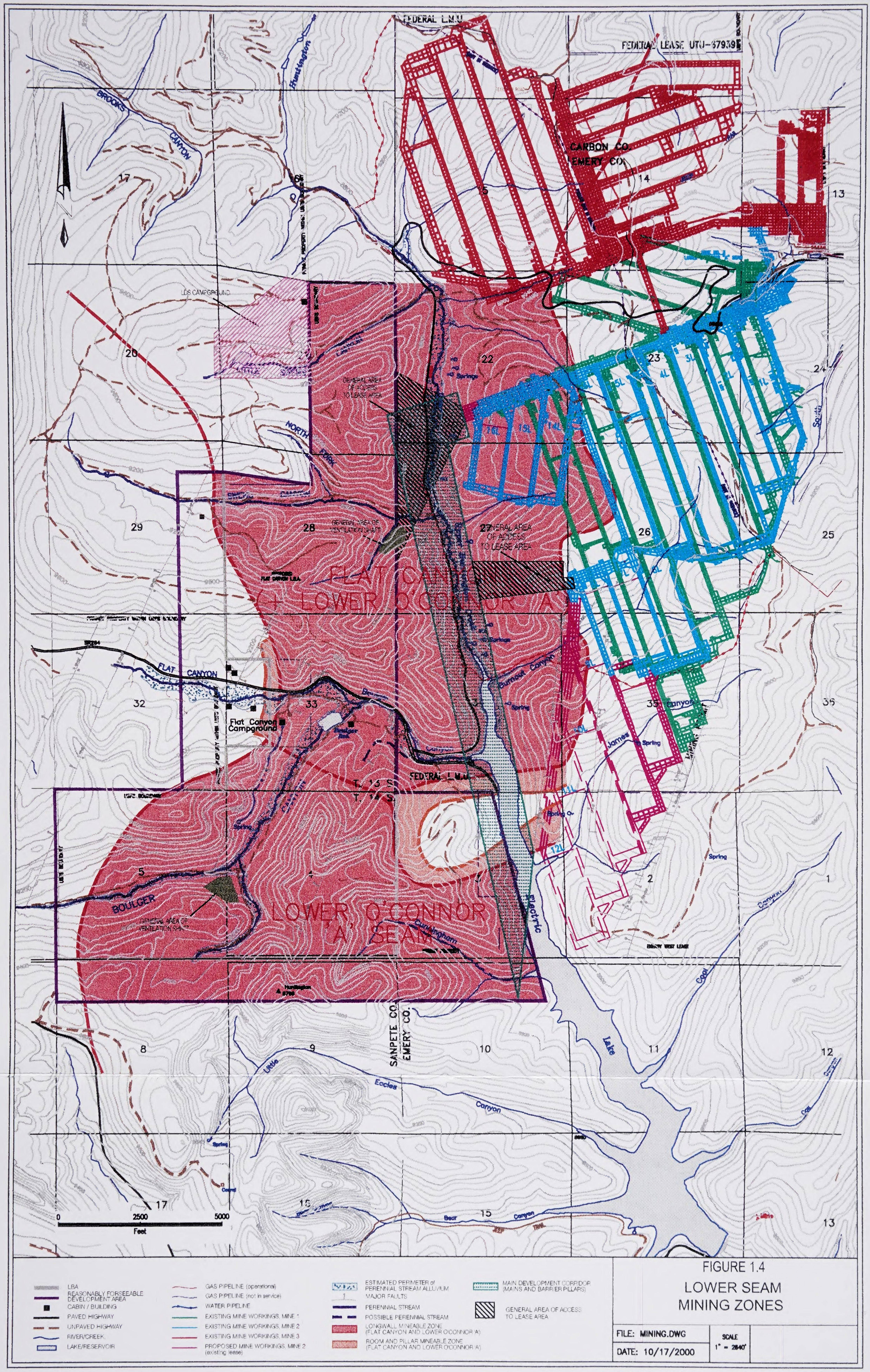
FIGURE 1.2

DETAILED PROJECT LOCATION MAP

DATE: 10/18/2000
SCALE 1"=2640'
FILE: VW1-2.DWG



FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT



FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Chapter 2 describes the scoping process used to obtain public and agency comments regarding issues, the comments received, and the issues and alternatives identified during the scoping process.

2.1 PUBLIC INVOLVEMENT/PROJECT SCOPING

Public involvement is an important part of the environmental analysis process. The public involvement plan describes the methods and techniques that were used to involve the public in the analysis. It allows the public to participate actively in the analysis and to communicate their concerns regarding the proposed action. In addition, involvement of local, State, and other Federal agencies helps the responsible officials to anticipate the effects and benefits that could occur from the project and to make necessary plans and changes in public policy.

The FS and BLM initiated scoping (30 day comment period) by publication of a Notice of Intent to Prepare an EIS in the *Federal Register* on March 17, 2000. A legal notice informing the public of the intent to evaluate the Flat Canyon Coal Lease Tract, prepare an EIS, and requesting issues and concerns, were published in the *Sun Advocate* Newspaper (publication of record) and the *Emery County Progress* (supplemental publication) on March 14, 2000. The legal notice was also published in the *Mt. Pleasant Pyramid* on March 15, 2000. A letter was sent to 100 agencies, individuals, and organizations on March 13, 2000 briefly explaining the proposed action and requesting comments regarding issues and concerns. The comment period ended at the close of business on April 18, 2000. The project was listed on the Forest Internet website and Quarterly Schedule of Proposed Actions. In addition, the proposed project was explained to local resource user organizations at the quarterly water users meetings and Emery County Public Lands Council meetings.

A letter was sent to the owners of private lands within and adjacent to the project area on October 30, 2000 informing them of the project and requesting comments followed by phone calls. Only one letter of response was received from the LDS Church asking for some additional information that was provided by telephone. The conversations with landowners divulged that they generally wanted to see the Federal and private lands mined. Some were concerned about potential damages to buildings from subsidence but felt that any necessary repairs would be made by the mining operator. At least two of the landowners were concerned about potential effects to springs within and adjacent to their property. One landowner was concerned about potential lowering of the private roads that cross Flat Canyon due to subsidence and that it would be difficult to relocate them because of the wetlands issue.

Nine letters and two phone calls were received in response to scoping. The Interdisciplinary Team (IDT) evaluated comments and identified the proposed issues based on the comments and concerns identified by participating agencies. The issues were approved by the agency responsible officials on June 8, 2000.

2.2 LEASING/MINING OUTCOMES AND PHYSICAL EFFECTS

Leasing and subsequent mining would cause physical changes to the environment that would result in effects to resources. These changes and how they are measured (Measures) and discussed in the analysis are shown below:

- Leasing of the Flat Canyon Tract would extend mining into additional areas, increase the life of mining operations at the Skyline Mine, and increase the amount of coal mined.
  Measures: Mining method, Time of extended mining at Skyline Mine (years) Amount of coal mined (tons).

- Construction of surface facilities needed to mine the project area would disturb the ground surface and cause human activities in the area.
  Measures: Activity levels, Area of disturbance (acres) by activity, Duration of activities/disturbance.

- Mining of the underground coal reserves can cause subsidence, seismicity, and cracking of the ground surface.
  Measures: Location and amount of subsidence expected (measured in feet), Maximum Credible Mining-Induced Seismic Event by range of magnitude and probability (Richter, % probability), The amount of energy transferred through rock at distance from the seismic event locations, Location and severity of cracks (primarily based on monitoring at Skyline Mine), Connection between surface and underground cracks relative to depth of cover, Angle-of Draw, Tension and compression zones, Perception of seismic events by people.

- Water is encountered in the underground workings and discharged to the surface environment into receiving water bodies (streams/lakes).
  Measures: Amount of water discharged, location of discharge, quality of water.

- Mining equipment and materials are used and consumed in the mining process and are incorporated into the underground mine workings as permanent additions to the underground environment.
  Measures: Type of materials, Estimated amount, Purpose of the materials.

2.3 ISSUES ADDRESSED IN DETAIL

The issues addressed in the analysis were identified through project scoping. They drive data collection and the subsequent analysis process. The issues that were determined to be significant form the foundation by which alternatives to the proposed action were developed. Other issues, not determined to be significant, are no less important but did not drive identification of alternatives to the proposed action. Both significant and non-significant issues are addressed in detail in the analysis.

The affects analysis addresses each issue. It was necessary to determine how the issues would be measured and compared relative to the alternatives. For this purpose, evaluation criteria were developed. The issues are listed and described in this section and the evaluation criteria are identified and discussed below the issue statements. The issues are grouped by functional area and significant issue statements are underlined.

2.3.1 Structures and Facilities (Including Transportation)

- Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage State Highway 264 (Significant Issue) and Forest Roads (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Extension of the mine life would increase the length of time that mining related traffic volumes would occur on State Highways (Non-Significant Issue).
  Evaluation Criteria: Length of extended use, Approx. traffic volumes.

- Mining-induced subsidence and seismicity could damage facilities at the Flat Canyon Campground (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage recreation cabins and/or camp facilities and roads on adjacent private lands that are mined as a result of leasing the Flat Canyon Tract (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

2.3.2 Surface and Ground Water

- Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek (Existing NPDES Permit) could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Significant Issue).
  Evaluation Criteria: Potential diversions, Estimates of amount of water encountered/discharged, Amount and location of discharge to surface waters.

- A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed (Significant Issue).
  Evaluation Criteria: Change in mine water discharge to each watershed (gpm, acre-feet), Expected change in flow duration and base flows in Eccles, Muddy, and Huntington Creeks (gpm, acre-feet, %), Expected change to inflow and discharge (%, acre-feet) to/from Scofield Reservoir and Electric Lake.

- Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Changes in flow and duration, Probability

- Subsidence of perennial streams and the Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology (Significant Issue).
  Evaluation Criteria: Changes in flow by quantity and duration, Probability,

- Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Potential changes in water quality by affected parameters and duration.

- Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies (Significant Issue).
  Evaluation Criteria: Water quality of the discharge water vs. water quality standards associated with the most restrictive of the designated beneficial uses of the receiving waters (meets/does not meet), Change in receiving stream water quality (parameters with and without limits specific to beneficial use standards including TDS, RCRA metals, oil and grease, TMDL, and drinking water standards) addressed in part by estimating volume of discharge water as percentage of resulting total flows and determining whether discharge water is being diluted or receiving waters are being "contaminated", Change in lake chemistry, including water column and lake bed sediments.

- Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Description of potential changes in quality by affected parameter and duration.

2.3.3 Vegetation

- Subsidence and other mining-caused changes to surface and ground water could affect vegetation, especially riparian vegetation/wetlands (Significant Issue).
  Evaluation Criteria: Riparian vegetation, wetlands, and other species and area (acres) affected, Changes in species diversity and wetland quality.

- Construction of a pipeline and/or roads in or across riparian areas and/or wetlands could destroy vegetation and related habitat and increase downstream sediment (Non-Significant Issue).
  Evaluation Criteria: Area disturbed, Duration of loss (vegetation and habitat), Estimate of sediment production.

2.3.4 Wildlife

- Exploration drilling, construction of mine vent holes, and reclamation activities could temporarily disrupt use of summer habitat by terrestrial species (Non-Significant Issue).
  Evaluation Criteria: Effects, Area affected (acres), Duration of effects and avoidance by affected species.

- Any changes in stream gradient/morphology, water flow, and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species. Includes changes in morphology due to flow changes and subsidence (Significant Issue).
  Evaluation Criteria: Changes to habitat, productivity, and populations, Length of stream habitat affected (miles), Duration of effects.

- Changes to flow in drainages and points of mine water discharge would affect aquatic wildlife species and habitat (Significant Issue).
  Evaluation Criteria: Water quality of discharge water vs. aquatic life standards and other published sensitivity data for both acute and chronic levels, Possible increases in contaminants to electric lake and changes to habitat quality.

2.3.5 Recreation

- Damage to recreation facilities and temporary closures (Boulger Dam/Reservoir, Flat Canyon Campground, Roads) could cause, displacement of recreation use to other areas, and/or loss of use during repairs/replacement and closure (Significant Issue).
  Evaluation Criteria: Duration of loss or displacement of recreation opportunity, Recreation capacity lost or displaced (Recreation Visitor Days or RVDs), Revenue lost by Concessionaire.

- Subsidence could cause surface disruption and seismic events that could cause safety hazards and disrupt the recreation experience (Non-Significant Issue).
  Evaluation Criteria: Safety hazard.

- Traffic and heavy equipment operation related to exploration drilling and drilling/construction of mine vent holes could temporarily disrupt dispersed recreation (Non-Significant Issue).
  Evaluation Criteria: Recreation Visitor Days (RVDs) affected, Duration of displaced use, Quality of recreation experience perceived by visitors.

2.3.6 Visual Quality

- Equipment and ground disturbance related to drilling exploration holes, construction of ventilation shafts, and reclamation would temporarily (construction phase) decrease visual quality (Non-Significant Issue).
  Evaluation Criteria: Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

- Ventilation shaft facilities, access roads, and any visible emissions (water vapor) would decrease visual quality for the life of the facilities (Non-Significant Issue).
  Evaluation Criteria: Visibility, Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

2.3.7 Cultural Resources

- Construction of surface facilities and mining-induced subsidence could damage cultural resources.
  Evaluation Criteria: Types of sites, Potential for damage.

2.3.8 Paleontological Resources

- Underground mining, subsidence, and construction of surface facilities could damage paleontological resources.
  Evaluation Criteria: Types of resources, Potential for damage.

2.3.9 Socioeconomics

- Leasing of the tract would extend the life of the Skyline Mine, provide an important energy resource, and result in social and economic benefits (Significant Issue).
  Evaluation Criteria: Coal produced (tons), Skyline Mine life (years), Employment (person/years), Royalties/Bonus Bids.

2.4 ISSUES IDENTIFIED BUT NOT CARRIED THROUGH THE ANALYSIS

The issues discussed below were considered but not identified as issues to be discussed in detail or carried through the analysis:

Range

- Mining-induced subsidence and construction of surface facilities could damage range improvements and facilities. Construction of surface facilities could interfere with livestock trailing or grazing.

No range improvements were identified in the Flat Canyon Tract that could be damaged by subsidence. The amount and duration of construction and operation of vent holes and exploration holes is negligible relative to the grazing area and is not considered to have measurable effects.

Survey Markers

- Mining-induced subsidence and construction of surface facilities could damage survey markers and monuments

  It is general practice in mine plans and permits to require identification, monitoring, and repair/replacement of survey markers if they are damaged.

Lands and Special Uses (Facilities)

- Mining-induced subsidence and seismicity could damage the dam at Beaver Dams Reservoir and Electric Lake.

  Neither dam would be mined-under of subsided. Beaver Dams Reservoir lies approximately 1.3 miles to the east of the project area. Electric Lake Dam lies approximately 2.0 miles south of the project area. The Maximum Credible Event (MCE) of Richter 3.45 would not produce ground shaking or vibration sufficient to cause damage to these facilities, considering their distance from the project area. The dams could withstand vibrations of up to 0.1g without damage and the MCE would produce vibrations less than 0.1g at distances greater than 5,500 feet (NorWest, 2000a). Neither of these facilities would sustain damage even if the MCE occurred at the closest point within the project area.

The general comments received during scoping that did not result in an issue statement involved issues that are beyond the scope of the analysis as follows:

Comment (EPA): "The DEIS should disclose that researchers have found coal combustion to be a significant source of CO2 a greenhouse gas which contributes to global warming."

Response: It is recognized that combustion of coal for electrical power generation at coal-fired power generation plants will result in release of CO2 into the air, but this issue is well beyond the scope of this EIS that considers leasing of coal for potential future coal production.

Comment (UEC): "Finally, UEC is concerned about the impact fossil fuels such as coal are having on the climate. We are also troubled by the fact that coal is a major contributor to environmental problems such as acid rain which has been a major concern in the eastern United States for some time. Opening up additional public lands to coal production discourages development of cleaner alternatives to coal as a source of energy and is, in our opinion, bad public policy."

Response: The quality of the coal in the Flat Canyon Tract is low in ash and sulfur (i.e. high compliance coal). These coals are desirable for power plants because they produce very few particulates, relatively little sulfur dioxide, and decrease the potential for acid rain relative to other coals. Coal in the tract contains less than 0.5 percent sulfur. It is reasonably foreseeable that the coal would be burned to produce electricity at power plants in Utah and western Nevada. Emissions at these plants are controlled by scrubber technology and are regulated through air quality standards. If Flat Canyon Tract coal is not mined and burned, coal from other sources with higher potential for producing pollutants would most likely be purchased and burned in these or other plants. The issues of climate changes and global warming from combustion of fossil fuels are considered beyond the scope of this analysis.

Comment (UEC): "The UEC asks the Forest Service and BLM to take into consideration current and future demand for coal when making its decision regarding this lease. Is demand for this fossil fuel keeping up with supply or is supply currently struggling to keep up with demand? If a careful examination of current and likely economic conditions and energy demands indicate the expansion of this mine is not necessary at this time there is no need to move ahead with the lease."

Response: Canyon Fuel Company, LLC has demonstrated that there is current and foreseeable future demand for coal to justify consideration of the Flat Canyon Tract at this time. Their mining sequence demonstrates that it is most logical and economic to extend existing underground workings into the tract at this time while developing coal reserves in the southern portion of the existing permit area. If not mined in the current sequence of mining, the coal would most likely be bypassed and rendered inaccessible considering current mining technology and safety requirements. If the coal is not leased and developed from underground workings in the Skyline Mine, it is not likely that it would ever be recovered due to the lack of economic access to the minable reserves from adjacent areas.

Effects to air Quality from Operations at the Skyline Mine Portal and Loadout Facilities

Emissions at the Skyline Mine facilities currently meet air quality standards and the Permit-to-Construct issued by the Utah Department of Air Quality. The proposed action would not lead to additional emissions but would extend the life of operations. It is not expected that operations would lead to any violations of the Clean Air Act.

2.5 ALTERNATIVES ANALYZED

Alternatives were developed to address the significant issues associated with the project and to meet the requirements of NEPA. The alternatives addressed cover both ends of the spectrum regarding the possibilities for leasing/mining. Alternative A (No Action) presents the effects of not leasing the Tract. Alternative B, at the other end of the spectrum is a leasing scenario with no special stipulations, representing the full-mining scenario where mining would be conducted to maximize efficiency and coal recovery without specific measures to protect surface resources. Alternative B' (B Prime) is a derivative of B that would result in the same mining scenario without restrictions to prevent subsidence of sensitive resource areas, but differs in that it includes Special Coal Lease Stipulations (SCLS) that would require specific monitoring and mitigations in the event that specific effects occur. Alternative C lies in between, representing a leasing scenario where SCLSs would be included in the lease and subsidence of sensitive resources and facilities/structures would not be allowed regardless of the potential level of effects to them. To provide information to the public and decision makers, so that combinations of these alternatives can be considered, each of the sensitive resources and structures/facilities are addressed individually in the analysis. All of the following alternatives will be considered in the EIS.

ALTERNATIVE A, NO ACTION - The no action alternative provides a baseline for estimating the effects of the action alternatives. Under this alternative the lease tract would not be offered for leasing and there would be no mining.

ALTERNATIVE B, OFFER THE TRACT FOR LEASING AS DELINEATED/WITHOUT SPECIAL LEASE STIPULATIONS - Under this alternative the tract would be offered for competitive leasing, as delineated by the Tract Delineation Team, with BLM standard lease terms and conditions only, as displayed in Appendix B. No special coal lease stipulations would be included in the lease to be offered. Longwall (full-extraction) mining would be allowed throughout the tract resulting in subsidence of perennial drainages, Boulger Dam and Reservoir, Flat Canyon Campground, State Route 264 (other than along Upper Huntington Creek), and structures on private lands within the project area. It would be analyzed as the basis for comparison with other action alternatives that would include special stipulations needed to protect non-mineral resources and uses.

This alternative does not specifically meet Forest Plan requirements because it does not include any of the 17 Special Coal Lease Stipulations (SCLSs) prescribed for coal leases on National Forest System lands, on an as needed basis (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4). Special stipulations were not included for the purpose of disclosing the effects of not including them

ALTERNATIVE B' (B PRIME), OFFER THE TRACT AS DELINEATED WITH SPECIAL COAL LEASE STIPULATIONS BUT WITHOUT RESTRICTIONS ON MINING THAT WOULD CAUSE SUBSIDENCE OF SENSITIVE SURFACE RESOURCES - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. The mining scenario would be the same as Alternative B, without restrictions on subsiding sensitive resources, but would include lease stipulations that require mitigation of effects. In some cases, the opportunity exists to include similar requirement in the mine permit during the mining plan review and permitting process. For the purposes if this analysis, it is assumed that similar measures not specifically required by law or regulation would not be applied.

This Alternative B' would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

ALTERNATIVE C, OFFER THE TRACT FOR LEASING AS DELINEATED/WITH SPECIAL LEASE STIPULATIONS (Do Not Allow Subsidence of Perennial Drainages, Boulger Dam and Reservoir, or Flat Canyon Campground) - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. Subsidence of perennial drainages, Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground would not be allowed. Subsidence of structures on private lands within the project area could occur, if the lessee/operator obtains permission from private coal estate owner(s), under agreement with the private surface estate owner(s).

This alternative would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

OTHER ACTION ALTERNATIVES – Alternatives B and C define the most and least restrictive action alternatives regarding leasing/mining and resource protection. Other alternatives can be considered in the decisions, as needed, to address significant social and environmental issues or opportunities. In formulating other alternatives for consideration in the EIS, the Forest Service and BLM can look at the tract boundary and potential restrictions on underground mining and surface occupancy needed to protect non-mineral resources and uses. Sensitive resource areas were specifically and individually evaluated under Alternative B and C sufficient to select another potential alternative.

If selected, this alternative would contain Special Coal Lease Stipulations (SCLSs) consistent with Forest Plan direction and would not require Forest Plan amendments.

2.6 ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

Alternative tract boundaries were considered but changing tract boundaries would not address any specific issues or change the overall affects of mining. A full spectrum of alternatives was addressed in the analysis allowing the responsible officials to select one of the alternatives analyzed in detail or an additional alternative incorporating specific elements of those analyzed.

2.7 PAST, PRESENT, REASONABLY FORESEEABLE FUTURE ACTIONS

CEQ regulations (40 CFR 1508.7) define cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal of non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Past, present, and reasonably foreseeable future actions in the project area have been developed in support of the EIS. The action, year of occurrence, and estimates of residual, current, or anticipated effects are presented in tables provided in Appendix A. Actions are grouped by resource. The sum of the effects of these actions, in addition to the anticipated direct and indirect effects of the proposed action, will form the basis for the cumulative effects analysis.

2.8 SUMMARY COMPARISON OF ALTERNATIVES RELATIVE TO THE OUTCOMES AND PHYSICAL EFFECTS OF LEASING/MINING

Table 2.1, Comparison of Alternatives, Mining Outcomes and Direct Physical Effects of Leasing/Mining, is a table that displays the outcomes of mining and the physical changes to the environment likely to occur from leasing and mining as anticipated in the Reasonably Foreseeable Development Scenario for each alternative. These changes are not in themselves identified as issues, but would cause changes to resources and the socioeconomic setting and, therefore, form the basis for the identified issues. This information sets the stage for the next section in this Chapter, Summary Comparison of Alternatives Relative to the Issues.

Table 2.1. Comparison of Alternatives, Direct Physical Changes Due to Mining

PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
MINING			
General	No mining of Federal or non-Federal coal in project area.	Two seams mined with limited room-and-pillar mining. 36 million tons recoverable. Extend mine life 9 to 12 years..	Two seams mined (mainly longwall, some partial extraction room-and pillar mining below perennial drainages) and other protected structures). 18 to 20 million tons recoverable. Extend mine life by 5 to 7 years.
Mine Discharge Water	No change. Discharge recently increased from 500 gpm to 2,600 gpm.	Possibility of changing the mine water discharge location from Eccles Creek to Electric Lake. Discharge could increase from 2,600 gpm to a maximum of 4,000 gpm.	Same as Alternatives B and B' Same as Alternatives B and B'
Vent Shafts	No effect	Two air vent shafts with temporary access roads. Temporary disturbance of 2.9 acres (2.0 acres for pads and 0.92 acres for access roads). Possibility of pumping mine water discharge from Swens Canyon Shaft to Electric Lake requiring new buried pipeline from shaft along Swens Canyon Road and SR-264.	Same as Alternative B and B'
Exploration Holes	No effect	About 10 additional boreholes with temporary surface disturbance of 9.2 acres (4.6 acres for pads and 4.6 acres for access roads)	Same as Alternatives B and B'

PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	**Alternatives B and B'**	**Alternative C**
SUBSIDENCE			
Longwall and Room-and-Pillar Mining (other than full-support mains).	No effect	Longwall subsidence of 2 to 14 ft, generally with flexure of ground surface producing localized slope changes of up to 3% and tension fractures in zones of high differential subsidence expected to be less than 1% of the mined area.	Same as Alternatives B and B' in areas where longwall extraction is allowed and no impact in areas with full-support mining. Area of differential subsidence would be increased as compared to Alternatives B and B' because full-extraction mining would be split into three blocks separated by subsidence protection zones.
Full-support mains	Same as Alternatives B and B' since mains under Upper Huntington Creek could still be driven to access coal reserves in existing permit area.	Full-support mains would be driven across/under Upper Huntington Creek to access the Flat Canyon Tract project area then south under the west slope of Upper Huntington Canyon to set up longwall panels. Full-support mains are designed to be stable and prevent caving and subsidence. Geotechnical design/models show safety factors in excess of 1.74. Empirical data from existing mines shows mains to be stable for at least 70 years and predictions indicate that they would be stable over 200 years. In unlikely event that pillars fail, they would fail over hundreds to thousands of years. Maximum subsidence, if pillars fail over large area, would be 4.7 ft. considering two seams of stacked mains.	Same as Alternatives B and B'. Same as Alternatives B and B'. Same as Alternatives B and B'.
Natural Slopes	Subsidence in existing permit area has not caused slope instability or movement of naturally unstable areas.	No accelerated slope instability expected.	Same as Alternatives B and B'.

PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
SEISMICITY			
General	No mining-induced seismic events generated from mining in project area. Seismic events from mining in adjacent area would continue. Maximum Credible Event (MCE) of Richter 3.45 at a rate of one event with magnitude greater than 2 every 5 days.	Longwall mining induced seismicity expected with increased potential at depths below 1500 ft. Maximum Credible Event (MCE) of Richter 3.45. Frequency of events over extended mine life expected to be about one event with magnitude greater than 2 every 5 days. Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas.	Same as Alternatives B and B'.
Natural Slopes	Same as Alternatives B and B'	No effect. Vibration levels are too low for potential impact to slope stability. Confirmed by no evidence of slope failure due to past mining at Skyline Mine.	Same as Alternatives B and B'.

2.9 SUMMARY COMPARISON OF ALTERNATIVES RELATIVE TO THE ISSUES

This section presents a summary of effects related to the issues, most of which would result from the physical changes to the environment from mining that are expected to occur under the Reasonably Foreseeable Development Scenario if the Flat Canyon Tract is leased. The physical effects and outcomes of mining are discussed above in Section 2.7 and presented in Table 2.1. Table 2.2 displays the effects of implementing each of the three alternatives analyzed. The effects are subdivided by resource groups, addressing each issue and general aspect of each alternative needed to be able to show the differences. It is a tabular presentation of the information presented in Chapter 4, Effects of Implementation.

Table 2.2 Comparison of Alternatives, Effects by Resource/Issue

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
FACILITIES				
Boulger Dam and Reservoir (Subsidence Pt. 6)				
Subsidence damage	No effect	Subsidence of up to 13 feet with high to very high differential subsidence. Dam could fail with downstream effects and potential hazard.	Subsidence of up to 13 feet with high to very high differential subsidence. Dam would be intentionally breached to prevent downstream effects and hazard.	No effect from subsidence
Seismicity damage		Based on the MCE, the dam would experience greater than 0.1g if the event occurs within 5,500 ft., and could fail with downstream effects and potential hazards.	Same as Alternative B, except downstream effects and associated hazard would be eliminated by taking the dam out of service prior to mining.	Same as Alternative B'.
Lost use		Dam would be out of service for up to 12 years. Damage estimated at about $390,000.	Dam would be taken out of service for up to 12 years, then repaired and improved by the lessee/operator at a cost of about $390,000.	Same as Alternative B', except the dam could be out of service for 5 to 8 years.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Highway SR 264 (Subsidence Pts. 5 and 6)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 14 ft., with the possibility of minor cracking of surface in some isolated areas. Two major culverts could be damaged. Damage estimated at $52,000.	Subsidence and damage to the road are the same as Alternative B. SCLS #13 would require monitoring and repair by lessee/operator. Total cost estimated at $52,000. Repairs could include filling cracks and regrading in some areas with resurfacing of road and replacement of culverts, but without long-term effects.	No effect. No longwall mining within angle-of-draw. Projected full support pillars would not cause subsidence. No cracks expected.
Safety hazard	No effect	Safety hazard exists without close monitoring and immediate repairs.	Safety hazard effectively avoided by monitoring and immediate repairs.	No effect
Seismicity damage		No effects from mining-induced seismicity.	No effects from mining-induced seismicity.	No effects from mining-induced seismicity.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Unpaved Roads (FS and pvt.)				
Subsidence damage	No effect	Small cracks 2 inches or less expected in tensile zones. Larger cracks are possible but not likely.	Subsidence and damage same as Alternative B.	Same as Alternative B'.
Safety hazard		Minor safety risk to motorists.	Monitoring required. Some repair work required in tensile zones to fill cracks and maintain slopes and drainage with temporary safety measures required. Cost of repair estimated at less than $10,000.	Same as Alternative B'.
Seismicity damage		No effect from seismicity.	No effect from seismicity.	No effect from seismicity.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Flat Canyon Campground (Subsidence Pts. 5, 6, and 8)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 14 ft. with very low to moderate differential subsidence. Minor cracking of surface expected in some areas. Water tank, water pipelines, tables, toilets, septic tank/drain field, spring collection system, and retaining wall could be damaged. Minor cracking of roads could occur. Damage costs are estimated at $150,000 by the Forest Service.	Same as Alternative B except that SCLS #13 would require monitoring and repair by the lessee/operator. Repair costs are estimated at $150,000.	No effect. Protected with no subsidence of the structures allowed. No possibility of cracks or subsidence damage to facilities provided pillar dimensions are adequate.
Seismicity damage		Longwall mining induced seismicity has the potential to vibrate structures once every 5 days at a Peak Particle Velocity (PPV) of over 1 in/sec within a range of 3,500 ft. from mining areas. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water system is expected.	Same as Alternative B, except that lessee/operator would be required to monitor and repair damage.	Same as Alternative B'.
		Some effects to recreation use at this facility are expected. See Recreation.	Some effects to recreation use at this facility are expected. See Recreation.	No effect

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Flat Canyon Cabins (Subsidence Pt. 5)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 4 ft., with very low to low differential subsidence. Potential for tensile strain and induced slope changes with the possibility of cracks. Lost use of facilities during active subsidence. Cost of repairs could reach $360,000.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Most cabins protected due to no longwall mining allowed for protection of perennial drainage. Two cabins north of canyon may be subject to tensile strains at edge of stacked pillars with some mitigation required. Repair requirements are same as Alternatives B'.
Seismicity damage	No effect	Longwall mining induced seismicity has the potential to vibrate structures once every 5 days. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water systems is expected.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Swens Canyon Cabins (Subsidence Pt. 3)				
Subsidence Damage	No effect	Longwall mining subsidence of 4 to 10 ft. with very low to high differential subsidence. Pillars at edge of longwall area could result in higher tensile strains with the possibility of damage and lost use during active subsidence. Estimated repair cost included with Flat Canyon cabins above.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Similar to Alternative B, but could be located above pillars giving rise to greater tensile zone and greater potential for damage.
Seismicity damage		Same as discussion for Flat Canyon cabins.	Same as discussion for Flat Canyon cabins.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Hunt Dam and Reservoir				
Subsidence damage	No effect	No effect from subsidence. Closest mining and subsidence would be over 1,000 ft. distance.	Same as Alternative B.	Same as Alternatives B and B'.
Seismicity damage	No effect. Nearest mining is more than 5,500 ft. away.	Mining-induced seismicity could damage the dam. If the MCE of magnitude 3.45 occurs within 5,500 ft. the dam would experience greater than 0.1g. It could potentially be taken out of service during active mining within 5,500 ft. resulting in a loss of use. If damaged, repairs would be required. Cost could reach $390,000. It is assumed that an agreement would be reached between the lessee/operator and private landowner to prevent downstream effects and make repairs.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Electric Lake Dam				
Subsidence damage	No effect	No effect. No mining or subsidence would occur for a distance of approximately 2 miles of the dam.	Same as Alternative B.	Same as Alternatives B and B'.
Seismicity damage	Same as Alternative B	No effect. The dam is approximately 2 miles from nearest mining. Longwall mining induced seismicity has no potential to impact this dam. A conservatively high MCE of 3.8 would result in vibrations below the Operating Basis Earthquake (OBE) of 0.1g for this dam.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
SURFACE WATER				
Prolonged and increased mine water discharge to Eccles Creek and Scofield Reservoir	Flow to Eccles Creek and Scofield Reservoir increased from 500 gpm to 2,600 gpm in 2000. Water quality and morphology affected.	Mine water discharge and flow could increase to 4,000 gpm and last 9-12 years. Stream morphology effects similar to Alternative A.	Same as Alternative B.	Same as Alternatives B and B' except that mine water discharge could occur for a shorter time (extended mine life of 5 to 7 years).
	Quality generally consistent with beneficial use standards, occasional exceedance of phenol, total phosphorous, and TDS. Some increase in sediment to Scofield Res.	Increased TDS and Phosphorous loading to Scofield Reservoir. Sediment increases to Scofield reservoir similar to Alternative A.	Same as Alternative B.	Same as Alternative B, but for a shorter time (5-7 years).

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Changing some or all of the mine water discharge from Eccles Creek to Electric Lake				
Flow	No effect	If mine water discharge is shifted to Electric Lake, flow in Eccles Creek and downstream waters would return to pre-mining flows and flow to Electric Lake would increase by a maximum of 4,000 gpm. Loss of 5.8 to 8.9 cubic feet per second (cfs) or approx. 5% Price River's annual yield. Gain of 5.8 to 8.9 cfs or approx. 7% of Huntington Creek's annual yield. Small change relative to 6,200 capacity of Scofield Reservoir and 2,300 cfs capacity of Electric Lake.	Same as Alternative B.	Same as Alternatives B and B', except that discharge would occur for a shorter time (5-7 years)..
Quality	No effect	Eccles Creek would return to near premining quality. Electric Lake quality decreased (TDS, Sulfate, and Phosphorus. Possible accelerated eutrophication. Water temperature increase at discharge outlet.	Same as Alternative B. Same as Alternative B, but some mitigations potentially required.	Same as Alternatives B and B'. Same as Alternatives B and B, but for a shorter time (5-7 years).'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence effects to springs/seeps and flow of receiving streams.	See Ground Water	See Ground Water	See Ground Water	See Ground Water
Subsidence of perennial streams and Boulger Res. could intercept water and divert it underground.	No effect	No loss of water expected due to deep overburden and sealing characteristics of clay in shales. If it should occur, state appropriated waters would be replaced by the lessee/operator's expense.	Same as Alternative B, except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	No effect because subsidence would be prevented except for the Cunningham Drainage. No loss of water expected due to deep overburden and sealing characteristics of clay in shales. In the event that loss occurs due to mining, SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
GROUND WATER				
Subsidence could change flow of springs/seeps, affecting flow of springs and receiving streams. Also water rights.	No effect	Spring locations could shift but no loss of water expected due to sealing characteristics of clay in shales. Lessee/operator required to replace state appropriated water if affected.	Same as Alternative B except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	Same as Alternative B', except that fewer springs would be subjected to subsidence.
Interception of mine water and discharge to Eccles Creek diverts water from Huntington Canyon drainage to Price River drainage (Transmountain Diversion)	No effect	Deep aquifers associated with channel sands are discontinuous. Mine water tested at 10,000 years old and transmissivity of rock layers (vertical and horizontal) is extremely slow, so any effect would not be quantifiable or perceptible	Same as Alternative B.	Same as Alternatives B and B'.

2.0 PROJECT SCOPING, ISSUES, AND ALTERNATIVES

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Water Quality Effects from Equipment Left Underground	No effect	Local ground water quality could be degraded by oils and other fluids (battery acid, transmission oil, diesel fuel, lubricants, etc.) if leaked underground and slow corrosion/oxidation of metals left underground. See mine water discharge in Surface Water Section. Connection with surface waters is very slow and unlikely, therefore effects are expected to be negligible.	Same as Alternative B, but SCLS #19 would require removal of equipment unless specifically approved. Less potential for contamination because equipment and materials left underground would be limited to corrosion/oxidation resistant metals and non-polluting fluids.	Same as Alternative B'.
VEGETATION				
Disturbance from Surface Facilities	No effect	Temporary (3-5 yrs.) removal of 2.9 acres of vegetation for vent shafts and 9.2 acres for exploration drill holes. Long-term (12-15 years) of vegetation affected for vent shafts of less than 1 acre.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence disturbance.	No effect	Changes in stream morphology in Swens Canyon, Little Swens Canyon, Boulger Canyon, and Flat Canyon could result in loss of streambank riparian vegetation from scouring. Increase in pond areas could increase riparian over the long-term after all subsidence is complete (increased land/water contact area).	Same effects as Alternative B but SCLS #3 and #7 require vegetation baseline information and monitoring necessary to quantify changes.	No effect
		Spring locations could shift causing associated localized riparian vegetation to shift. Temporary loss during adjustment.	Same as Alternative B, except SCLS #3 and #7 would require vegetation baseline information and monitoring necessary to quantify changes.	Same as Alternative B', but fewer springs subjected to subsidence.
Threatened, Endangered, and Sensitive Species	No effect	No effect	No effect	No effect

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
WILDLIFE				
Terrestrial				
Disturbance from Surface Facilities	No effect	Short-term loss of habitat for exploratory drilling and construction/drilling of vent shafts due to avoidance. Sensitive bird species (individuals) could be affected during nesting season, causing abandonment.	Same as Alternative B, except SCLS #14 reduces effects to sensitive species and species of high interest by imposing appropriate timing restrictions on construction and drilling operations. Does not affect operation of vent holes, once constructed.	Same as Alternative B'.
		No effect to Threatened or Endangered Species. Activities would be postponed in critical habitat to avoid effects.	Same as Alternative B.	Same as Alternatives B and B'.
Subsidence/Seismicity	No effect	No effect	No effect	No effect
Aquatic				
Disturbance from Surface Facilities	No effect	Crossing Boulger Canyon and Swens Canyon could add minor amounts of sediment to creeks. Use of bridges or bottomless arches would reduce streambed disturbance, therefore negligible effect to habitat.	Same as Alternative B.	Same as Alternatives B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence caused changes in stream gradient/morphology/flow/ quality could affect habitat.	No effect	Stream morphology changes and sediment additions in streams could degrade habitat and productivity for aquatic species in perennial drainages with gradients of 5% or less including the majority of Boulger Creek, (4.0 miles), lower portions of Swens (0.5 mile) and Little Swens (0.5 mile) Canyons, and in Flat Canyon (1.5 miles). Individuals affected but population viability not lost. Recovery could take 10-30 years after subsidence. No flow changes expected (see Surface and Ground Water).	Same effects as Alternative B, but SCLS #3 and #7 would require monitoring to quantify effects to habitat and aquatic species and potentially require mitigations.	No effect except for Cunningham Drainage. Negligible effects because stream gradient is steeper than 5% (similar to Burnout Canyon).
Seismicity	No effect	No effect	No effect	No effect
Mine Water Discharge	Increased discharge to Eccles Creek and Scofield Reservoir from 500 gpm to 2,600 gpm not evaluated.	Discharge could increase to 4,000 gpm. Not evaluated. If discharge to Electric Lake is approved, degradation of water quality from mine water discharge into Electric Lake could degrade habitat in Electric Lake.	Same as Alternative B.	Same as Alternatives B and B', but mine water discharge would occur for a shorter time (5-7 years)..

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
LANDS AND SPECIAL-USES				
Disturbance from subsidence, seismicity, and surface facilities	No effect	Land uses and Forest Plan management emphasis remain the same, but some facilities could be impaired as discussed under Facilities.	Land uses and Forest Plan management emphasis remain the same, but facilities would be monitored and repaired. Some lost use of facilities to prevent safety hazards.	Land uses and Forest Plan emphasis remain the same. Most facilities protected from subsidence and associated effects.
RECREATION				
Disturbance from Surface Facilities	No effect	Single-season degradation of recreation experience in Boulger Canyon and Swens Canyons during construction of vent shafts.	Same as Alternative B.	Same as Alternatives B and B'.
		Single-season degradation of recreation experience for coal drilling in any specific area.	Same as Alternative B.	Same as Alternative B and B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence				
Boulger Reservoir	No effect	Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs) due to potential damage to dam. Failure of dam could cause a safety hazard to fishermen and sightseers in the stream channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B except the safety hazard would be avoided by requiring the dam to be breached prior to mining.	No effect
Flat Canyon Campground		See the facilities section for description of damages. Loss of one season of use for each of the two seams for a total of two seasons of lost use (3,000 RVDs/season for a total of 6,000 RVDs). Potential safety hazard to people using the facilities.	Same as Alternative B, except safety hazard would be avoided by closing campground during active subsidence.	No effect

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B’	C
Seismicity				
Boulger Reservoir	No effect	Dam could be damaged by seismicity (see Facilities). Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs). Potential safety hazard to fishermen and sightseers in channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B, except safety hazard avoided by requiring dam to be breached prior to mining.	Same as Alternative B’.
Flat Canyon Campground	No effect	Some minor potential for damage (see Facilities) that could cause a low safety hazard.	Safety hazard avoided because campground closed due to subsidence concerns. Campground closed for two seasons (see subsidence above).	No effect.
Dispersed recreation	Events greater than magnitude 2 could be perceived once every 5 days within 3,500 ft. of existing permit area.	Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas. Events could occur for 9 12 years.	Same as Alternative B.	Same as Alternative B’ but length of time that events could occur and be felt is decreased to 5-7 years.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
VISUAL QUALITY				
Disturbance from Surface Facilities	No effect	Consistent with Visual Quality Objectives. Drilling operations for coal exploration and vent shafts would be visible along SR-264 for one season for each specific hole/vent.	Same as Alternative B.	Same as Alternatives B and B'.
		Vent shafts in Swens and Boulger Canyons would be visible over the long-term (12 years) from the immediate vicinity. Both screened from view from SR-264. Water vapor plumes would be visible from SR-264 and SR-31 on infrequent occasions.	Same as Alternative B.	Same as Alternative B and B' but for less time (5-7 years).
		Drained Boulger Reservoir could be a visual detraction to visitors along SR-264 (12 years).	Same as Alternative B.	Same as Alternatives B and B' but for less time (5-7 years).
TRANSPORTATION				
Extended Mine Life	No effect	Existing mine related traffic on SR-264 and SR-31 (total of about 56 cars/trucks per day) would be extended for another 9-12 years.	Same as Alternative B.	Same as Alternatives B and B' except traffic use would be extended by 5-7 years.
Disturbance from Surface Facilities	No effect	Addition of drilling traffic for two – three seasons (one season for individual vents/hole) on SR-264, SR-31, private roads, and Forest Development Roads.	Same as Alternative B.	Same as Alternative B'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence	No effect	Minor cracks could occur on SR-264 that would need repairs.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards.	Same as Alternative B'.
		Larger cracks are expected on Forest Development roads and private roads on ridge tops that could present short-term hazard.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards.	Same as Alternative B', except fewer roads would be subjected to subsidence.
		Private roads that cross Flat Canyon Creek could be flooded requiring work to raise running surface to above water levels.	Same as Alternative B.	No effect.
Seismicity	No effect	No effect.	No effect.	No effect.
SOCIO-ECONOMIC				
Lease Bonus Bid	No Bonus Bid	Bonus Bid	Same as Alternative B.	Bonus bid but less than Alternatives B and B'.
Life of Mine, Employment, and Support Services Jobs Extended	No extension. Loss of 220 jobs in 2003. This does not consider the potential for mining U 67939.	Mine life including 220 jobs extended up to 12 years.	Same as Alternative B.	Mine life including 220 jobs extended 5 to 7 years.
Coal Production	None	36 million tons	Same as Alternative B.	18-20 million tons
Value of Coal Recovered	None	$612 million	Same as Alternative B.	$306 - $340 million
Royalties	None	$49 million	Same as Alternative B.	$24 - $27 million

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
CULTURAL AND HISTORIC RESOURCES				
Disturbance from Surface Facilities	No effect.	Site surveys required and sites would be avoided or recovered on Fed. lands. Sites on private lands subject to landowner discretion.	Same as Alternative B.	Same as Alternatives B and C.
Subsidence	No effect.	Site surveys required and sites on Federal lands would be protected, repaired or recovered. Disposition of sites on private lands subject to discretion of landowner.	Same as Alternative B. SCLS #1 serves as a notice to lessee that surveys and protection required on Federal lands.	No effect. Structures located in subsidence protection zones. For other sites, Same as Alternative B'.
		Historic log structures not likely damaged. Rock foundations could be cracked.	Same as Alternative B. Federal sites protected, repaired, or recovered.	Same As Alternative B'.
		Historic roads and trails not likely affected.	Same as Alternative B.	Same as Alternative B'.
		Lithic scatters not likely affected.	Same as Alternative B.	Same as Alternative B'.
Seismicity	No effect.	No effect.	No effect.	No effect.
PALEONTOLOGICAL RESOURCES				
Mining	No effect	Some dinosaur footprints, bone fragments, and vegetation imprints destroyed in the underground coal seam during mining.	Same as Alternative B	Same as Alternatives B and C.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Disturbance from Surface Facilities	No effect	Surveys would be conducted and sites would be avoided or recovered.	Same as Alternative B	Same as Alternatives B and C.
Subsidence	No effect	No effect to buried dinosaur fossils. Pleistocene mammal fossils buried in glacial materials could be displaced by subsidence. Not likely that bones would be broken.		No effect to buried dinosaur fossils. Very low potential for displacement of Pleistocene mammal fossils because high occurrence potential areas lie within subsidence protection zones.
Seismicity	No effect.	No effect.	No effect.	No effect.

This chapter presents a description of those aspects of the current human and natural environment likely to be affected by the proposed action and alternatives evaluated in the analysis. This provides the basic information on current conditions that is used for comparison when presenting changes that are likely to occur from the proposed action in Chapter 4. Those aspects of the current environment likely to be affected are related to the specific issues identified in Chapter 2, presented under subheadings for the functional area or resource area involved. This chapter does not present a discussion of the effects of the proposed action or alternative. The affects analysis is presented in Chapter 4 under similar functional area or resource category subheadings.

3.1 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1.1 Physiography

The tract lies in the interior of the Wasatch Plateau, a sub-province of the Colorado Plateau Physiographic Province. The Wasatch Plateau has also been described as lying in a transition zone between the Colorado Plateau Physiographic Province to the east and the Great Basin Physiographic Province to the west since it exhibits characteristics of each.

The Wasatch Plateau was uplifted then exposed to accelerated wind and water erosion. It overlooks Castle Valley to the east and the Sanpete and Sevier Valleys to the west. The eastern margin of the Plateau is defined by abrupt erosional escarpments or cliffs. The western margin is less abrupt since it is controlled by the westerly dip of the rock layers and the Wasatch Monocline (single-limbed fold). The rock layers along the central and eastern portions of the Plateau dip gently to the west. West of the Plateau's crest, the rock layers tilt more abruptly to the west plunging into the Sanpete and Sevier Valleys forming a single-limbed fold known as the Wasatch Monocline. North-south trending normal faults are common throughout the plateau.

The Plateau has been incised by numerous deep canyons shaped by the advance of glaciers and by wind and water erosion. Huntington Canyon drains the eastern flank of the Plateau. Upper Huntington Creek along the eastern boundary of the project area lies at the headwaters of Huntington Canyon, trending north-south.

The project area lies along the western slope of Upper Huntington Creek and the tributaries that drain the west slope of Huntington Canyon. The major tributaries generally trend east-west. From north to south they include Little Swens and Swens Canyons, Flat Canyon, and Boulger Canyon.

The project area is situated on the western limb of the Clear Creek Anticline and the dip of the rock layers is generally toward the west. Dips range from 3 to 6 degrees. To the west of the project area the eastern bounding fault of the Gooseberry Graben (downthrown block of land between two faults) has a displacement ranging from 850 to 1,180 feet. The geomorphology of the project area suggests the probability of at least three northeast-southwest trending fault zones.

Other minor fault orientations occur in an east-west direction that usually have less than 10 feet of vertical displacement. Phlogopite mica-rich igneous dikes known as lamprophyres that trend nearly east-west occur within the project area.

The Wasatch Plateau was glaciated at least twice during the Pleistocene Epoch and the last glacial episode ended approximately 15,000 years ago. This is evident in the project area by the U-shaped canyons scoured by the advancing glaciers and low rounded hills along the flanks of the canyons and present stream channels formed by earth materials deposited when the glaciers retreated.

3.1.2 Geology

Bedrock formations were deposited during the Late Cretaceous and Tertiary periods. Multiple transgressions and regressions of the Western Cretaceous Interior Seaway resulted in the deposition of a heterogeneous sequence of rock types that are both horizontally and vertically discontinuous. On the terrestrial side of the shoreline (Wasatch Plateau area) sediment deposition occurred in lacustrine (lake), fluvial (river and stream), floodplain, and swamp environments. Beach sands accumulated along the shoreline. Offshore, sands swept from the beaches and were laid down as bars and blankets of sand in the near-shore shallow marine waters. Muds and clays were deposited in deeper, quieter portions of the sea.

The rock layers exposed in and adjacent to the project area are described below from oldest (lowest elevation) to youngest (highest elevation) as follows (Figures 3.1 and 3.2):

Star Point Sandstone (Cretaceous) - This unit is not exposed in the project area but forms the foundation below the coal seams and forms prominent cliffs to the east. It is a marine shoreface deposit formed by accumulation of beach sands of the Cretaceous seaway. The sandstone consists of two massive units, the Storrs Tongue and the underlying Panther Tongue, which intertongue with the overlying Blackhawk Formation. Both Tongues consist of massive buff-colored sandstone units with a thickness of approximately 1,300 feet. The Storrs Tongue pinches out westward within the Flat Canyon Tract.

Blackhawk Formation (Cretaceous) – The Blackhawk Formation crops out within the project area and forms the canyon bottoms and lower and lower-intermediate slopes of the canyons. It is easily eroded and forms slopes. It is approximately 1,900 feet thick and consists of lenticular sandstone, siltstone, and claystone or shale. The lower portion is the coal-bearing section of mining interest. None of the coal seams crop out at the surface within the project area. They are buried by varying thicknesses of overburden within the project area, ranging from approximately 800 feet along the eastern boundary to over 2,000 feet along the western boundary. Within the bottom 100 feet of the Blackhawk there are several coal seams between the Storrs and Panther Tongues. Of these seams only the lowest-lying Flat Canyon Seam is mineable.

The upper coal-bearing unit of the Blackhawk Formation, immediately above the Storrs Tongue, contains three mineable seams, but only the Lower O'Connor B seam is mineable under the majority of the Tract. The Lower O'Connor A Seam is not considered mineable until it merges with, and becomes part of, the Flat Canyon Seam in the central and northern section of the project area, although there may be areas with mineable thickness in the southern section.

Other coal seams occur in the upper part of the Blackhawk, but these are typically discontinuous and only locally of mineable thickness.

The coals are classified as low-sulfur, high-volatile "B" bituminous. Sulfur content is less than 0.5 percent by weight.

Castlegate Sandstone (Cretaceous) – The Castlegate Sandstone is a cliff-forming massive unit in most of the Wasatch Plateau. In the project area it does not form prominent cliffs but forms steep slopes. The thickness is 220 to 320 feet and forms the steep intermediate slopes of the canyons.

Price River Formation (Cretaceous) – The Price River Formation is a slope-forming unit that is poorly exposed in the project area because of vegetation and the thick soil mantle. It consists of sandstone and mudstone about 220-280 feet thick. It forms the gently sloping upper slopes of the canyons in the project area, mostly indiscernible from the overlying North Horn Formation.

North Horn Formation (Cretaceous-Tertiary) – The North Horn Formation is a slope-former that caps the upland ridge tops in the project area. It consists of interbedded lacustrine limestone, sandstone, and mudstone or shale. It is approximately 1,350 feet thick.

Alluvium and Colluvium (Quaternary) – Alluvial (stream gravels) are found in the canyon bottoms. Soil and colluvium are relatively thick and drape most of the slopes.

Glacial Deposits (Quaternary) – Glacial deposits in the project area consist of terminal, recessional, and ground moraines. Morainal deposits are most notable in Boulger Canyon but are found in the other drainages. Boulger Dam was constructed on a very prominent terminal moraine.

3.1.3 Coal Reserves, Mining, Subsidence, and Seismicity

Previous mining in the vicinity of the Tract has been at the Skyline Mining Complex with surface facilities located east of the Tract in Eccles Canyon. The complex is made up of the Skyline No.1, No.2, and No.3 Mines that have extracted coal underground using the longwall mining method (See Appendix D for a description of mining methods and subsidence). They utilize common infrastructure and are located in three separate coal seams which partially overlap each other in the current mine permit area. Historically, production has utilized two sets of longwall mining equipment operating concurrently in separate mines. However, current production is from a single longwall face operating in the Lower O'Connor B Seam of the Skyline No.2 Mine. The relation of the existing mine workings to the Tract is shown on the Location Map presented in Figure 1.2.

The longwall mining method requires continuous miners to create development entries used for access to longwall mining areas. The coal is then fully extracted using longwall face equipment from panels about 800 ft. wide and up to 15,000 ft. long. The continuous miners can also be used to extract coal by methods using partial or full-extraction where feasible. Previous mining at Skyline has included little production from continuous mining areas.

The Skyline No.3 Mine has been restricted to extraction of the Lower O'Connor A Seam in the northern section of the current lease. In the central and southern sections of the current lease the No.1 Mine workings in the Upper O'Connor Seam have been mined and production is now from the Lower O'Connor B Seam below. In this area extraction of multiple seams has been carried out, with the seams extracted sequentially from the top down with extraction heights of up to 14 feet in a single seam and up to 25 feet where both seams have been mined.

Full extraction longwall mining results in failure of the immediate roof strata, leading to fracture and flexure of the overburden rocks progressing upwards and resulting in surface subsidence. The degree of subsidence varies with mining layout and thickness of extraction. With the overburden depths at Skyline, flexure of the rock strata occurs near the surface due to differential subsidence, generally without fracture. However, in some isolated areas tension fractures can open up where the degree of tension is more pronounced and the strain is not uniformly distributed, such as where strong rock beds are located near the surface.

The dynamic subsidence resulting from a longwall face passing beneath the surface produces a zone of flexure where tension can sometimes result in minor cracking of the surface that is soon followed by a zone of compression where the fractures close and rapidly heal.

Permanent tensile zones are observed above coal pillars left underground at the edge of longwall extraction areas and if fractures open up in these areas they may take longer to heal. The experience of longwall mining at Skyline is that very few tensile fractures are observed following extraction of a single seam at depths greater than 600 feet. The majority of cracks are associated with mining of the lower seam and are located where differential subsidence is concentrated at pillars which are vertically aligned in both seams. These conditions give rise to the highest degree of flexure with associated tensile zones near surface.

Although the vertically aligned or stacked pillars produce the greatest zones of tension, the formation of fractures does not generally occur unless the surface has little lateral constraint, as in the case of ridges. Of the total area mined at Skyline, less than 0.5% has produced tensile fractures. The majority of this area was associated with an area known as Trough Springs Ridge.

Sometimes it is necessary to leave pillars between two adjacent longwall areas. This can result in increased tension, such as that experienced at Trough Springs Ridge above a fire barrier pillar left in both seams. In this case major fractures were observed after mining of the lower seam in an area where strong sandstone beds were located near the surface on a ridge where lateral constraint was absent. Tension fractures opened up in a zone that was 1500 feet long with fractures that were from several inches to 5 feet wide and up to 200 feet long. The fractures created a short-term safety hazard, but were mitigated by filling with soil. No long-term adverse impact is expected. In this area up to 23 feet of coal was extracted in two seams with depths from 650 to 1100 feet.

An expanded zone of fracturing can increase the potential for vertical groundwater permeability. Experience at Skyline with longwall mining of two seams below Burnout Canyon has shown that no long-term adverse effects have been observed with surface waters and near surface aquifers. This has included a section above the same fire barrier that led to the Trough Springs Ridge tension cracks opening up. Overburden in the Burnout Canyon area has been as low as 600 feet with extraction of up to 23 feet and subsidence of up to 14 feet observed.

Subsidence can also have adverse effects on slope stability, but no major slope failures have been observed at Skyline. Undermining of State Highway SR 264 has also taken place with minor damage observed that required repair without long term impact.

Mining induced seismicity has also been experienced as a direct result of longwall mining at Skyline. A study of this phenomenon was carried out from 1986 to 1996 while the Skyline Mine was operating in the northern section of the current mining lease (Arabasz et. al., 1996). During this time one longwall unit was operating at depths ranging from 1200 feet to 2000 feet while a second longwall unit was operating at depths ranging from 400 to 1300 feet.

Results of the study indicated a very strong correlation between mining induced seismicity and longwall production at depths greater than 1500 feet. During this time the Mine was experiencing stress-related problems caused by coal bumps at depth in the Skyline No.3 Mine. No surface damage associated with this mining was reported, although mining was not carried out in close vicinity to sensitive structures. A large campground, small dam, and private cabins were location within 7,000 feet of these mine workings. The mining was also in the vicinity of Highway SR264 and a gas transmission pipeline. There was no reported damage due to seismicity. The natural slopes in the area are similar to those in the Tract and no evidence was reported of slope instability as a result of seismicity.

Current mining is projected to continue with extraction of the Lower O'Connor B Seam in a limited area at the southern end of the current lease and a new lease is required if the mine life is to be extended.

3.1.4 Facilities/Structures

This section presents a description of the facilities in and adjacent to the project area that could be affected by leasing/mining. These facilities are also discussed from the perspective of their managed uses by specific resource category in the appropriate resource subheadings. The associated resource subheadings are shown in parenthesis ( ) by the title. These facilities are shown on Figure 1.2.

Mainline #41 Gas Transmission Pipeline (Lands and Special-Uses)

The Mainline #41 buried natural gas transmission pipeline in the Tract area runs in Burnout Canyon and then under Highway SR 264 on the west side of the Upper Huntington Creek valley floor. This segment of the pipeline was abandoned in 2000. There are currently no plans to reactivate this pipeline for natural gas transmission. Effects to this pipeline were therefore not identified as an issue, but it is discussed for information purposes.

Electric Lake Dam (Lands and Special-Uses)

This is an earth and rock dam located about 2 miles south of the Tract. It was constructed by Utah Power and Light Company (currently PacifiCorp) in 1974 to provide water to the Huntington Canyon Coal-Fired Power Plant in Huntington Canyon near Deer Creek. Capacity is 31,500 acre-feet.

Boulger Dam & Reservoir (Recreation)

The Dam was constructed in 1938 to create a fish pond at the junction of Boulger Canyon and Flat Canyon. A cross-section through the Dam shows homogeneous earth-fill constructed on the original streambed with a nominal key trench into the foundation materials. As originally constructed, the Dam was approximately 220 ft long, a maximum of 16 ft high, with a crest width of 10 ft. The slope of the upstream face was 3H:1V with 3 ft. of riprap protection, and the downstream face was 2H:1V. A note on the original drawing indicates organic soils were removed prior to fill placement in 6-inch layers compacted by roller, with coarser material in the downstream half of the Dam. An overflow masonry chute spillway was constructed on the right abutment at a grade of approximately 8-10%. The chute was provided with 3 ft. deep cut-offs at the top, Dam centerline and bottom of the chute. The Utah Division of Water Rights listing indicates a drainage area of 3.1 square miles and a maximum storage of 45 acre-ft.

In 1994, the chute spillway was replaced with a reinforced concrete fish ladder, a toe drain was installed to control seepage and the riprap was upgraded on the upstream face. The fish ladder was constructed in 10 ft. sections and was provided with strip foundations at the top and bottom of the chute constructed at a 10% grade. The 1994 modifications were designed by the Forest Service and funded by Canyon Fuel for offsite mitigation of potential effects of mining in Burnout Canyon.

No descriptive information on the foundation or sub-surface conditions is available from drill holes or test pits, and no qualitative data has been located on the Dam fill or foundation materials. Other than the toe seepage that indicates a phreatic surface at ground level at the downstream toe, there is no recorded information on the phreatic surface through the dam.

Construction of the fish ladder effectively resulted in lowering of the water level in the reservoir. Over the past 62 years of operation there has likely been significant siltation of the reservoir. The combination of these two factors has likely reduced the maximum storage to less than the original capacity of 45 acre-ft., but no measurements have been carried out to confirm a more definitive figure.

A typical cross section through the highest part of the Dam was prepared based on the available information. Consistent with the descriptive data, a homogeneous fill section placed on stream bed material has been assumed, with a phreatic surface profile typical of a non-zoned construction. Reasonably conservative shear strength parameters were assigned to the various materials, although it should be noted that the nature of the foundation remains highly speculative and has been based on inspection of near surface materials in the vicinity of the Dam.

Limit equilibrium analyses of the structure under normal and extreme loading conditions was carried out by Norwest Mine Services, Inc. (NorWest, 2000) to investigate the potential for both circular and composite (part circular/part linear) failure surfaces to develop through the upstream and down stream slopes. The results of the analyses show that under normal conditions the structure is stable with factors of safety of 2.5 and 1.3 for the upstream and downstream slopes respectively. An acceptable factor of safety for normal conditions is generally 1.5, thus the downstream face with a 2H:1V slope and high phreatic surface is likely already below normal standards.

State Highway 264 (Transportation)

This is a paved, all-weather State highway maintained by the Utah Department of Transportation.

This paved two lane highway runs east-west through the center of the Tract along Flat Canyon as shown on Figure 1.2. The road runs along the base of the Canyon over terminal moraine-type deposits at the lower east end and over alluvial sand deposits further west.

The road construction comprises flexible asphalt surfacing over granular roadbase material. Drainage is provided by inside ditches, collection inlets, culverts, and outlet structures. The estimated thickness of the surficial materials under the constructed roadway is up to 90 ft.

Flat Canyon Campground & Facilities (Recreation)

The Flat Canyon Campground facility is operated by the Manti-La Sal National Forest and consists of camping areas with associated freshwater impoundments and toilet facilities.

The Campground is located at the junction of Flat Canyon and Boulger Canyon overlooking the Boulger Dam and Reservoir. There are several prepared campsites located within a forested area on a gentle slope, together with centrally located restrooms. Water supply to the campground is from a spring located approximately 3,000 ft. southwest along Boulger Canyon. Access roads to the campsites and the sites themselves are all of flexible construction. Details of the restroom facilities, indicate a wood frame superstructure supported on a 6.5 inch reinforced concrete pad integral with a below grade storage vault approximately 12 ft. long, 7 ft. wide and 4 ft. deep.

A small aluminum tied-back retaining wall impounds a small headpond at the spring location that feeds into a short length of 4" cast iron pipe to a valve and vent, and then into a 2" galvanized steel pipe to the campground. At the campground, the galvanized steel pipe feeds into a buried 3,000-gallon fiberglass tank that in turn feeds 7 hydrants and the restrooms. The system is gravity fed and contours shown on the plans supplied by the Forest Service indicate a head differential of approximately 5 ft.

Private Cabins & Buildings (Recreation, Transportation))

Within the area influenced by mining in the project area there are a number of privately owned cabins in Flat Canyon and Swens Canyon. The cabins include access roads and spring developments.

The four private cabins within the project area in Flat Canyon and the one in Swens Canyon are relatively modest log or timber frame structures supported on concrete strip or pad foundations. There are some other properties further along Flat Canyon and up Little Swens Canyon, but these are outside the area under consideration.

Hunt Reservoir Dam (Recreation)

This is a small earthen dam located at Camp Shalom in Swens Canyon outside of the project area but within the cumulative effects area regarding mining-induced seismicity. The capacity of the reservoir is small and is operated to contain water only during the summer use season for the camp facilities. The camp facilities are extensive with several buildings, native surface access roads, camp loops, and a trail system.

3.1.5 Surface Water

The study area is located in an area of subalpine climate. Precipitation is measured at the Skyline Mine surface facility in Eccles Canyon west of the study area. Between 1985 and 1995 the annual (calendar year) precipitation ranged from 17.2 to 29.4 and averaged 23.9 inches (Mayo and Associates, 1996). Monthly average temperatures at the mine range from 8.0 to 74.4 °F (CFC, 1999).

The National Resource Conservation Service (NRCS) maintains two high elevation precipitation stations east of the study area. During the period 1961-1990 (NRCS, 1995) the average annual precipitation was 29 inches at the Mammoth-Cottonwood Station (elevation 8,800 feet), and 33 inches at the Red Pine Ridge Station (elevation 9,200).

The study area is in a region that experienced several extremely wet years during the early and mid 1980s, followed by an extended drought from 1987 to 1993. Since 1993, the region has enjoyed mostly wet conditions. However, beginning in January 2000 the region entered a drought period. It is important to note that most baseline hydrologic collection occurred during the moderately wet period in the late 1990s.

All surface waters in the study area, with a single exception, drain into Upper Huntington Creek, which is a tributary of the San Rafael River. The San Rafael River flows into the Green River approximately 80 miles southeast of the study area. A small portion (< 6%) of the study area is in the Upper Gooseberry Creek drainage. Upper Gooseberry Creek flows into Fish Creek above the Scofield Reservoir on the Price River. The Price River flows into the Green River approximately 60 miles southeast of the study area. The region of investigation for this analysis is an area of approximately 12.7 square miles. Perennial stream reaches have been identified in Boulger, Flat, Swens, Little Swens, and Cunningham Canyons. Upper Huntington Creek, which defines the northern and eastern boundaries of the study area, is also a perennial stream. In order to simplify the characterization and analysis of surface water systems in the study area, the surface water drainages have been divided into sub-basins. These sub-basins are shown on Figure 3.3. Also shown on this Figure are the reaches of the individual streams that have been classified as perennial for this analysis.

Several drainages that have not previously been classified as perennial were determined to possibly be perennial as a part of this study. These reaches are shown on Figure 3.3. Determinations of possibly perennial reaches were based on field observations of streamflow and vegetation types and through inspection of aerial photographs.

Both ephemeral and perennial drainages in the project area are supported in the late winter and spring months by the annual snowmelt event. Because of the large quantities of snowmelt water relative to the amount of groundwater that can be stored and discharged from shallow groundwater systems in the area, perennial streams commonly have high-flow discharge rates that exceed their low-flow baseflow discharge rates by many times.

Perennial streams in the project area exist where 1) there is adequate groundwater recharge and subsurface storage capacity in the drainage basins to sustain discharge from shallow groundwater systems throughout the year and 2) there is a low-permeability confining layer beneath the stream that prevents downward percolation of water in the stream channel (i.e. the stream is perched).

Field observations during 1997-2000 suggest that the perennial streams in the project area are generally gaining streams. Observations of stream conditions in the springtime and late fall suggest that this condition persists throughout the year. The streams gain flow from discharge from shallow groundwater systems in the form of springs, seeps, and discharge directly to the stream channel. These are common along the lengths of the perennial drainages. Figure 3.4 shows water monitoring points, including streams, springs, wells, and water discharge points.

The specific characteristics of each sub-basin in the study area are described below.

Flat Canyon Sub-Basin

The Flat Canyon sub-basin includes an area of 1.76 square miles, which is approximately 13.8% of the study area. The gradient in Flat Canyon, approximately 0.93%, is the lowest of any of the sub-basins in the project area. Flat Canyon is so called because of the broad, flat-bottomed valley floor through which Flat Canyon Creek flows. The broad riparian corridor in Flat Canyon is up to 1,000 feet wide. Flat Canyon Creek in its upper reaches, where it meanders through the broad alluvial valley, is a E5 stream type. This reach is dominated by run features. The channel substrate underlying the creek in Flat Canyon consists primarily of thick saturated glacio-lacustrine sediments. The sediments along the margin of the canyon are approximately 80 feet thick, consisting mostly of sand.

In the lower reaches of Flat Canyon Creek, the channel is more deeply incised and the gradient is much steeper (3%). This reach is a B3 type (Rosgen, 1996), which consists primarily of riffles with less than 5% pools. The banks in this reach are well vegetated and stable. The substrate in lower Flat Canyon Creek consists primarily of cobbles and boulders. It appears well armored and stable.

The north-facing canyon walls in Flat Canyon are vegetated with dense conifer forests. Portions of these conifer stands have recently undergone logging. The south facing canyon walls are vegetated primarily with scattered, dense stands of quaking aspen. Flat Canyon creek is separated from the underlying coal seams by 1,000 to 1,800 feet of overburden.

Discharge and water quality at Flat Canyon Creek were measured in October 1999 and July 2000 (NorWest, 2000a). The October discharge measurement was 91 gpm while the July measurement was 215 gpm. The water in Flat Canyon Creek during October was of the calcium-bicarbonate chemical type with a TDS concentration of 169 mg/l.

Boulger Canyon Sub-Basin

The Boulger Canyon sub-basin, which occupies approximately 3.92 square miles, or 30.8% of the study area, is the largest of the sub-basins. Included in this area are the upper drainage (above Boulger Reservoir), which is approximately 3.22 square miles in area, and the lower drainage, which occupies an area of approximately 0.70 square miles (Figure 3.3). Boulger Creek is a third order stream that flows to the northeast where it joins Flat Canyon Creek and then flows into Electric Lake. The gradients on Boulger Creek are steeper than are those of the adjacent Flat Canyon creek. The gradient on the main reach below the confluence of the two forks and above the reservoir averages 1.7%.

The reach of Boulger Creek extending from below the upper forks to Electric Lake contains sections that are C3, E3, and B3 (Rosgen, 1996). The stream in this area, which meanders tightly, is 8-10 feet wide and is dominated by riffles and runs with a channel depth ranging from 6 inches to 2 feet. The substrate in areas of low gradient appears stable and well armored. It is composed of approximately 50% cobbles, 15% gravel, and 35% sand/silt. The stream banks in this portion of the drainage are well vegetated and appear stable. The drainage in this area supports a moderately wide strip of riparian vegetation up to approximately 350 feet wide along the valley bottom. Much of the riparian vegetation along the margins of the valley bottom appears to be supported by inflows of alluvial and colluvial groundwater from the lower canyon walls. This groundwater also provides recharge to the creek.

Approximately 1,800 feet above the confluence with Electric Lake, a small unnamed tributary to Boulger Creek enters from the south side of the canyon (Figure 3.3). This stream appears to be perennial based on the narrow corridor of riparian vegetation that exists along and adjacent to the stream channel. Discharge and field parameters were measured in this drainage by Mayo and Associates during October 1999 and July 2000. On both occasions water was flowing in the stream. The stream was flowing at 32.8 gpm during July 2000. Inspection of aerial photographs suggests that the stream has the appearance of being perennial for a distance of approximately one-half mile above the confluence with Boulger Creek.

The right (north) fork of Boulger Creek has an average gradient of approximately 4.3%; however, several stream segments have gradients less than 3%. There is a narrow strip of riparian vegetation associated with this reach of the creek. The first approximately 1,800 feet of this drainage, is a B3 stream type. The channel substrate in this reach is made up of material ranging from 2-inch gravels to 12-inch and greater cobble/boulder material. Runs and riffles make up approximately 60% of the stream, with approximately 40% pools. Raleigh Consultants (1992) noted sedimentation in the right fork of Boulger Creek that was attributed potentially to inactive beaver dams. The next approximately 2,000 feet of the right fork consists of a meandering C3 stream type. The channel in this reach is approximately 10 feet wide and 6 inches deep. The stream contains approximately 80% riffles and runs and 20% pools and the substrate in this reach is made up of approximately 50% cobbles, 20% sand and silt, and 35% gravel. The stream banks appear stable. The final approximately 5,000 feet in the uppermost portion of the drainage is a steep, A2 or B2 stream type with riffles comprising about 90% and pools 10%. The width of the stream in this reach is approximately 5 feet, with depths ranging from 4 inches in the riffles to 1 foot in the pools. The substrate in this reach is dominated by large cobbles, boulders, and bedrock.

The left (south) fork of Boulger Creek is a steep drainage with an average gradient of approximately 7.5%. The channel in the lower reach of the left fork is a A3 channel, while the upper, headwaters area is a C5 or E5 type. The channel substrate in the lower part of the south fork is comprised of large cobbles and boulders. In the headwaters region of the left fork, a large wetland is present in a glacial cirque. The stream channel substrate in this region consists primarily of fine-grained alluvial material. Much of the baseflow of the left fork of Boulger Creek originates from springs along the margins of wetland and groundwater from the wetland itself.

The depth of cover separating Boulger Creek from the coal seams that may be mined ranges from 700 feet in the lower reaches near Electric Lake to more than 2,200 feet in the headwaters areas.

Discharge and water quality in Boulger Creek have been monitored at C-4, C-7, and C-8 (Figure 3.4). Discharge has been measured at C-4 (below the confluence with Flat Canyon creek) since 1997. The maximum recorded discharge, 3,120 gpm, occurred during July 1999. A minimum flow of 450 gpm was measured during October 1999. Streamwater in Boulger Creek is of the calcium-bicarbonate chemical type. TDS concentrations at C-4 have remained relatively constant during the baseline monitoring period, ranging from 140 to 190 mg/l.

Boulger Reservoir is a man-made water body with a surface area of approximately 4.52 acres with a storage capacity of 45 acre-feet. The reservoir is a popular recreation site for fishing, swimming, and rafting. Boulger Reservoir is separated from the underlying coal seams by approximately 1,200 feet of cover. Comparison of discharge and water quality measurements from C-8 (immediately above the reservoir) and C-7 (immediately below the reservoir) suggests that the water quality of Boulger Creek is not degraded as a result of being in the reservoir.

Swens Canyon Sub-Basin

The Swens Canyon sub-basin occupies 2.33 square miles or 18.4% of the study area. The stream drains eastward into Upper Huntington Creek, with a gradient averaging 3.1%. Swens Canyon Creek is a third order stream that meanders tightly, particularly in the lower reaches of the drainage. The stream banks and adjacent areas are heavily vegetated with riparian vegetation and appear to be relatively stable. Swens Canyon Creek appears to be a gaining stream over its entire reach.

Along the length of Swens Canyon Creek, there is evidence that the hillsides have periodically encroached into the stream channel resulting in impounding of the stream. These encroachments appear to be the result of mass movement (i.e. hillside slumping) of the Blackhawk Formation sediments that compose the hillsides. The fact that the lowermost canyon slopes are commonly wet from groundwater seepage may be a contributing factor to the frequency of mass movements. It is evident that the drainage has also been periodically dammed in many locations by beavers. As a result of these occurrences, thick sections of sediment have been emplaced by stream deposition in the backwater areas that existed when the stream was dammed, while adjacent areas have not experienced that degree of sedimentation. These conditions, in conjunction with changes in geologic formation or geologic structure underlying the stream bottom, have resulted in a somewhat stair-stepped topography in the canyon bottom.

The lower 5,000 feet of the stream channel in Swens Canyon is comprised of fine-grained material interspersed with gravel, cobbles, and occasional boulders. This reach is a C3 type. This reach of the stream consists of approximately 80-90% runs and riffles, and 10-20% pools. In this reach the stream meanders tightly and the stream channel is well incised in its channel. Groundwater inflows are apparent along much of the extent of this reach of the drainage. These commonly consist of small springs or seepage fronts that emerge near the transition between the valley bottom and the canyon walls.

A small tributary to Swens Canyon Creek enters from the south approximately 1,000 feet above the confluence with Upper Huntington Creek. This tributary, which extends for approximately one-half mile, appears to possibly be perennial based upon the well-established riparian vegetation along the stream banks. No baseline discharge data are available for this tributary. However, it was noted by Mayo and Associates that there was appreciable flow in the drainage during October 1999 and again in July 2000.

The North Fork enters Swens Canyon Creek approximately 3,000 feet above the confluence with Upper Huntington Creek (Figure 3.3). This tributary is approximately 2,500 feet in length and is very steep. The average channel gradient is approximately 13.8%. This stream reach appears to possibly be perennial based upon the well-established riparian vegetation along the stream banks. No baseline discharge data are available for this tributary. However, it was noted by Mayo and Associates that there was appreciable flow in the drainage during October 1999 and again in July 2000. Much of the baseflow discharge to the stream originates from a series of springs discharging from colluvial groundwater systems in its headwaters region.

In the reach of Swens Canyon Creek extending from the confluence with the North Fork and upstream for approximately 3,500 feet the stream channel narrows considerably. In this reach, the channel substrate is dominated by cobbles and boulders. In some locations, bedrock outcrops are visible in the channel bottom. The channel, which meanders slightly in this reach, contains many active and inactive beaver dams.

In the headwaters reaches of Swens Canyon Creek, the valley broadens into a region of wide meadows and grasslands. The stream channel in this reach is a narrow A2 type. Many springs and groundwater seepages enter the stream channel from the lower hillsides adjacent to the stream.

Swens Canyon Creek is separated from the underlying coal seams by 800 feet of cover at the confluence with Upper Huntington Creek to approximately 2,400 feet of cover in its headwaters area.

Swens Canyon Creek has been monitored by CFC at C-3 since 1997 (Figure 3.4). Discharge has ranged from 30 gpm during October 1998 to 300 gpm during both July 1998 and July 1999. The water in Swens Canyon Creek is of the calcium-bicarbonate chemical type. Baseline TDS concentrations in Swens Canyon Creek have ranged from 177 to 213 mg/l.

Little Swens Sub-Basin

Little Swens Creek flows northeast from highland areas toward its confluence with Upper Huntington Creek. The basin encompasses an area of 0.98 square miles, which is 7.7% of the study area. The drainage is steep, with a stream gradient of approximately 5.9%. Little Swens Canyon Creek is a tightly meandering stream with relatively stable, well-vegetated stream banks. Like the adjacent Swens Canyon drainage, there is evidence of a long history of encroachment of hillsides by mass movement onto valley floor. There is also evidence of a long history of beaver dam construction in the drainage. These conditions have resulted in accumulation of sediment in some areas with considerably less sediment in other areas resulting in a somewhat stair-stepped topography on along the canyon bottom.

The stream channel in the lower approximately one-half mile of the drainage is a Rosgen (1996) B3 type. The valley bottom in this reach is approximately 30 feet wide. The channel substrate in this reach consists of gravel, cobbles, and boulders. Generally, the stream channel in Little Swens Canyon is more dominated by rocky material and appears to have less fine-grained material in the substrate than does the adjacent Swens Canyon. The stream banks in this reach are heavily vegetated and appear stable.

In the next 1,000 feet of the drainage, the channel narrows slightly and the channel substrate is dominated by boulders and bedrock. This reach appears to have been impacted considerably by beaver dams and encroachment of the lower canyon walls into the drainage by mass movement. This reach of the drainage is a Rosgen (1996) A2 type.

A small reservoir has been constructed in the upper reaches of this drainage. This pond has a surface area of approximately 3.15 acres and is used for recreation purposes by a privately owned girl's camp that surrounds the pond.

The Little Swens Canyon drainage is separated from the underlying coal seams by 1,100 feet of overburden near the confluence of the stream with Upper Huntington Creek. In the headwaters regions, the overburden is approximately 2,100 feet. The overburden between the reservoir at the girl's camp and the coal seams ranges from about 1,900 to 2,000 feet

Baseline water quality and discharge measurements have been performed on Little Swens Canyon Creek at C-2 from 1998 to 2000 (Figure 3.4). Discharge at C-2 has varied from 16 gpm during October 1998 to 211 gpm during July 1998. Discharge in the creek is of the calcium-bicarbonate chemical type. TDS concentrations have ranged from 151 to 214 mg/l.

Cunningham Canyon Sub-Basin

The Cunningham Canyon sub-basin, with an area of 0.92 square miles, is a relatively small drainage located near the southern margin of the project area. Cunningham Canyon Creek is an easterly flowing drainage that flows into Electric Lake in the Upper Huntington Creek drainage. The drainage has a steep gradient, averaging 8.0%. The channel substrate in the upper reaches is dominated by cobbles and boulders. In the lower reaches, near the confluence with electric lake, the channel substrate is dominated by fine-grained materials including silt and soil. The stream is entrenched below the land surface by approximately 1 to 2 feet in the lower reaches of the drainage. Riparian vegetation along the stream banks and adjacent flood plain in the lower reaches of the canyon is dense and the stream channel appears stable.

Water quality and discharge have been monitored by CFC at C-5 (Figure 3.4) from 1997 to 2000. Discharge at C-5 has varied from 20 gpm in October 1998 to 162 gpm during October 1997. TDS concentrations at C-5 have varied from 118 to 165 mg/l.

The Cunningham Canyon drainage is separated from the coal seams by 700 feet in its lower reaches near Electric Lake to approximately 1,900 feet in the headwaters area.

Upper Huntington Creek Sub-Basin

Within the project area there are a series of unnamed ephemeral drainages to Upper Huntington Creek (Figure 3.3). These drainages, on the steep western slope of Upper Huntington Creek, range in size from 0.4 to 0.78 square miles. Gradients of the unnamed Upper Huntington Creek sub-basins are all very steep, ranging from approximately 17% to 32%.

None of these drainages are known to support perennial streams. One intermittent stream located immediately south of Little Swens Canyon (Figure 3.3) was monitored for discharge and field parameters by CFC in July 2000. Discharge from this stream was 7 gpm.

The overburden separating the unnamed Upper Huntington Creek drainages from the coal seams ranges in thickness from approximately 700 feet near Electric Lake to more than 2,000 feet in the highland areas above Huntington Canyon

Upper Gooseberry Creek Sub-Basin

A small portion (0.73 square miles, less than 6%) of the project area drains to the Upper Gooseberry Creek drainage. Gooseberry Creek drains to the north-northwest and flows into Fish Creek which discharges to Scofield Reservoir. While Upper Gooseberry Creek near the project area may possibly be perennial, the stream itself is beyond the project area and would not be undermined. For this reason, this stream has not been investigated.

All of the Upper Gooseberry Creek sub-basin within the project area is separated from the coal seams by more than 1,500 feet of cover.

3.1.6 Ground Water

Geologic Setting

The geology of the study area has been described in the previous Physiology and Geology sections in this chapter. Five bedrock formations of concern to coal mining activities in the study area are, in descending stratigraphic order, the North Horn Formation, Price River Formation, Castlegate Sandstone, Blackhawk Formation, and Star Point Sandstone. These rocks are composed of interbedded shale, mudstone, siltstone, and sandstone layers that are laterally discontinuous. The heterogeneity and lateral discontinuity of these rocks have a profound effect on water-bearing and water-transmitting properties. Water is not generally transmitted great distances either vertically or horizontally, and the many low-permeability units create perched conditions. Unconsolidated alluvial, colluvial, and glacial deposits as well as soil are important hydrogeologic units in the study area.

Ground Water Systems

The concept of a groundwater system refers to 1) where and how recharge occurs, 2) how flow is accommodated, and 3) where and how groundwater discharges. Five types of groundwater systems are defined in the study area. These systems are:

- Colluvial/shallow bedrock groundwater systems;
- Boulger Canyon alluvial groundwater system;
- Flat Canyon groundwater system;
- Deep Blackhawk Formation groundwater systems; and
- Star Point Sandstone groundwater systems

These five systems have been defined because stratigraphic, lithologic, and structural constraints cause each type of system to operate differently. The concept of a groundwater system is limited to how a system operates and does not indicate or preclude hydraulic communication among the systems of a given type. This concept is useful in places such as the study area where groundwater commonly occurs in localized areas, and where aquifers, in which there is hydraulic communication over a greater expanse, do not exist.

<u>Colluvial/Shallow Bedrock Groundwater Systems</u>

Colluvial/shallow bedrock groundwater systems occur throughout the study area. This type of system occurs in the thick soil mantle, slope wash colluvial deposits, and shallow bedrock in which the porosity has been enhanced by weathering or fracturing. Groundwater in shallow alluvial deposits is also included in this type of system. The abundance of relatively low-permeability horizons in bedrock formations of the study area hinders appreciable migration of groundwater to deeper stratigraphic horizons and creates perched groundwater conditions in colluvium and shallow bedrock.

The depth of colluvial/shallow bedrock groundwater systems has not been investigated but is estimated to range from several tens of feet to perhaps over 100 feet in some areas. Data from the Skyline Mine area indicate that a water-monitoring well (W79-14-2a) completed in the Blackhawk Formation at a depth of 102 to 122 feet exhibits seasonal water level responses (Mayo and Associates, 1996), which, as discussed below, is a characteristic of colluvial/shallow bedrock groundwater systems. However, two wells completed at depths ranging from 150 to 200 feet do not show seasonal water level responses.

Colluvial/shallow bedrock groundwater systems are directly recharged by snowmelt; especially snow that melts relatively slowly in dense wooded stands common in the study area. Groundwater flow follows topographic gradient and flow path lengths are relatively short: no more than from the top of a ridge to a canyon bottom.

Groundwater in colluvial/shallow bedrock systems supports discharge from nearly all of the springs in the study area. Discharge from this type of system directly to creeks is indicated by gaining stream flows. Groundwater discharge from this type of system occurs primarily along the bottoms of canyons. Some groundwater discharge occurs higher on a number of hillsides because of 1) local breaks in slope such as in the head of Swens Canyon where glacial moraine materials create a less steep slope, or 2) groundwater in permeable shallow bedrock, such as a sandstone paleochannel or the Castlegate Sandstone, encounters a less permeable bedrock horizon.

Storage in colluvial/shallow bedrock groundwater systems is small because of the generally limited depth of colluvial and shallow bedrock materials, short flow path lengths, relatively large hydraulic conductivities, and relatively steep hydraulic gradients. Consequently, this type of groundwater system is acutely sensitive to seasonal and climatic variations in precipitation. Seasonal and climatic dependence is demonstrated by variations in spring discharge rates. Discharge from springs is typically greatest in the springtime and declines appreciably during the summer and fall months. A number of springs had lower discharges in springtime 2000 than during previous spring. This reflects sensitivity to climatic changes such as the drought conditions that the region has seen since the beginning of 2000.

Spring and seep survey data also indicate the dependence on seasonal recharge. The total discharge from all of the springs located in the fall 1997 survey was 1,073 gpm. During the following spring the total discharge was 2,895 gpm, a nearly three-fold increase. Although these data were not collected during the same snowmelt recharge cycle, both surveys were conducted during similar moderately wet climatic conditions.

That springs respond quickly to season and climate suggests that time between recharge and discharge in colluvial/shallow bedrock groundwater systems is less than one year. As noted, much of the baseline discharge data for these springs have been collected during a lengthy wet-spell. Because of the heavy climatic dependence of these springs, it is expected that many of the springs in the study area would have much lower discharge rates or dry up in drought years.

CFC has collected unstable isotopic data from five springs in the study area (NorWest 2000a). All spring waters sampled in the study area contain anthropogenic carbon and abundant tritium. These compositions indicate that recharge to the groundwater systems supporting discharge from these springs occurred within the last approximately 50 years.

Boulger Canyon Alluvial Groundwater System

Alluvial sediments deposited in the relatively broad-bottomed portions of Boulger Canyon support groundwater. A distinct groundwater system has been designated for these sediments because of the comparatively larger depth and extent of these deposits relative to other, much steeper canyons in the Project area. The depth of this alluvium is known in one location where exploration drilling (drill hole 99-4-1; Figure 3.4) encountered 40 feet of alluvial sediments.

Groundwater in these sediments is recharged largely by interflow from colluvial/shallow bedrock groundwater systems. During dry times Boulger Creek could also provide recharge. However, visual observations of the creek by the principal authors suggest that Boulger Creek is a gaining creek year round, suggesting that discharge from the alluvial groundwater system is predominately to the creek.

Flat Canyon Groundwater System

Exploration drilling by CFC in the Flat Canyon area has revealed that there is a thick deposit of unconsolidated sediments in the canyon. Drill logs for wells 98-32-1 and 95-33-1 were provided for review by CFC. The locations of these two wells are indicated on Figure 3.4. The drill logs indicate that these sediments are 70 to 90 feet thick on the margins of Flat Canyon. These sediments consist primarily of sand and gravel with only minor fine-grained materials, and thus are expected to be fairly permeable. Inspection of geomorphology in air photos and in the field suggests that these alluvial sediments were likely deposited in an impoundment created by the glacier(s) in Boulger Canyon and the lateral and terminal moraine deposits of the Boulger Canyon glacier(s). Glacial moraine deposits typically have low hydraulic permeability (Freeze and Cherry, 1979). Consequently, water is largely impounded in glacio-lacustrine sediments behind the lateral and end moraines at the confluence of Flat and Boulger Canyons. Because of the thickness, lateral extent, and saturation of these deposits, the Flat Canyon glacio-lacustrine sediments have been designated as a distinct groundwater system.

Discharge from colluvial/shallow bedrock groundwater systems provides the bulk of recharge to the Flat Canyon glacio-lacustrine sediments.

A large portion of the discharge from the Flat Canyon groundwater system occurs directly to Flat Canyon Creek. Flat Canyon Creek does not appear to be fed by perennial creeks in any of the side drainages. Rather, Flat Canyon Creek appears to gradually gain flow throughout the year along its course due to discharge from springs and groundwater discharge directly to the creek.

A limited amount of water is also transmitted from the Flat Canyon alluvium through the glacial moraine deposits. This water supports several small wet areas on the hill slope west of Boulger Reservoir. Groundwater discharge from the Flat Canyon alluvium at this location has not been quantified or monitored. It is believed that this groundwater discharge is largely consumed by transpiration due to the presence of phreatophytes on the hillside. It is expected that because of the large storage volume in the Flat Canyon glacio-lacustrine sediments, that discharge in this location will be essentially constant even during drier climatic cycles.

Discharge from the Flat Canyon groundwater system may also occur via underflow through the basal moraine deposits or bedrock underlying the moraine deposits. Any underflow would recharge the glacial/alluvial sediments below the moraine and would ultimately discharge to either Boulger Creek below the reservoir or via groundwater inflow to Electric Lake. A small amount of water may also migrate downward and recharge underlying bedrock. However, there is no evidence suggesting that discharge occurs via these two mechanisms.

Deep Blackhawk Formation Groundwater Systems

Deep Blackhawk Formation groundwater systems occur at depths greater than about 150 feet where the Blackhawk Formation is exposed at the surface. Deep Blackhawk Formation groundwater systems have been encountered in underground workings at the Skyline Mine and have been encountered by exploration drilling in the Project area (CFC, 1999). These systems occur in paleochannel sandstones that are encased in three dimensions by relatively impermeable mudstones and shales. Consequently there is poor hydraulic communication between sandstones both laterally and vertically. Groundwater in these sandstone channels may occur under unconfined or confined conditions. Confined conditions in the underlying Star Point Sandstone attest to the ability of fine-grained units in the Blackhawk Formation to act as substantial barriers to vertical groundwater flow.

Experience at Skyline Mine and other mines in the Wasatch Plateau indicates that coal seams themselves do not bear water; in fact, water must be used to control dust as coal is cut by mining equipment.

The mechanics of deep Blackhawk Formation groundwater systems are not as well understood as the mechanics of near surface groundwater systems described above. Mining encounters groundwater in these systems at a point along the flow path but recharge and discharge locations are not obvious. Groundwater flow direction is estimated to be in the direction of bedrock dip (westward).

Mayo and Associates (1996) have determined that groundwaters in the deep Blackhawk Formation groundwater system have radiocarbon ages of 2,500 to 18,500 years and contain essentially no tritium. This suggests that these systems are hydraulically isolated from the surface and that groundwater flow is likely slow. The stable isotopic ratios of mine inflow waters are considerably more negative than shallow subsurface groundwaters, suggesting that these waters likely recharged anciently under cooler paleoclimatic conditions such as glacial periods.

Mayo and Associates (1996) cite several other lines of evidence to demonstrate that deep Blackhawk Formation groundwater systems are discontinuous and hydraulically isolated from the surface (and recharge sources). First, a 192-foot long upward well was constructed in the roof of the Lower O'Connor A Seam (Hydrometrics, 1987). The well only encountered groundwater at the 40-, 100-, and 120-foot intervals while all other horizons were dry. Similarly, a 128-foot deep well in the floor of the mine intercepted water at 98 feet. From the bottom of the mine to 98 feet the rock was not saturated. Second, discharge rates decline rapidly in newly exposed roof drips. Lastly, the total mine water discharge rate does not increase appreciably with time despite the fact that the total mined area continues to increase. The rate of discharge from mine workings is dependent on the rate of coal production and the timing of the encounter of large water-bearing features.

Faults do not appear to be important in the conveyance of water in the deep Blackhawk Formation groundwater system. CFC (1999) reports that of the 44 individual fault planes that were encountered prior to 1999, groundwater inflows occurred from only five. Four of the five appeared to intersect water-saturated sandstone paleochannels in the mine roof. Indeed, experience has indicated that most water-bearing faults encountered in Wasatch Plateau coal mines are associated with sandstone paleochannels. Thus, it is not anticipated that in the project area, large volumes of water would be encountered in faults in the Blackhawk Formation. Recently large groundwater inflows have occurred in the Skyline Mine from two faults; however, these appear to be connected with the Star Point Sandstone and are discussed in the next section.

Potential discharge locations of deep Blackhawk Formation groundwater systems have not been identified. Due to the estimated low flow rates in this type of groundwater system, groundwater discharge at the natural discharge location is not expected to be large in magnitude and thus would be difficult to identify. Nevertheless, because of the westward dip of rocks in the Skyline Mine area and the Project area, groundwater in deep perched bedrock groundwater systems likely discharges, under natural conditions, west of the Project area. However, there are no outcrops of the lower Blackhawk Formation west of the project area. Instead, the lower Blackhawk Formation is dissected by the East Gooseberry Fault west of the study area (Figure 3.1), which likely hinders further westward groundwater flow.

Experience in the Wasatch Plateau suggests that large-offset faults are generally barriers to lateral flow across a fault due to the presence of low-permeability fault gouge. If the East Gooseberry Fault is indeed a barrier to horizontal flow across the fault, then groundwater flow is diverted at the fault in some direction along the fault. The damage zone (rock on either side of the fault that is fractured due to faulting) likely facilitates and supports groundwater flow along the fault. It is doubtful that groundwater from deep Blackhawk Formation groundwater systems discharges to the surface along the surface trace of the East Gooseberry Fault because deep perched systems would not have sufficient hydraulic head.

Star Point Sandstone Groundwater Systems

As described in the Physiography and Geology sections of this chapter, the Star Point Sandstone is comprised of two sandstone members, the upper Storrs Tongue and the lower Panther Tongue. Mining at the Skyline Mine has encountered water associated with both the Storrs Tongue and the Panther Tongue. Because of the westward dip of the bedrock, there is a high probability that mining in the project area would encounter additional inflows of water from the Star Point Sandstone.

The Storrs Tongue interfingers with the Blackhawk Formation and divides the Lower O'Connor A Seam from the Flat Canyon Seam. However, in the western portion of the project area, the Storrs Tongue pinches out and the Lower O'Connor A Seam and the Flat Canyon Seam merge. The Panther Tongue underlies the Flat Canyon Seam, the lower-most seam where mining would occur in the project area. The Flat Canyon Seam is separated from the Panther Sandstone by 15-30 feet of shale, mudstone, and thin coals.

The tongues of the Star Point Sandstone are laterally more extensive than individual sandstones in the overlying Blackhawk Formation. It is anticipated that over larger areas, such as the Skyline Mine and project areas, each tongue operates as a single groundwater system. However, it is not believed that the Star Point Sandstone is a regional aquifer in the sense that there is hydraulic continuity throughout the Wasatch Plateau.

The mechanics of Star Point Sandstone groundwater systems are not well understood. The Star Point Sandstone is exposed in Pleasant Valley east of the Skyline Mine area and the project area and dips westward. This suggests that recharge occurs in the east and groundwater flow is to the west. Because of the inclination of the formation and the low hydraulic conductivity of Blackhawk Formation shales and mudstones overlying the Star Point Sandstone members, confined groundwater conditions are created. Similar confined conditions in the Star Point Sandstone have been observed at other coal mines in the Wasatch Plateau such as the Trail Mountain Mine.

Large groundwater inflows from faults have recently been encountered in the workings of the Flat Canyon Seam in the Skyline Mine. CFC (1999) reports that a fault with approximately 8 feet of offset was encountered during development of the 14L Headgate. The fault initially produced water from the roof and the floor at a rate of 1,200 to 1,400 gpm. Discharge from the roof ceased after a short period but water still continues to be produced from the floor. A second fault along the same trend was encountered in the 16L Headgate. This fault produces 300 gpm of water from the floor. It is believed that this water discharges from the Panther Tongue of the Star Point Sandstone.

Mayo and Associates (1999a) report that groundwater inflows to the Skyline Mine from the Star Point Sandstone have radiocarbon ages greater than 13,000 years and contain no tritium. This suggests that groundwater flow through the Star Point Sandstone is slow and that there is limited hydraulic communication with the surface. Slow flow rates in the Star Point Sandstone are substantiated by the measurement of hydraulic conductivity in other areas of the Wasatch Plateau. At the Crandall Canyon Mine in the Huntington Canyon area, slug testing revealed a hydraulic conductivity of 4.8×10^{-8} to 7.4×10^{-8} ft/s (Mayo and Associates, 1997a). Bills (2000) determined a hydraulic conductivity of 4.06×10^{-6} ft/s for the Star Point Sandstone in the Straight Canyon area. This latter result is higher than the first because of fracturing associated with the Straight Canyon syncline.

The Star Point Sandstone does not crop out west of Pleasant Valley. Consequently discharge locations for Star Point Sandstone groundwater systems have not been observed in the study area. The Storrs Tongue pinches out in the project area indicating that groundwater is not transmitted westward beyond the study area by the Storrs Tongue. As noted in the previous section, the East Gooseberry Fault truncates the bedrock formations west of the project area. This fault is presumed to be a barrier to lateral flow across the fault. This being the case, groundwater flow is diverted at the fault in some direction along the fault and flow is accommodated in the damage zone of the fault. Potentiometric levels in two monitoring wells, 99-21-1, and 99-28-1 (Figure 3.4), in the project area that are completed in the first sandstone below the Flat Canyon Seam (which may be the Panther Tongue) suggest that the hydraulic head in the Panther Sandstone (elevation 8,419 and 8,515 feet, respectively) is not sufficient to cause water to discharge at the surface trace of the East Gooseberry Fault (elevation greater than about 8,800 feet, directly west of the project area).

Although it is not known where groundwater in the Star Point Sandstone in the study area ultimately discharges, it can be surmised with some certainty that groundwater in the Star Point Sandstone in the study area is not in hydraulic communication with the Star Point Sandstone groundwater systems that supply water to the large-discharge culinary water supply springs in Huntington Canyon (Big Bear, Little Bear, or Birch springs). First, as noted above, the radiocarbon ages of Panther tongue water encountered at the Skyline Mine is 13,000 years. The radiocarbon ages of groundwater that discharges from the Huntington Canyon Springs (Mayo and Associates, 1997b; Mayo and Associates, 1999b) are summarized below.

Spring	Radiocarbon Age
Birch Spring	1,700-3,600 years
Big Bear Spring	Mixed; 3,500-4,500 years
Little Bear Spring	Modern

Because water in the Star Point Sandstone in the study area has appreciably greater radiocarbon ages, it is unlikely that this water is hydraulically connected to the Star Point Sandstone in the Huntington Canyon. Second, the East Gooseberry Fault, the surmised location for groundwater discharge from the Panther Tongue, is not structurally connected to fault systems in the vicinity of the Huntington Canyon springs. The Huntington Canyon springs discharge in and near the Pleasant Valley Graben and associated faults whereas the Gooseberry Graben is on the same trend as the Joes Valley Graben.

Water Quality

Groundwater discharge from springs in the study area is low-TDS, calcium-bicarbonate water. For springs that have been monitored for baseline water quality, the average TDS ranges from 60 to 280 mg/l and the average TDS is 180 mg/l (NorWest, 2000a). Concentrations of sodium ion and sulfate are very low. Groundwater quality meets State of Utah drinking water standards for the parameters that have been analyzed. Untreated spring water is used throughout the study area at cabins and campgrounds for culinary uses. Additionally, groundwater discharge supports baseflow to creeks that have been classified as "High Quality Waters – Category 1" by the State of Utah (UAC R317-2).

3.1.7 Vegetation

This summary provides a description of the vegetative resources in the vicinity of the Flat Canyon Tract with the potential to be impacted by the Proposed Action and alternatives as described above. Vegetative resources potentially affected include those riparian associated plant communities that are dependent on surface flow and groundwater recharge within the zone of impact of a reasonably foreseeable development scenario. For a more detailed description of vegetative resources and a listing of scientific names of plant species in the area please see Technical Report for Vegetation and Wildlife (Norwest 2000).

Vegetation resources within the Flat Canyon Tract have been described and mapped to five general vegetative community types (Figure 3.5). The approximate number of acres associated with each vegetative community within the approximately 8,800-acre area are presented in Table 3.1.

Table 3.1. Acres of Vegetative Community Types In The Flat Canyon Tract, Utah

VEGETATIVE COMMUNITY	AREA (acres)
Grasslands	218
Meadows/Wetlands	180
Sagebrush/Grass	2081
Conifer-Timber	2412
Aspen	3868
Total	**8759**

Grassland communities in the area are dominated by slender wheatgrass, mountain brome, and subalpine needlegrass. Several forb species also occur in the grassland community type.

Primary species found in the dry meadow communities include Kentucky bluegrass, bentgrass (redtop), and Ross sedge. Wet meadow communities are composed primarily of species such as water sedge, Nebraska sedge, beaked sedge, and tufted hairgrass.

The sagebrush/grass communities are dominated by mountain big sage and silver sage. Grass species associated with the sagebrush type include slender wheatgrass, subalpine needlegrass, and sandberg bluegrass.

Conifer cover types in the area occur primarily on the upper sloping hillsides, typically on northern or eastern exposures. These sites are dominated by Englemann spruce and subalpine fir. Understory vegetation within these conifer stands varies in density and distribution, depending on canopy cover of the overstory. Representative understory species include gooseberry, arnica, butterweed, and lupine.

The aspen community is the most common forested type within the tract and is dominated by mature aspen in the overstory with snowberry, elderberry, Oregon grape, and butterweed making up the primary species in the understory.

Riparian communities occur within all vegetative types and are associated with stream and spring influence areas. The extent of these riparian communities varies from those areas adjacent to the stream channel to expanses of sub-irrigated acreage covering an entire drainage bottom. Hydrologic contributions to these riparian cover types includes direct stream flow, toe slope springs at the valley edges, springs and seeps, or a combination of surface and groundwater influences (see Water Resources Technical Report (NorWest 2000)).

Historic beaver activity in all drainages in the project area has had dramatic local influence on the extent and distribution of riparian vegetation. Some residual riparian communities exist that extend the total drainage width (20-60 feet) in the middle reaches of Boulger Creek. Forested riparian cover occurs along the lower ½ mile of the south fork of Boulger Creek in Section 4, in the middle reaches of Swens Canyon, and the upper reaches of Little Swens Canyon. These riparian communities are typically adjacent to the creek banks and vary in width from 2-10 feet on either side of stream channels.

Pothole type riparian communities also occur in otherwise upland cover types below the reservoir in Boulger Canyon. These small wetland areas appear to be dependent on subsurface flows originating on the adjacent upland slopes, and comprise valuable sagebrush/grassland associated riparian areas. The majority of acres of riparian associated communities in the area are found however within the meadow and grassland cover types in Boulger Canyon, Flat Canyon, lower Swens Canyon, and lower Little Swens Canyon drainages. Table 3.2 displays estimated acres of riparian community types within the Flat Canyon Tract.

Table 3.2. Estimated Acres of Riparian Community Types found in Flat Canyon Tract, Utah

DRAINAGE	FORESTED	MEADOW/GRASSLAND
Boulger Canyon	2.0 acres	13.0 acres
Flat Canyon	0 acres	9.0 acres
Swens Canyon	0.5 acres	2.0 acres
Little Swens Canyon	0.4 acres	1.0 acres
TOTAL	2.9 acres	25 acres

To a large extent, current distribution of vegetation has been influenced by historic human-caused disturbance. Grazing (primarily sheep) has occurred throughout the tract since at least the early 1900's and has in the past resulted in degraded streambank and riparian condition (USFS files). Since about the 1960s, reductions in grazing season length and intensity on area allotments has resulted in improved riparian condition (USFS files). Bank stabilization projects (e.g., willow plantings and organic rip rapping) have been implemented in Boulger, Swens, and Little Swens creeks with varying levels of success, though it is evident from field observation that recent bank stabilization has occurred in these drainages.

Level two (reconnaissance level) riparian inventories conducted in Boulger Creek in 1991, summarized fish habitat and bank conditions in mainstem Boulger Creek (Raleigh Consultants 1992). Field evaluations of riparian condition and fish habitat in Boulger, Flat Canyon, Swens, and Little Swens were also conducted in 2000. Current riparian condition throughout these drainages is generally considered good to excellent. Most reaches of all area streams have fully vegetated banks that are currently stable. Vegetative cover on most streambanks appears to be vigorous, with little evidence of recent perturbances, other than localized sloughing actions. Fish habitat condition assessments are summarized below in the Wildlife and Aquatics Resources sections.

Threatened, Endangered, Proposed, and Sensitive Plants

There are no known threatened, endangered, proposed, or sensitive plant species in the project area (personal communication with Bob Thompson, Range Conservationist, Manti-La Sal National Forest, Price, Utah). Therefore, there will not be further discussions of them in this document other than to explain that they were considered.

3.1.8 Wildlife

Terrestrial Wildlife

The tract contains habitat for numerous wildlife species common to southeastern Utah, including amphibians, big game, other mammals, and raptors. Species of particular concern relative to land management in the area are the goshawk, flammulated owl, and three-toed woodpecker, which have been designated as sensitive by the USFS, and for which habitat occurs in the area (USFS files).

An evaluation of U.S. Fish and Wildlife Service information indicates that the bald eagle (wintering populations only) is the only federally listed species with the potential to occur in the Upper Huntington drainage.

<u>Goshawk</u>

Goshawks breed in coniferous and mixed deciduous forests throughout much of North America (Reynolds et al. 1991) and have been documented as nesting in the area. Preferred habitat during the spring and summer breeding season is mature forests where the birds can maneuver in and below the canopy while foraging, and where large trees are available in which to build nests. In the Rocky Mountains, goshawks frequently nest in dense stands of mature lodgepole pine or aspen trees and in stands of mixed coniferous species (Jones 1979). Potential goshawk habitat occurs throughout the tract along upper slopes in all drainages. Of particular concern for this sensitive species is the avoidance of human disturbance (e.g., road building, mine vent construction) during the nesting and early post fledging periods (May through September), which could potentially cause nest failure.

<u>Flammulated Owl</u>

This small migratory forest owl is associated primarily with old growth and/or mature open growth stands of ponderosa pine, fir, or aspen. They are somewhat dependant for foraging habitat on a shrubby understory as they feed almost exclusively on small invertebrates (e.g., moths, beetles and grasshoppers) (DeGraaff, et. al. 1991). Nests are usually located in abandoned flicker or other woodpecker cavities in aspens, oaks, or pines.

Though no flammulated owls have been documented in the area, suitable habitat is present and they are suspected to occur in upper slope aspen and mixed forest habitats.

<u>Three-toed Woodpecker</u>

Three-toed woodpeckers primarily inhabit coniferous forests of the West, where they rely on wood boring and bark beetles associated with beetle and fire related ecology. They occur throughout the Rocky Mountains in mixed conifer stands, including Englemann spruce/sub alpine fir and lodgepole pines, similar to those found on north and east slopes in the area. In

Colorado, this species consumes spruce beetles for 65 percent of its annual diet and 99 percent of its winter diet (DeGraaff et al. 1991). This species is known to occur in the area.

Aquatic Resources

Upper Huntington Creek is the only disease free source of Yellowstone cutthroat trout in Utah (Canyon Fuels Company 1999). Boulger, Swens, and Little Swens Creeks are tributaries to Upper Huntington Creek and as such provide spawning habitat for cutthroat trout (Canyon Fuels Company 1999). Rainbow trout are also present in the system, and are stocked yearly in Boulger reservoir by the Utah Division of Wildlife Resources (UDWR). No other trout species of concern are known to inhabit the Upper Huntington Creek Watershed (Canyon Fuels Company 1999).

Boulger Creek

Boulger Canyon is characterized by open grass and sagebrush meadows and wetlands, a moderately entrenched stream channel, and relatively stable banks. Boulger Creek is a third order stream that flows approximately 4 miles west to east and drains into Electric Lake. Flat Canyon Creek enters Boulger Creek from the west approximately 1 mile upstream from the lake. Another tributary (South Fork) enters the channel from the south approximately 2.5 miles from the Lake. Boulger Reservoir is located between the two tributaries approximately 1 mile upstream from Electric Lake.

The lower reaches, from Electric Lake to Boulger Reservoir, total approximately 5,000 feet in length and have an average gradient of 2-3 percent. Channel types found in these lower reaches are C3 and B3 (Rosgen 1996). The stream is 8-10 feet wide and is dominated by riffle and run habitat (approximately 90%) with some lateral scour and small plunge pools (10%). Stream depth varies from 6 inches to 2 feet. Substrate in the lower gradient areas (1-2% gradient) is composed of approximately 50% cobble in the 6-24 inch class, is well armored, and appears stable. Gravel (15%) and sand/silt (35%) were also present in the substrate during the 1991 survey, and appear to be distributed slightly differently at present (approximately 30% gravel and 20% sand/silt). Banks are well vegetated and stable, though evidence of previous bank instability does occur. As indicated earlier, historic bank stabilization projects (e.g., willow plantings and organic rip rapping) have been implemented in this drainage. Cutthroat trout and sculpin were observed in these reaches.

While Raleigh Consultants (1992) reported excessive sediment in these reaches during their 1991 surveys, indications from this year's assessment are that instream sedimentation was light to moderate, though obviously, these data are difficult to compare due to variability in season of survey and yearly runoff conditions. Surveys conducted by the Utah Division of Wildlife Resources in 1986 (UDWR 1999) indicated that these reaches contained stable riparian zones, little or no erosion, 90-95% bank stability, good to excellent substrate (10-25% sand/silt), and poor bank shade (10-20%).

Boulger Creek above the reservoir contains four primary reaches for habitat comparison purposes. The first reach is approximately 1 mile long with an average gradient of about 1.5 percent. Riffle and run habitat dominates this reach, with pool habitat making up approximately 5 percent of its length. Stream depth is typically about 6 inches deep, though depth of some pools reaches up to two feet. The Rosgen channel type that typifies this reach is C3 with particle size in the substrate being dominated by 2-4 inch cobbles. Local sections in this stream reach contain varying amounts of cobble ranging from 6 to 12 inches in diameter. Overall stability of the channel is considered good. Undercut banks occur on approximately 90 percent of the reach and appear to provide good cover for fish observed there. Banks are predominately well vegetated with grass/sedge communities and are stable. Willow communities begin to occur along the stream approximately ½ mile up from Boulger Reservoir. Also in this area, evidence of historic bank stabilization activities, as discussed earlier, was found. Sediment was noted by the Raleigh (1992) survey, and was also evident, though not considered excessive, in slack water and pool areas during the 2000 assessment. Fish habitat surveys conducted by the Utah Division of Wildlife Resources in 1999 (UDWR 1999) indicate that from the reservoir to its headwaters, Boulger Creek contained good substrate (50-75% gravel/rubble/boulder, 25% sand/silt) and excellent cover (75-100%). Field observations in July 2000 showed an abundant population of cutthroat trout ranging from adult spawning trout to younger age classes (from field observations, R. Davies, pers. commun.).

The second reach above the reservoir begins at the creek's confluence with the southern tributary and is approximately 1,800 feet long. The gradient in this reach averages between 2 and 3 percent, though substrate composition varies considerably from 2-inch gravels to 12 inch and greater cobble/boulder material. Run and riffles make up approximately 60 percent of the habitat, with an increased representation of pools (approximately 40%) over the previous reach, apparently related to those areas with larger substrate (pool forming) material. The channel is typical of a B3 type (Rosgen 1996). Willow cover is prevalent in this reach as is evidence of historic and recent beaver activity. The stream is fed in this reach by several springs and seeps adjacent to the channel in the valley toe slopes. Several cutthroat trout were observed in this reach. Sedimentation was noted by Raleigh Consultants (1992), and was attributed (potentially) to inactive beaver dams. Moderate sedimentation was also noted during 2000 in the pools within the reach, though no obvious sedimentation was observed in riffles or runs. Sediment sources are likely from erosion, including stream fords, gullies in existing roads, and unauthorized ATV use observed in the upper reaches.

The third reach above the reservoir is approximately 2,000 feet long and consists of a meandering C3 (Rosgen 1996) channel, approximately 10 feet wide and 6 inches deep. Riffles and runs comprise approximately 80 percent of the habitat in the reach with pools (primarily lateral scour pools at meander bends) comprising the remaining 20 percent of the reach. The substrate is made up primarily (50%) of 6-12 inch cobble, with approximately 20 percent sand and silt, and 35% gravel. Undercut banks are evident, but not dominant. Banks and substrate appear stable. Sedimentation was noted as minor and appears to be related to bank sloughing at meander bends. Cutthroat trout on spawning redds were observed in this reach.

The stream channel in the fourth and final reach narrows and steepens to an average 6 percent gradient over approximately 5,000 feet. Rosgen channel types most typical of this stream segment are A2 or B2. These riffles make up nearly 90 percent of the habitat, with the remaining habitat comprised of small rock and boulder formed pools. Width is approximately 5 feet and depth ranges from 4 inches in the riffles to one foot deep in the pools. The substrate is dominated by large cobble (6 inches and greater), boulders, and bedrock. Sediment was not noted in this headwaters reach. Fish habitat appears limited due to shallow depth during most of the year, though use by fish during the early season is likely not limited.

South Fork Tributary

The lower reach of the south fork tributary is approximately 3,500 feet long. It is a A3 channel type (Rosgen 1996) with an average width of 3-5 feet and depth of less than one foot. Substrate composition in this reach is primarily large cobble (greater than 6 inches) and boulders. There is also abundant large woody debris present in the channel from the adjacent spruce/fir community. Habitat quality for fish in this reach is poor, due to small stream size and low flow.

The upper reach of this tributary is approximately 500 feet long and originates and flows through a flat, wet, meadow. The stream in this area is approximately 1 foot wide and less than a foot deep. The substrate is composed of fine sand and silt and fish habitat is rated as poor. The Rosgen classification for this reach is C5 or E5.

Flat Canyon Creek

Flat Canyon Creek is a small tributary flowing from west to east into Boulger Creek approximately ¼ mile downstream of Boulger Reservoir (Figure 3.3). The creek originates from springs near the western edge of the Tract and flows approximately 1 1/4miles before its confluence with Boulger Creek. In its upper reach (approximately ¾ mile long) it has a gradient of less than one percent as it meanders through a flat valley bottom (Rosgen E5). Average width of the stream is about ten feet, though the wetted width of the floodplain in the upper reach is approximately 100 feet or more. Substrate is dominated by silt and sand, and fisheries habitat value is considered low due to slow moving water and siltation in the stream. Fish habitat in this reach is dominated by run features.

The lower reach of Flat Canyon Creek is a relatively incised channel (Rosgen B3) (approximately three feet wide and 1,200 feet long) that is constrained by highway 264 on its northern bank. The average gradient in this reach is three percent, and habitat is primarily riffle dominated, with occasional pools (<5%) formed as a result of rock and boulder substrate. The substrate is composed of 4-12 inch cobble and boulders and appears well armored and stable. Several cutthroat trout were observed in this reach. Vegetation associated with this reach is primarily sedge communities, though willow clumps do occur. Banks are well vegetated and stable.

Swens Canyon

Swens Creek is a small third order tributary to Upper Huntington Creek that flows from west to east in the north central portion of the Tract. Reach one, beginning at the Highway 264 crossing, is a narrow (five feet wide) meandering channel with 75 percent undercut banks and multiple lateral scour pools at the meander bends. Habitat distribution in this stream is made up of approximately 80-90 percent runs and riffles and 10-20 percent pools. These pools range in depth from one to two feet. The reach length is approximately 4,000 feet.

The stream in this reach is incised approximately two feet below ground surface, and evidence of historic riparian degradation, perhaps due to grazing, and stream stabilization projects also occurs. The floodplain in this reach ranges up to 60 feet in width. Substrate consists primarily of 2-4 inch gravel and cobble with occasional areas of large (greater than 12 inch) boulders. The Rosgen channel type is C3 (Rosgen 1996).

A perennial tributary enters the main drainage from the south approximately 1,000 feet from the beginning of reach one. The tributary extends approximately ½ mile to the south and west and appears to lack any suitable fish habitat value due to its small size.

Immediately upstream of its confluence with this small tributary in reach two, historic beaver activity (dams, lodges) is evident. Fish habitat in this reach is similar to that described for reach one in that meanders are still prevalent in the channel, but willow vegetation on the banks is more dominant than below in reach 1. Substrate is dominated by slightly larger cobbles in the 4-6 inch diameter range. Reach two extends for approximately 3,000 feet to its confluence with a second tributary, which enters the drainage from the north. Tributary two is a perennial A type channel (Rosgen 1996), and it appears to be too small to support quality fish habitat.

Upstream from its confluence with tributary two, the channel in reach three (approximately 1,000 feet long) narrows and willow vegetation along the channel becomes dominant. Channel dimensions in reach three are approximately six feet wide and six inches deep. Substrate is dominated by boulder and bedrock in places, which has prevented the downcutting that has been observed in other streams in the area. Beaver activity is prevalent in reach three, as are cutthroat trout.

Reach four begins at a small, willow/conifer lined, perennial stream that enters the main channel from the south and extends approximately 2,500 feet. Reach four is a low gradient (two percent), slightly meandering channel. Average depth is approximately six inches, and substrate material is predominately small (2-4 inch) cobble. One large beaver pond occurs in the middle of the reach and adult cutthroat trout were observed in the pond.

Reach five begins approximately 1 ¼ mile up the stream in the northeast portion of Section 10 (Figure 3.3). This reach is a narrow A2 channel type (Rosgen 1996) that does not appear to support fish habitat as its substrate is composed of large glacial till material (three feet diameter).

The gradient is between 4 and 6 percent and bank vegetation is dominated by grasses and sedges. Several springs and seeps occur on the adjacent slopes in this reach.

Little Swens Canyon

Three reaches, approximately one mile in total length, were surveyed in Little Swens Creek. Evidence of historic beaver activity is common throughout this drainage. Reach one begins at the highway crossing and extends nearly ½ mile. It is a moderately incised channel (two feet), B3 channel type (Rosgen 1996) with a floodplain width of approximately 30 feet. Substrate consists of 2-4 inch gravel and cobble with 12 inch boulders commonly occurring. Fish habitat consists primarily of shallow (6 inches or less) riffle habitat; though boulder associated plunge pools were also observed. Bank vegetation is dense and overhanging banks are common. Cutthroat trout are present in this reach.

Reach two narrows slightly and becomes a boulder and bedrock dominated channel (B2 channel type). Willows are prevalent and historic beavers dams appear to have influenced the channel to a large degree. This reach extends approximately 1,000 feet. A four-foot high waterfall currently exists in the middle of the reach. The waterfall appears to have been formed by recent channel migration in the reach. No fish were observed above the waterfall.

Reach three is a very narrow A2 channel type that is dominated by large 6-24 inch boulders in the substrate, though bedrock substrate was also found in local areas within the reach. The average gradient is nearly 6 percent. Evidence of historic beaver dams also occurs in this reach. No fish were observed.

3.1.9 Range/Livestock Grazing

The Flat Canyon Tract includes portions of the Swens Canyon, Boulger Canyon, Eccles Canyon, and Bear Canyon Sheep and Goat Allotments. The allotments are used in conjunction with adjacent non-Federal lands. The allotments are managed under the deferred rotation system. Sheep are allowed to graze at different times during the summer season, depending on the place of each allotment for a given year in the rotation. The allotments combined support approximately 2,000 animal unit months (AUMs) per year. There are no range improvement facilities such as fences, stock ponds, or troughs in the project area.

3.1.10 Lands and Special-Uses

Questar Pipeline Company's Mainline #41 18-inch buried natural gas transmission pipeline lies underneath State Highway 264. During the summer of 2000 the pipeline was rerouted back to the original utility corridor approximately 1 mile to the east of the project area. The pipeline in the project area was abandoned and left in place. Since it is no longer in use, maintenance will be discontinued. Mainline #41 is maintained and operated as authorized by a Forest Service special-use permit. This pipeline transmits natural gas from sources in eastern Utah and western Colorado to Utah Valley.

Where private roads described in the transportation section cross National Forest System lands, they are operated and maintained under a private-road special-use permit or easements have been issued authorizing long-term use.

Electric Lake Dam and Reservoir were constructed in 1974 by Utah Power and Light Company (currently PacifiCorp) to provide water for the Huntington Canyon Coal-Fired Power Generation Plant in Huntington Canyon just below the Forest boundary. The dam is an earthen dam that impounds approximately 31,500 acre-feet of water in upper Huntington Creek. The reservoir encompasses approximately 400 acres. It is operated by PacifiCorp under a special-use permit issued by the Forest Service. Operation of the dam and water discharge is coordinated with the Forest Service, responsible agencies of the State of Utah, and local water users associations. Water monitoring above the reservoir, in the reservoir and below the reservoir in Huntington Creek is being conducted by PacifiCorp in accordance with requirements of the special-use permit.

3.1.11 Recreation

The Upper Huntington Creek/Flat Canyon area contains several stream fisheries, reservoirs, roads, and trails, developed recreation sites, cabins, a girl's camp, and boat ramp facilities at Electric Lake. The area is one of the highest recreation use areas on the Forest for both developed and dispersed recreation activities, including camping, hiking, boating, fishing, motorized sightseeing, hunting, snowmobiling, and cross-country skiing. The Recreation Opportunity Spectrum (ROS) classification for the tract area includes both Roaded Natural areas and Semi-Primitive Motorized areas. State Highway 264 has been designated as part of the Huntington and Eccles Canyons National Scenic Byway and is managed to provide motorized access and interpretation of natural resources and land management activities, including development of energy resources.

Recreation demand is increasing each year for the State of Utah and the project area. The State of Utah has projected that the State's population could grow to 3 million people by the year 2015. This translates to increased demand for recreation opportunities.

Developed recreation facilities on National Forest System lands include the Boulger Reservoir and Dam complex that supports dispersed camping and fishing opportunities. A spillway/fish ladder was constructed in 1997 to allow passage of Yellowstone cutthroat trout upstream from Upper Huntington Creek to the reservoir and perennial reaches of Boulger Creek above the reservoir. A hardened (gravel or aggregate surface) access road and parking area and a toilet have been constructed just east of the reservoir to support these activities. Dispersed campsites are located just south of the reservoir and parking area. The Forest has made a decision to do additional improvement work and to add the area to the Fee Demo profile currently in place.

Flat Canyon Campground is open to public use during the summer season and it closed during the winter months. It consists of an asphalt road with two loops. One loop accesses a group camping area and a second loop provides access to 12 individual campsites with parking spurs. The PAOT (People At One Time) capacity at the site is 110. The occupancy rate is the highest on the Manti Division of the Forest at about 30%. The use season is about 93 days, equating to about 3,000 Recreation Visitor Days (RVDs) per year. The water system is fed by a spring located on the west slope of Boulger Canyon. A retaining wall has been constructed to stabilize the unstable slope at the spring. Water is transmitted to a holding tank on a bench just above the campground by a buried pipeline. The water is then piped to seven individual pressurized faucets. The primary use is reserved group camping by organizations and families. The campground is concessionaire managed. Annual revenue to the concession permittee averages $4,000 per year. There is a host pad site with septic system at the campground from which the concessionaire operates the campground along with Gooseberry Campground and Gooseberry Reservoir Campground.

Private cabins in and adjacent to the project area are generally used for recreation throughout the year for all-season recreation opportunities, including hiking, fishing, hunting, recreational vehicle use, snowmobiling, x-country skiing. The four private cabins within the project area in Flat Canyon and the one in Swens Canyon are relatively modest log or timber frame structures supported on concrete strip or pad foundations. There are some other properties further along Flat Canyon and up Little Swens Canyon, but these are outside the area under consideration. The State Highway, Forest roads, and private roads used for access to these facilities are discussed in the Transportation section.

3.1.12 Visual Quality

The project area is located in a sparsely populated portion of Sanpete and Emery County. The topography is characterized by the broad U-shaped glacial canyons of Upper Huntington Canyon and it's tributaries. The valleys are bounded by rounded high vegetated ridges and slopes. The valley perimeters are typical of glaciated terrain, consisting of low rounded mounds and ridges (moraines) consisting of earth materials left behind by the retreating glaciers.

The area is more developed than most other areas of the Forest due to the recreational popularity of the area and private inholdings. Developments consist of State Highway 264, Forest and private roads in the tributaries, Electric Lake and Dam, Boulger Reservoir and associated dispersed recreation area, Flat Canyon Campground, as well as privately owned summer cabins and access roads. State Highway 264 has been designated as a Scenic Byway as part of the Huntington and Eccles Canyon Scenic Byway loop. Interpretation of land management activities and energy developments, including coal mining, is emphasized.

The portal facilities for the Skyline Mine lie approximately two miles to the east and northeast of the project area in Eccles Canyon. Even though underground mining has taken place under the east slope of Upper Huntington Canyon, there is no visible evidence of mining.

Landscapes within the project area are classified by the Forest Service by their scenic quality, sensitivity level, and the distance from which they are seen. Scenic quality is measured by describing landscapes as distinctive, common, or minimal. Sensitivity is categorized as low, moderate, or high. The sensitivity level of a particular view is determined by the viewing point, the number of viewers, and the duration of viewing. The viewing distances are further defined as foreground, middleground, and background. This classification system has been used to determine visual quality objectives (VQO) for landscapes within the project area. VQOs provide a standard for scenery management. Each VQO describes a different amount of acceptable change or alteration of the scenery.

The canyon bottom along Upper Huntington Creek and Flat Canyon, including State Highway 264, is classified as fg1A: foreground viewed, high sensitivity level, distinctive variety class. The western slopes of Upper Huntington Canyon in the northern portion of the coal lease tract are classified as mg1A: middleground viewed, high sensitivity level, distinctive variety class. The remaining areas are foreground and middleground viewed with lower sensitivity levels and variety classifications due to developments that dominate the landscape.

The visual quality within the majority of the tract and directly adjacent to the tract is designated in the Forest Plan as "Partial Retention". Upper Huntington Creek, the highway, Flat Canyon Campground, and Boulger Reservoir lie within the area classified as "Partial Retention". This VQO provides for management activities that are "visually subordinate" to the characteristic landscape.

The southwestern portion of the tract has areas designated as "modification". This VQO provides for management of activities that are "visually dominant" within the characteristic landscape.

The upper end of Electric Lake, east of the Flat Canyon Tract in the Skyline Mine Permit area, is designated as "Retention". This VQO provides for management activities that are not evident and must remain subordinate to the characteristic landscape.

No specific visual quality objectives have been designated for management of the Huntington and Eccles Canyons Scenic Byway (State Highway 264). The areas visible from scenic byways are managed for visual quality as designated in the Forest Plan. The Forest Service has not classified the adjacent private lands.

3.1.13 Transportation

The transportation study area affected by the project is bounded by State Route (SR) 264 on the south, Electric Lake and SR 264 on the east, Forest System Road 50225 to the north, and a combination of Forest System Road 50173 and a segment of SR 264 on the west. There are approximately 63 miles of road on the Forest and Private lands in the transportation study area; 7.3 miles of road are within the planimetric project area boundary. Road segments that are within 800 feet of the outer boundary are included in the study as having potential to be affected by the project from subsidence, based on an angle-of-draw of 22 degrees from vertical. There are approximately 9.6 miles of road that could be potentially affected by mining, considering those within the project boundary and those segments within 800 feet of the boundary.

The paved segments potentially affected are: SR 264 and Forest Road 50057; approximately 2.0 miles. The Forest Service aggregate-surfaced roads are 50056 (partial), 50057, 50230, 50222; approximately 1.0 mile , and 0.3 miles on private lands (continuation of roads 50222 and 50230. The remaining miles are native-surfaced roads including 50228, 53068, 53065, 53069, 50056 (partial), 53084 (5 miles), and 1.3 miles of private roads. The paved segments and those with aggregate (gravel) surfacing are double-lane roads. The native-surfaced roads are single-lane with turnouts.

State Highways

SR 264, a bituminous-surfaced double-lane highway, traverses the tract in a west-to-east direction, providing the main transportation access to the project area. It trends southeast through the project area to Electric Lake, then north to SR 96. It is part of the Huntington and Eccles Canyons Scenic Byway. Both highways are maintained by the Utah Department of Transportation. They are paved and are plowed in the winter, providing year-long access to Skyline Mine, private lands within the Forest, and general recreation areas from Sanpete Valley and Castle Valley. It is used extensively for mine related, private lands access, and recreation purposes. In 1998 average daily traffic was 440 vehicles per day, increasing by approximately 20 vehicles per day over each of the previous two years.

Forest System Roads

In general, these roads are maintained for Traffic Service Level D at operational and objective maintenance level 2 for existing forest uses. Roads in this maintenance level are typically low speed, single-lane with some spot surfacing. These roads provide for access by high clearance vehicles during the normal season of use. User comfort and convenience are not considered priorities for these roads (USDA-FS 1992). Some of the roads in the project area have been further improved as described below due to high use levels and are maintained for Traffic Level C and Objective Maintenance Level 3 where improved surfacing exists, such as at Boulger Reservoir, Flat Canyon Campground, and Camp Shalom. The major Forest Roads are described below. There are additional small segments that lie in the project area or within 800 feet of the outer project boundary.

Forest Road 50230 provides access to private lands in Little Swens Canyon from SR-264. It is an aggregate-surfaced road that provides access to the Camp Shalom. Numerous private roads provide access to buildings and structures at the camp.

Forest Road 50228 is a single-lane aggregate-surfaced road that provides access to private lands in Swens Canyon. Numerous private roads provide access to cabins.

Forest Road 50056 provides access to Boulger Reservoir and beyond to upper Boulger Canyon. It is gravel surfaced to the parking area and native surface from the parking area beyond Boulger Reservoir in Boulger Canyon. It is primarily used for recreation, including sightseeing, hunting, camping, and fishing.

Forest Road 50057 is a single-lane, paved, bituminous-surfaced road that provides access to Flat Canyon Campground and individual camping sites.

Forest Road 53084 is a single-lane native surface road from Skyline Drive (west of the project area) that provides access to the east along the ridge between Flat Canyon and Boulger Canyon.

Private Roads

There are numerous private roads on the adjacent private lands that provide access to privately owned cabins and facilities. Private roads that cross National Forest System lands are permitted under a special-use permit or easement.

At least two single-lane native surface private roads lead north and south from SR-264 in the Flat Canyon area, approximately 1 mile west of Flat Canyon Campground, that provide access to private cabins. The roads that lead south traverse Flat Canyon Creek and the associated riparian and wetlands in the floodplain. They lie entirely on private lands.

Forest Road 50230 that provides access into Little Swens Canyon and Camp Shalom becomes private at the boundary of the private lands. The road loops through the camp area with spurs that provide access to individual camp areas and facilities.

Forest Road 50222 is a single-lane aggregate-surfaced road that leads from SR 264 to the Electric Lake boat ramp. A portion of this road lies within 800 feet of the eastern boundary of the Tract.

3.1.14 Cultural and Historic Resources

Archaeological surveys for ten previous projects have been conducted within the project area and a Class I inventory has been completed for the leasing analysis (Hauck, 2000). Approximately 16% of the project area has been field inventoried, and additional reconnaissance has been conducted for this analysis. This inventory provides sufficient cultural resource data to assess the effects of the proposed leasing.

Inventories indicate that there are few prehistoric archaeological resources in the proposed area. Temporary camps, tool manufacturing evidence and occasional isolated artifacts such as projectile points or stone flakes have been recorded, suggesting that the area was used mainly for upper elevation hunting activities, from Paleo-Indian (10,000 B.C.) times through the Formative culture period (AD 1200) and probably on into the historical period by ethnographic Native American groups. Rock shelter formations that could have been used by prehistoric people are not expected in the project area.

Historical Euro-American resources in the proposal area are more numerous and include the remains of historical sawmill and dairy sites, cabins, roads and trails, and inscribed aspens.

3.1.15 Paleontological Resources

Paleontological resources of concern in the project area are limited to vertebrate animal species. Even though plant fossils and invertebrate animal species are present, they are not specifically identified for protection or as a concern.

Fossil Sites and Footprints

The potential for significant fossilized paleontological resources in the project area is generally limited to the Cretaceous Blackhawk and Price River Formations, and the Cretaceous-Tertiary North Horn Formation.

The coal seams in the Blackhawk Formation contain compressed vegetation with remnant imprints of the plant tissues, such as leaves and stems, and dinosaur footprints. Dinosaur footprints occur in the discontinuous lenticular sandstone and mudstone units that separate the coal seams. These lithologic units were deposited as paleostream channels flowed through the peat bogs and swamps where vegetation suitable for coal production accumulated. Footprints and tail drags were left in the swamps/bogs by passing dinosaurs, then the imprints were filled in by the sand, silt, and clay deposited by streams, forming casts or imprints. Rarely fossils of bone material are found in the coal, but they have little scientific value since only bone fragments are found because their structure was destroyed by the coal formation process and high-energy paleostream channel environments.

The upper Price River Formation and lower North Horn Formations contain extensive fossils of late Cretaceous vegetation and animals, including dinosaurs. The upper North Horn Formation contains early Tertiary mammal fossils. The Price River Formation crops out on the upper slopes of the canyons and ridge tops in the project area covered by thick deposits of soil and talus materials. The North Horn Formation forms isolated caps on the ridges in the project area. No significant sites have been identified in the project area to date.

Pleistocene Mammals

Deep glacial deposits in the form of moraines are extensive in the canyons in the project area. In other similar areas of the Forest, skeletons and individual bones of Pleistocene mammals have been found buried in the lowland depressions in the canyon bottoms buried by glacial deposits. A Colombian mammoth skeleton and short-faced bear skull were discovered beneath glacial materials in Spring Creek, a glaciated tributary of Huntington Creek in 1988. It is probable that Pleistocene mammal remains occur within the canyon bottoms and floodplains in the project area adjacent to the stream channels below the glacial materials. No discoveries have been made in the project area to date.

Pleistocene mastodon, horse, camel, and bison fossils/bones have also been found on the Forest and could occur within the project area.

3.1.16 Socio-Economics

The proposed action involves potential leasing of the Flat Canyon Coal Lease Tract on National Forest System lands with Federal coal. It also involves the potential for mining of the adjacent non-Federal coal reserves on non-Federal lands in private ownership.

The area of analysis for socio-economics and coal recoverability encompasses the immediate vicinity of the project area, portions of Carbon, Emery, Salt Lake, Sanpete, Sevier, and Utah Counties considering the locations of direct employment, production, and support services such as materials supply, trucking, and maintenance.

Canyon Fuel Company, LLC employs 220 people at the Skyline Mine. These employees reside in the following Counties by percent:

Sanpete County	51.36%
Carbon County	31.36%
Utah County	12.73%
Emery County	3.18%
Salt Lake County	0.91%
Sevier County	0.45%

In 1999 approximately 26.5 million tons of coal were produced from Utah coal mines. Mining from Federal coal leases on the Wasatch Plateau Coal field within the Manti-La Sal National Forest totaled approximately 21.7 million tons. This accounts for approximately 82 percent of the State's total production. In 1999 1,843 people were employed at Utah coal mines. The Utah Office of Energy and Resource Planning projected direct employment in the year 2000 at 1,748. The Skyline Mine accounts for approximately 12 percent of the total direct employment of Utah coal mines. These figures do not account for employment by Utah coal mine support services such as supply, repair/maintenance, and trucking.

Coal mining and related support services are the largest employers and the largest industry in Carbon and Emery Counties. Coal mining is of less economic importance in the other counties but still provides important jobs and employment opportunities.

At a mine-mouth value (does not include shipping) of approximately $17.00 per ton, the value of the estimated 36 million tons of recoverable reserves in the project area would be $612 million. At a mining rate of approximately 5 million tons per year, the annual value of the coal produced is $80 million.

Under current State and Federal laws, 50 percent of the mining royalties go to the Federal government. The other 50 percent goes into the State Mineral Lease Account and is allocated as follows:

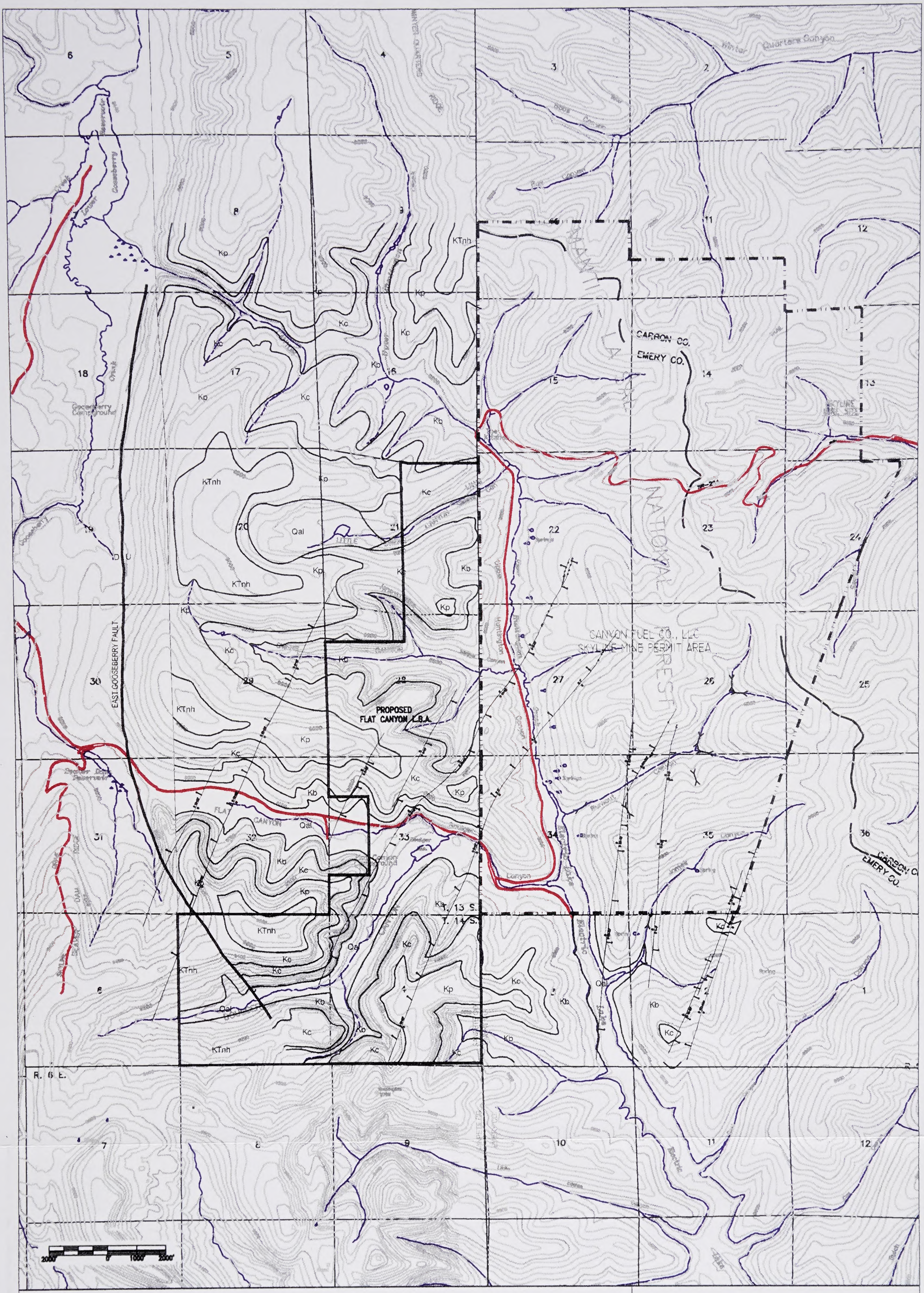
32.50 percent	Community Impact Fund
33.50 percent	Board of Regents to divide among higher education facilities
2.25 percent	State Board of Education
2.25 percent	Utah Geological Survey
2.25 percent	Utah State University Water Research Lab
25.00 percent	UDOT (Utah Department of Transportation) for distribution to special service districts in the county for construction/repair/maintenance of roads

Royalties, energy production, employment, and taxes related to development of Federal coal reserves benefit the Federal, State, and local economies.

Royalties paid to the private coal estate owners on adjacent lands would be subject to negotiations between the coal owners and the mine operator. The amount paid to surface land owners for remediation of potential effects to surface resources is also subject to negotiations between the surface estate owners and the coal operator. Compensation for damages to surface resources and structures is required under Utah State law. It is not possible to estimate the amounts at this time. The coal mined from the non-Federal lands would also contribute to the life of the mine and associated benefits of extended employment. The coal would be made available for energy production and royalties would be considered taxable income, further benefiting the Federal, State, and local economies.

Total direct coal mine employment has been on a downward trend since 1997, decreasing from 2,091 to 1,843 in 1999 (Utah Office of Energy & Resource Planning, July 2000). Two local mines closed during 2000 and 2001 and 4 additional mines are projected to close by 2003. It is also possible that one new mine could open and for an existing mine to reopen. Approximately 300 direct mining jobs and an unknown number of mine support jobs could be lost. This is having a significant economic impact to the Carbon and Emery County areas and to a lesser degree to Sanpete, Utah, Salt Lake, and Sevier Counties.

Due to the mine closures discussed above, Utah coal production and royalties received are on a downward trend and will decrease markedly over the next 5 years, decreasing revenue to the Federal, State, and local governments.



LEGEND

FLAT CANYON COAL LEASE TRACT	
RFDS AREA	
SKYLINE MINE PERMIT AREA	
GEOLOGIC UNITS	
FAULTS	
Qal	QUATERNARY ALLUVIUM
KTnh	NORTH HORN FORMATION
Kp	PRICE RIVER FORMATION
Kc	CASTLEGATE SANDSTONE
Kb	BLACKHAWK FORMATION

(After Knowles, 1996 and Doelling, 1980)

FIGURE 3.1

GEOLOGY MAP

FILE: HYDRO1-2.DWG
DATE: 9/11/2000
SCALE 1" = 3200'

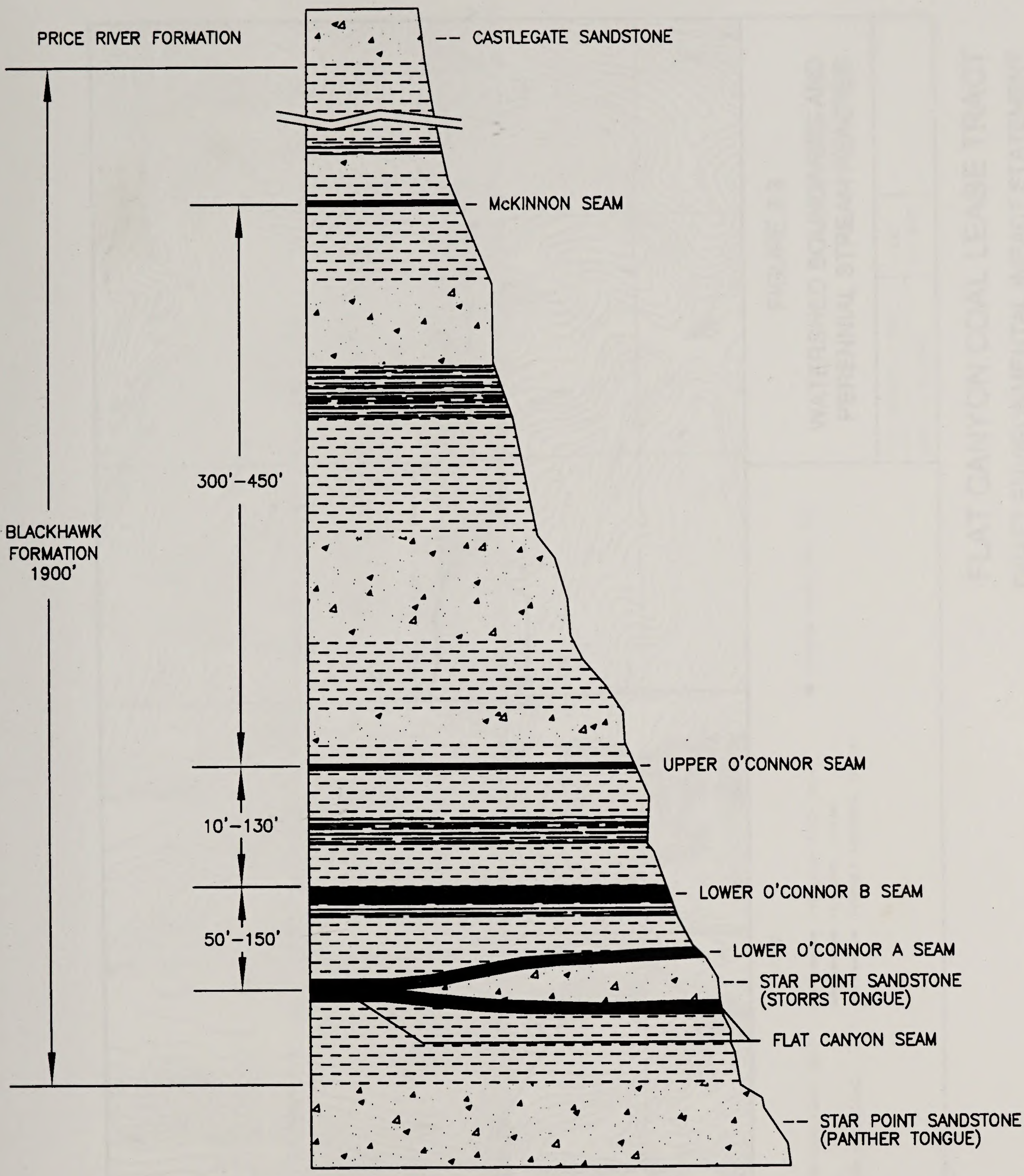


FIGURE 3.2

GENERALIZED COLUMNAR SECTION
FLAT CANYON TRACT AREA

DATE: 8/30/2000

DWG: HYDRO3–4.DWG

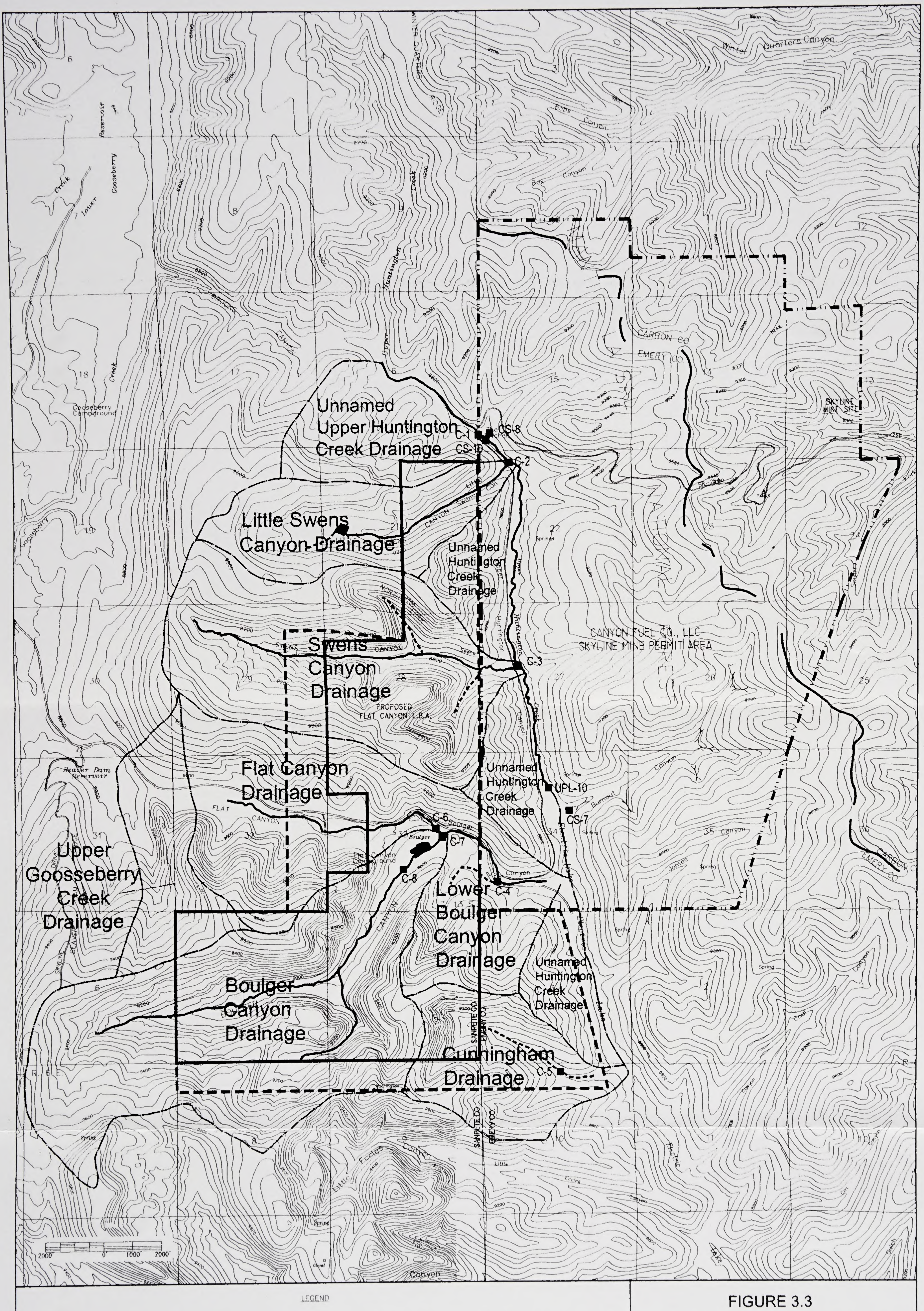


FIGURE 3.3

WATERSHED BOUNDARIES AND PERENNIAL STREAM REACHES

FILE: HYDRO1-2.DWG
DATE: 8/30/2000
SCALE 1" = 3200'

FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

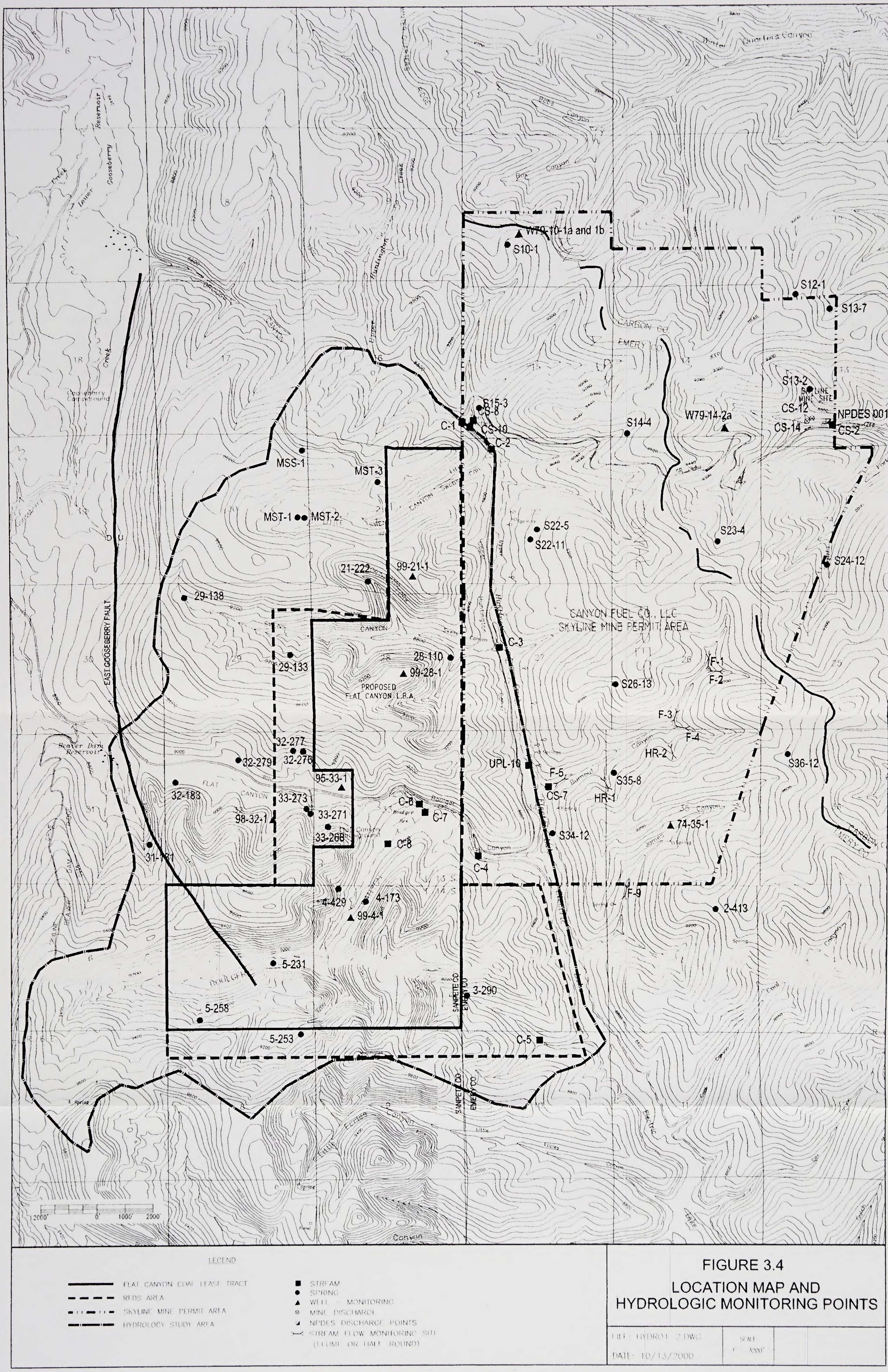


FIGURE 3.4
LOCATION MAP AND
HYDROLOGIC MONITORING POINTS

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

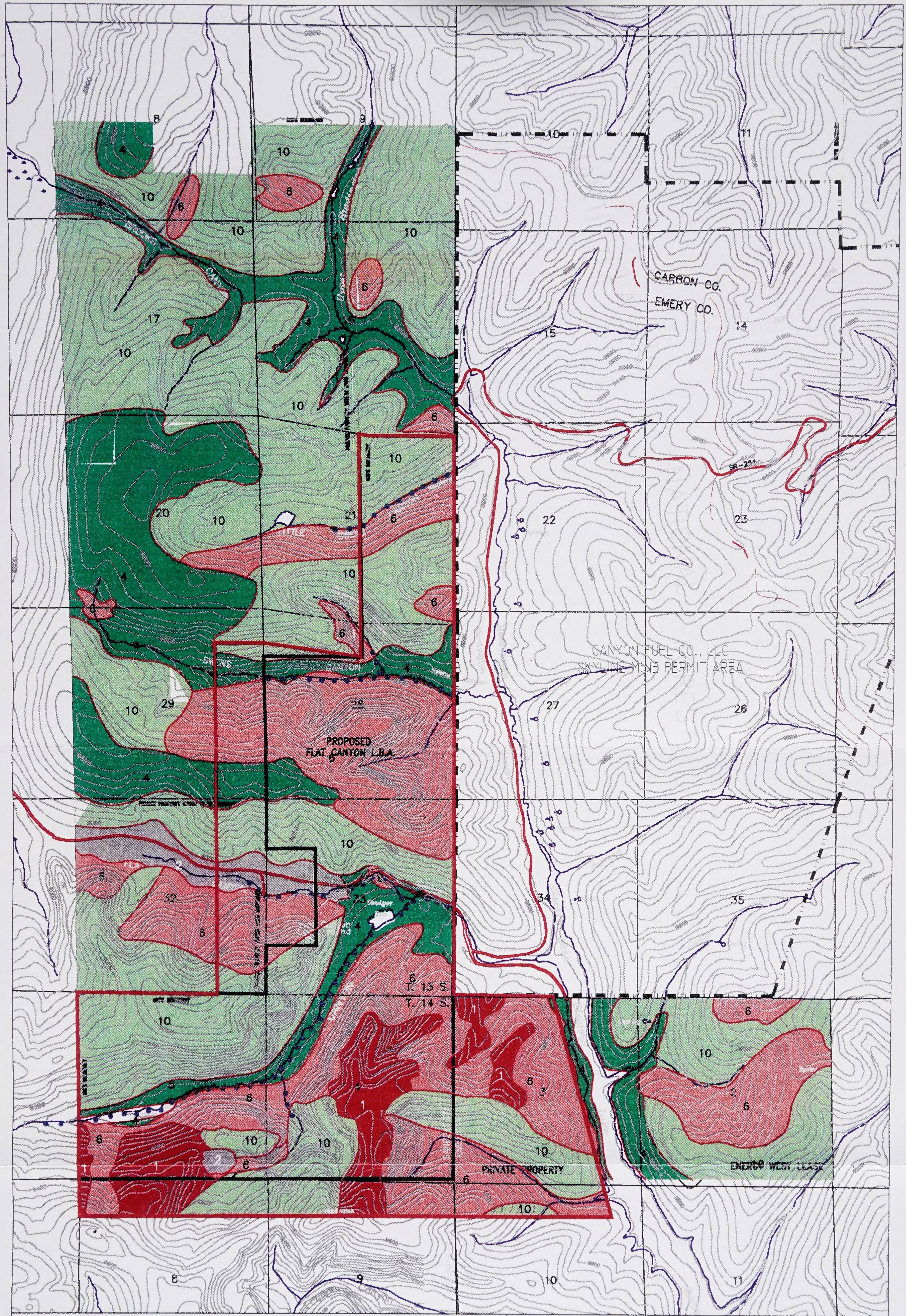


FIGURE 3.5

VEGETATIVE TYPES

DWG: VW3-1.DWG

DATE: 10/18/2000

SCALE 1" = 2640'

FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

4.0 EFFECTS OF IMPLEMENTATION

This chapter presents a description of the effects of implementing the No Action, Proposed Action, and other identified alternatives on the current human and natural environment likely to be affected. The effects are discussed by issue under functional areas or resource categories for each alternative as compared to current conditions. The subheadings are the same as those presented for the affected environment in Chapters 2 and 3. Direct, indirect, and cumulative effects are included.

The issues are evaluated by the evaluation criteria identified in the individual issue statements found in Chapter 2.

4.1 EFFECTS OF IMPLEMENTATION

The effects of mining would involve surface disturbance related to the construction and operation of exploration drill holes, two ventilation holes, the associated access roads, and surface subsidence caused by extraction of the underground coal seams. If leased, the life of the Skyline Mine would be increased by as much as 12 years, extending the effects of the existing mining operation by approximately the same length of time.

4.1.1 Mining/Coal Reserves

Under each alternative a different amount of the in-place mineable coal could be recovered by underground mining. The amount of coal that could actually be mined is called "recoverable coal", measured in million tons. The amount of recoverable coal is dependant on the mine layout, type of mining conducted, and local geology/structure. Faults are known to occur within the project area but it is not known if there is sufficient offset to prevent mining through them. For the purposes of this analysis, it is assumed that they would not inhibit mining. The differences in coal recoverability for the action alternatives discussed below are therefore caused by differences in the mine layout/method needed to prevent subsidence of specific surface resources.

4.1.1.1 Alternative A (No Action)

Under this alternative the Flat Canyon Tract would not be leased, therefore no coal would be recovered from the delineated tract area or the private lands with non-Federal coal reserves directly along the western and southern boundaries of the tract. If the tract were not leased, access to these reserves would not be provided. Even if an underground right-of-way were granted through the tract area solely for the purpose of accessing the private reserves, it would probably not be economical to drive access tunnels or mains through the tract (a distance of approximately one mile) to mine the small amount of recoverable private coal reserves by the room-and-pillar method. It could be possible to mine the private lands in the project area, but this would be a relatively small amount of coal.

Without the addition of the Flat Canyon Tract, Canyon Fuel projects closure of the mine around the year 2003. If other available reserves in Federal Coal Lease (U-67939) that lie along the northern boundary of the existing permit area are mined, the mine life could be extended another 6 to 8 years.

Cumulative Effects

If the Tract is not leased and mined, mining would not occur on the adjacent private lands. In addition, it is possible that Canyon Fuel would close the mine in 2003. It is also possible that coal reserves in Federal Coal Lease U-67939 would be mined, extending the mine life an additional 6-8 years.

Irreversible/Irretrievable Commitment of Resources

The recoverable coal reserves in the Flat Canyon Tract and adjacent private lands could be irreversibly and irretrievably lost.

Short-Term Use vs. Long-Term Productivity

If the recoverable coal reserves in the project area are not mined in conjunction with the Skyline Mine as proposed, the long-term coal productivity related to the estimated additional years of mine production discussed under Alternatives B and C would not occur.

4.1.1.2 Alternatives B and B'

Under this alternative underground mining would occur to maximize coal recovery and mining efficiency without specific measures for the protection of surface resources from the effects of subsidence. The project area would be accessed from the Skyline Mine Permit Area by driving full-support (no subsidence) mains westward under Upper Huntington Creek (near perpendicular crossing) and then southward paralleling Upper Huntington Creek under west flank of the drainage. Figures 1.2, 4.1, and 4.2 show the general locations of the mains. The mains would provide access for setting up development workings in preparation of longwall and room-and-pillar recovery areas (See Section 1.6 Reasonably Foreseeable Development Scenario). The majority of the coal would be mined by the longwall method with some fringe areas being mined by room-and-pillar recovery methods. Mining could take place in two overlapping seams in the majority of the tract, but there are some areas where only one of the seams could be mined. The Lower O'Connor Seam (upper seam) would be mined first. The Flat Canyon Seam (lower seam) would be mined after the upper seam is mostly mined out. Figure 4.1 (Upper Seam Mining Scenario, Alternative B) shows the probable longwall and room-and-pillar mining areas in the Lower O'Connor Seam. Figure 4.2 (Lower Seam Mining Scenario, Alternative B) show probable longwall and room-and-pillar mining areas in the underlying Flat Canyon Seam. Longwall panels would most likely be oriented in a general east-west direction, but could possibly be oriented in a north-south direction. The recoverable coal reserves are estimated to be approximately 36 million tons. It is estimated that the life of the Skyline Mine could be increased by 9 to 12 years at a production rate of 3 to 4 million tons per year.

Cumulative Effects

Production of coal from the project area is estimated at 36 million tons.

Irreversible/Irretrievable Commitment of Resources

The energy fuels and materials expended in the mine process would be irreversibly and irretrievably consumed. Since coal is a nonrenewable resource, the coal reserves mined and consumed would represent an irreversible commitment of this resource. Coal left in place for roof support and safety reasons would be irreversibly lost under the current capabilities of mining. BLM estimates that 50% of the estimated 72 million tons in-place mineable coal could be recovered. This is based on a conservative estimate of the capabilities of longwall mining with current technology. This means that 36 million tons could be mined and an equal amount would be unmined and lost to future production, under current technology.

Short-Term Use vs. Long-Term Productivity

Long-term productivity of available coal resources would be 9 to 12 years for the Flat Canyon Tract project area.

4.1.1.3 Alternative C

Under this alternative, the mine plan presented under Alternative B would be modified to prevent subsidence of specific surface resources. The perennial drainages, Boulger Dam, Flat Canyon Campground, and SR-264, would be protected from subsidence using a 23 to 30 degree angle-of-draw to determine the protection areas. Generally, this would separate the project area into three distinct zones of full-extraction mining. Full-support mains could cross under the perennial drainages providing access to the full-extraction blocks. Figure 4.3 shows the mining scenario for the upper Lower O'Connor Seam (Upper Mining Scenario, Alternative C). Figure 4.4 shows the mining scenario for the lower Flat Canyon Seam (Lower Seam Mining Scenario, Alternative C).

This would reduce the mineable area and recoverable reserves about 50%. The recoverable reserves would be reduced to approximately 18 to 20 million tons. The life of the Skyline Mine would be extended by 5 to 7 years.

Cumulative Effects

The mining of underground coal reserves depends on the geologic, geotechnical, and economic factors associated with the extraction of the coal. If extensive acreage is blocked from full-extraction due to surface resource protection, the operating cost associated with the extensive development required to extract each longwall panel could lower overall mine efficiency and coal recovery (BLM, 1999). This decreased ratio of coal mined during longwall mining to that coal mined for development (LDR-Longwall Development Ratio) could make the overall productivity marginal.

Not allowing full-extraction under surface features considered in these alternatives divides the mining blocks into essentially three irregular areas or regions (Figures 4.3 and 4.4). If the longwall panels were to be set up perpendicular, or near perpendicular, to the main-entry corridor, much of the coal in the smaller areas may not contain enough extractable coal to be considered a reserve. The northernmost area is probably too small by itself at the present time for longwall extraction. The middle or second block is less than the average panel length in the United States of 8,907 feet (Coal Age Magazine, 2001) for viable longwall coal extraction and most of the panels would be less than the average panel lengths in Utah mines of 6,140 feet (Coal Age Magazine, 2001). There could be many tons of coal lost due to the short panel lengths. Longer longwall panels that would intersect protected areas to the south cannot be considered because the non-mining areas are too large to consider moving around. The third (southern) block could probably be developed through longwall mining. However, if the northern and middle blocks are not viable for longwall mining, the distance necessary to access this block could be too great for it to be considered a reserve. Other longwall panel orientations or additional development from the main corridor needed to access the coal may require considerable development for panels and could affect the minability.

Canyon Fuel has detected several faults in the area through geophysical exploration. Existence of these faults has not been confirmed. The panels in the middle block are less than the average panel length and any other features, such as faults, could negate the potential minability. This is because the longwall panels may be too short to be viable. Because of the complexity of operational, economic, and geotechnical issues influencing coal recovery, the smaller irregular, nonperpendicular structural conditions and boundaries imposed by not allowing full-extraction, in addition to geologic and geotechnical factors, may affect minability of the coal. If the company feels that the risk is too high, the coal may not be mined and could be bypassed

Irreversible/Irretrievable Commitment of Resources

The energy fuels and materials expended in the mine process would be irreversibly and irretrievably consumed. Since coal is a nonrenewable resource, the coal reserves mined and consumed would represent an irreversible commitment of this resource. The total amount of coal that could be mined from the project area could be reduced from 36 million tons to 18-20 tons. This means that an additional 16 to 18 million tons would be left underground as compared to Alternative B.

Short-Term Use vs. Long-Term Productivity

Long-term productivity of available coal resources would be 5 to 7 years for the Flat Canyon Tract project area.

4.1.2 Topography/Physiography, Geology (Includes Direct Surface Disturbance, Subsidence, and Seismicity)

This section describes the effects of disturbance for surface facilities, subsidence, and seismicity on the geology and topography of the project area. It is separated by subheadings for each of these categories.

4.1.2.1 Alternative A (No Action)

Disturbance from Surface Facilities

Under this alternative the lease would not be issued and there would be no surface disturbance associated with surface facilities that could cause effects to other resources.

Subsidence

Under this alternative the lease would not be offered or issued and no underground mining would occur. There would be no subsidence or related effects.

Seismicity

Under this alternative, the lease would not be issued and there would be no mining that would cause subsidence in the project area or any related mining-induced seismic events. The project area would continue to experience seismic events from mining currently being conducted in the Skyline Mine permit area to the east. The University of Utah earthquake catalog has been used to evaluate the seismic activity in the area, with emphasis on mining-induced seismicity. A total of 1,013 events with magnitudes greater than 2 (Richter) were recorded within a range of several miles from the Skyline Mine workings. The frequency of events is much greater at the lower magnitude levels and decreases as magnitude increases. The fifty events with the highest magnitudes have been plotted in the cumulative frequency plot against magnitude presented in Figure 4.5. All of the events were recorded from 1993 to 1996 when Utah Fuel was extracting coal from the deeper sections of Mine No. 3.

Events of magnitude 2 or greater can be felt by humans for a distance of 3400 feet from the location of location of origin (epicenter). Except for a 3.45 magnitude event that occurred in 1996, neither the Forest Service nor Canyon Fuel has received inquiries or complaints from the public or private landowners regarding these events. It is assumed that, even though these events could have been felt by people in the area, they were not noticed or did not cause concern from those within the area.

4.1.2.2 Alternatives B and B'

Disturbance from Surface Facilities

It is estimated that about ten exploration drill holes would be required. The drill pads and temporary access roads would be short-term. Construction of the pads and access roads and drilling would take place for each hole in a single summer season, then would be reclaimed the same year in the fall. It would take approximately 3-5 years to meet revegetation standards. The temporary disturbance for access roads would be about 4.6 acres and about 4.6 acres for the drill pads. The total disturbance would be about 9.2 acres.

Ventilation shafts would not be constructed until underground mining progressed to each location and additional ventilation was required for safe operations. The general area proposed for location of these shafts is shown in Figure 4.1. The construction footprint for each ventilation shaft would be approximately one acre and about 1,000 feet of access road would be required, giving a total of about 2.9 acres. Crossing of Swens Canyon Creek would be required using a bridge to prevent disturbance of the stream channel. The roads would be reclaimed after one season of use. Most of the pad area would also be reclaimed, leaving just the vent shaft and fenced area 6-8 foot high chain link) for the life of the mine. These areas would be disturbed for the majority of the mine life and then they would be plugged and reclaimed.

The total new surface disturbance for the Tract would be about 12 acres with this divided into about 5.5 acres for access roads and 6.6 acres for drill pads and ventilation shafts. This disturbance is related to predicted surface facilities only and does not include subsidence resulting from underground mining.

The effects to other resources are discussed based on the issues identified in Chapter 2 and the evaluation criteria identified for each issue.

Subsidence

As underground mining occurs the coal is removed leaving a void. Due to the weight of the overlying rock and the resulting downward pressures, the rock immediately above the void is rubbleized and caves into the void. The rock strata above the caved and rubbleized zone also reacts to the loss of support and the weight of the overlying rock until equilibrium is reached. This results in downward and lateral movement of the rock and fracturing in three distinct zones above the mine void. If an area of coal removed is sufficient in size to cause the entire column of rock above to move downward before equilibrium is reached, subsidence of the ground surface will occur. Rock strata failure/subsidence is a complicated process. The amount of subsidence and disruption of the ground surface is dependent upon rock strength, discontinuities, stress, thickness of the overburden (depth of the coal seam), topography of the ground surface, mining method and orientation of mine workings, as well as the area, thickness, and number of overlying seams extracted. A detailed description of the subsidence process based on longwall mining is included in Appendix D.

The amount and location of subsidence and the amount and type of associated surface disturbance expected is based on subsidence models that were locally adjusted using subsidence monitoring information from the adjacent Skyline Mine Permit area. Since the topography and geological conditions in the project area are generally the same and the mining method and general configurations of mine workings are similar, the subsidence predictions should be very accurate. There could however be variations based on differences between the mine layout used in the Reasonably Foreseeable Development Scenario and actual mining as conducted by a future lessee/operator. For this reason, the mine layout used for the analysis presents a maximum reasonable subsidence/surface disturbance type scenario for predictions and effects analyses. The subsidence predictions were conducted by NorWest Mine Services, Inc. under the direction of the Bureau of Land Management and Forest Service. The shallowest overburden above the upper seam is 700 feet in Huntington Canyon at the southernmost portion of the project area.

Maximum subsidence (S_{max}) of 10 to 13 feet would occur at the center of longwall panels or blocks of panels where both mineable seams are extracted. From the edge of the panels, the amount of subsidence decreases laterally away from the center of the subsidence profile to 0, defining the edge of the profile. The subsided ground surface area extends beyond the vertical projection of the underground panel edge location to the ground surface, a horizontal distance determined by geological conditions and overburden thickness. The angle-of-draw defined as the angle between the vertical projection of the panel edge to the surface and the inclined projection from the panel edge to the point on the surface where subsidence decreases to zero. The angle-of-draw, determined from monitoring of subsidence at the Skyline Mine to the east, was determined to be approximately 22 degrees. The angle-of-draw is relatively constant over large mining areas with consistent geologic conditions, unless disrupted by major faults. This angle was used to predict the subsidence area for the analysis or project area.

Horizontal compression and tension zones occur at the ground surface due to the vertical ground movement from subsidence. It is these forces that tend to cause lateral ground movement and fractures in addition to the elevation changes. Tension zones form at the ground surface in the area between the vertical projection of the panel edges and the flanks of the subsidence troughs in the area defined by the angle-of-draw. This is caused by the subsiding land surface pulling away from the adjacent unaffected ground as vertical movement takes place. It is here that tension cracks are most common. Compressional forces occur at the ground surface in the area at the center of the subsidence troughs where the land is squeezed together as it moves downward during subsidence. As mining in individual rectangular longwall panels progresses, the subsidence trough develops within days behind advance of the mine face. This results in transient (moving) tensional strain that becomes a compression zone after the panel is completed. In other words, the surface is temporarily pulled apart as mining progresses then is squeezed back together after mining is completed. These forces occur in each panel and only become permanent after mining of a panel block, consisting of several parallel panels, is completed. The majority of the final subsidence movement occurs rapidly as mining advances then tapers off to smaller amounts of movement that can occur for up to two-years following completion of mining. Room-and-pillar recovery mining sections experience subsidence in a similar manner but the subsidence can take a longer time to be complete and there can be more surface disruption and cracking because of the effect of differential settlement above individual pillars.

Where mains (see Appendix D for a description of mains) are driven for access to the mining areas, entry widths and pillars are designed to provide sufficient support of the overlying rock to prevent subsidence in the short or long-term (200 years) with a safety factor of 1.74. Even though pillar failure over centuries is unlikely, the effects of pillar failure have been analyzed. In the unlikely event that pillars fail over time, failure of the pillars would occur over a long time span, resulting in very slow, gradual subsidence. Within the outer edge of the mains, only 40% of the coal would be mined. The maximum amount of subsidence that could occur over one seam is less than 2 feet and less than 5 feet for two overlapping seams.

Under this alternative, no special lease stipulations would be added to the lease to protect sensitive resource areas from subsidence. The lease would be offered by BLM with the standard terms and conditions included on Lease Form 3400-1 only. It represents a scenario where the mine plan would be developed to maximize recovery of the coal resource. The majority of the Tract and project area would be subsided from longwall mining with a high proportion of the area subjected to multiple-seam mining. This mining scenario is depicted on Figures 4.1(upper seam) and 4.2 (lower seam). The related subsidence zones are depicted in Figure 4.6.

The exact amount of subsidence and disruption of the ground surface at any particular location would be dependent on a specific detailed mine plan and extraction sequence. However, the degree of subsidence expected from different aspects of the mine layout is discussed below in relation to the mining layout features below:

- panels (above the center of panels);
- single abutment pillar (above the edge of solid coal pillars);
- stacked abutment pillars (above the edge of coal pillars aligned in two seams);
- single fire barrier pillar (a fire barrier pillar is in one seam only);
- stacked fire barrier pillars (fire barrier pillars are aligned in two seams);
- gate roads (where gate road pillars are left between panels); and
- longwall face (dynamic effect at center of panels during retreat).

The manner in which subsidence occurs and the location of pillars left underground defines the range of temporary and permanent subsidence impacts to be expected. Particular zones where permanent subsidence might lead to a higher impact are related to areas of higher differential subsidence above fire barrier pillars and abutment pillar zones. Where these pillars are stacked above each other in multiple seam cases the degree of differential subsidence is much greater. The location of fire barriers cannot be reliably predicted without a specific mine plan, but the location of the major abutment zones can be reasonably estimated from the mining scenarios evaluated. The variation of subsidence and the relative degree of effect in relation to the Skyline subsidence is presented for different mining layout features are discussed below in relative terms and shown on Figure 4.6.

The qualitative descriptors used to define the degree of differential subsidence are defined below in relation to typical conditions experienced at Skyline. They should not be regarded as quantitative and have been developed based upon relating observations at Skyline to expected subsidence from the mine layout.

Very Low: This generally applies to most of the areas between panels (above gate roads) and dynamic subsidence as the longwall face retreats at greater depth. A gentle flexure of the strata is expected with no major tension cracking and induced surface gradient changes less than about 0.4%.

Low: This generally applies to some single abutment and fire barrier pillars at greater depth and above some gate roads and dynamic subsidence areas at shallower depth. Flexure of the strata is expected with a low potential for tension fractures to occur and induced surface gradient changes of about 0.4 to 0.8%.

Moderate: This generally applies to single abutment pillars at shallower depth, single fire barrier pillars at depth and stacked abutment pillars at depth. Generally flexure of the strata is expected with a low to moderate potential for some minor tension fractures to occur at ridges with low lateral constraint. Induced surface gradient changes of about 0.8 to 1.5% are expected.

High: This generally applies to stacked abutment pillars at shallower depths and stacked fire barriers at depth. Flexure of the strata has a moderate potential for tension fractures to form at ridges or steeper slopes with reduced lateral constraint. Induced surface gradient changes of about 1.5 to 2.5% are expected.

Very High: This only applies to stacked fire barrier pillars at shallow depths. Major flexure of the strata has a high potential to create major zones of tension fractures in areas with reduced lateral constraint. Induced surface gradient changes of over 2.5% would be expected.

For the purpose of analysis, a total of nine representative subsidence prediction points have been used for the evaluation of impacts to the most sensitive (most vulnerable to effects of subsidence) locations of the project area that includes structures, facilities and resources and their locations are presented in Figure 4.7. The main resources, structures and facilities that have been evaluated for impact from mining induced subsidence are listed below together with their description and reference to the numbered prediction points used to characterize the degree of subsidence.

Boulger Dam & Reservoir

This is an earthen dam and associated reservoir located at the mouth of Boulger Canyon near its confluence with Flat Canyon. The reservoir is below and adjoining the Flat Canyon Campground and provides recreational amenities. Characterization for this structure is covered by Subsidence Point No. 6.

State Highway 264

This is a paved, all-weather highway passing through the project area following the valley floors of the Upper Huntington Creek, Boulger Canyon, and Flat Canyon. Characterization of this structure in Flat Canyon is covered by Subsidence Point No.5 and in Boulger Canyon by Point No.6. Where it runs alongside the west side of the Upper Huntington Creek valley floor it is protected from subsidence by restrictions on longwall mining below this important drainage.

Flat Canyon Campground & Facilities

The Flat Canyon Campground facility consists of camping areas with associated freshwater and toilet facilities. Freshwater is provided by a spring collection system located on the west side of Boulger Canyon with the water fed to the campground through a buried pipeline and storage tank near the campground. Characterization of these facilities is covered by Subsidence Point No.8 for the spring collection system and No.5 and No.6 for the Campground.

Private Cabins & Buildings

Within the area influenced by mining there are a number of privately owned cabins in Flat Canyon and Swens Canyon. Characterization of the four cabins in Flat Canyon is covered by Subsidence Point No. 5 and the one cabin in Swens Canyon is covered by Point No. 3.

Upper Huntington Creek Perennial Drainage

This drainage system is defined as the perimeter of the Upper Huntington Creek valley alluvium. No longwall mining that would subside this area is planned for the Tract area, but it is likely that a main development corridor would be required running parallel and under the creek at depths from 700 to 1000 feet.

Flat Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Flat Canyon valley alluvium. Characterization of this canyon is covered by Subsidence Points No. 5 and No. 6.

Boulger Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Boulger Canyon valley alluvium. Characterization of this Canyon is covered by Subsidence Points Nos. 1, 6, 7, and 8.

Swens Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Swens Canyon alluvium. Characterization of subsidence in this canyon is addressed by Subsidence Points 3 and 4.

Little Swens Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Little Swens Canyon alluvium. Characterization of this Canyon is covered by Subsidence Point No. 2.

Cunningham Possible Perennial Drainage

This drainage system is not projected as perennial within the Tract, but has been designated as possibly perennial on adjacent private land. Characterization of this area is covered by a single Subsidence Point No.9.

Table 4.1 displays the number of seams to be mined, overburden thickness, amount of maximum subsidence, and relative degree of differential subsidence for each of the above described locations.

Table 4.1
Predicted Subsidence and Relative Degree of Effect in Comparison to Skyline

Parameter	Subsidence Prediction Point								
	1 Boulger South	2 Little Swens	3 Swens West	4 Swens East	5 Flat West	6 Boulger Dam	7 Boulger West	8 Boulger Central	9 Cunn-ingham
Overburden Thickness above Lower Seam (feet)	1850	1600	1700	1100	1500	1200	1750	1500	1600
Number of Seams Mined	2	1	2	2	1	2	1	2	2
Maximum Subsidence (feet)									
Panels	10	5	10	12	4	13	4	13	12
Single Fire Barrier Pillar	7	2	6.5	7	2	9	2	8	7
Stacked Fire Barrier Pillars	4.5	-	4.5	5.4	2	6	3.5	5.9	5.4
Gate Roads	9.5	4.5	9.5	11.5	3.5	12.5	3.5	12.5	11.5
Maximum Slope Change (%)									
Single Abutment	0.6	0.8	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Abutment	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Single Fire Barrier	0.6	0.7	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Fire Barrier	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Gate Roads	0.2	0.1	0.2	0.4	0.2	0.4	0.1	0.2	0.2
Longwall Face (Dynamic)	0.3	0.4	0.3	0.7	0.3	0.6	0.3	0.5	0.4
Degree of Differential Subsidence (Relative to Skyline)									
Single Abutment Pillar	VL	L	VL	M	L	M	VL	L	L
Stacked Abutment Pillars	M	-	M	H	-	H	-	H	H
Single Fire Barrier Pillar	L	M	L	H	M	M	L	M	M
Stacked Fire Barrier Pillars	H	-	H	VH	-	VH	-	H	H
Gate Roads	VL	VL	VL	L	VL	L	VL	VL	VL
Longwall Face (Dynamic)	VL	VL	VL	L	VL	L	VL	L	VL

VL = Very Low, L = Low, M = Moderate, H = High, VH = Very High (relative to experience at Skyline)

Seismicity

Subsidence causes ground shaking or seismic events as the rock strata above the extracted coal fractures and bends. Prediction of seismic events and the resulting ground vibrations at a given point from mining activity requires evaluation of the following parameters:

- Magnitude of the Maximum Credible Event (MCE) that is historically reported as local magnitude on the Richter scale. This is based on recording vibrations within a frequency range that is important for evaluation of the impact on typical structures.
- Source location, type, and period of vibrations generated.
- The mechanism involved in transmitting the vibrations through rock and soil to the ground surface, typically defined by an attenuation equation based on the distance from the source.

- The site-specific reaction of the surficial materials with the bedrock interface and the degree to which particular structures respond to ground vibrations. This may involve separate evaluation of the different vibration parameters for displacement, velocity, and acceleration in three orthogonal planes and their variation with frequency.

The effects would be the same for both action alternatives, but they would occur for a longer period of time under Alternative B so there would be more total events. It is expected that up to 12 years of mining could occur for Alternative B. They would occur for a shorter period of time (5 to 7 years) with fewer total events for Alternative C because of the decreased recoverability associated with protection of resources and structures from subsidence. Since the geologic and mining conditions in the project area are generally the same as the conditions in the Skyline Mine permit area to the east, the frequency and magnitude of events experienced at Skyline Mine would continue as has occurred in the past.

Evaluation of historic mining induced seismicity at the Skyline Mine has been used to predict the MCE level to be used in calculations. Only 12 events exceeded 3 in magnitude. Of these, only 4 exceeded 3.2. Only one event in 1996 exceeded 3.4 at a magnitude of 3.45.

A magnitude of 3.45 was selected for the MCE based on evaluation of the results from monitoring. Even though it is highly unlikely that an event of the magnitude would occur again, it is possible, therefore this MCE was used for evaluations of potential effects. A source location about 500 feet above mine workings was selected to be conservative. A conservative attenuation relationship, known as the McGarr Equation, was selected for estimation of ground vibrations variation with distance from the MCE. It is known, from monitoring of seismic events and ground shaking at the Joes Valley Dam, that the McGarr equation shows that more energy would reach structures on the Wasatch Plateau than would actually occur. However, no data are available at this time to adjust the equation to local conditions. No site-specific data were available concerning the effect of vibrational coupling between bedrock, superficial materials and structures, consequently it was assumed that there was no magnification. Ground vibrations at structures are measured as peak particle velocity (PPV) or peak particle acceleration (PPA). Peak particle acceleration is used to determine how much vibration would be experienced at structures based on the MCE at distance. Perception of vibrations by humans is generally measured as peak particle velocity.

The issues of importance related to mining-induced seismicity involve potential damages to reservoirs and dams and the response by humans to these events. These effects are evaluated in the related sections of this chapter.

The potential for damage to structures is a function of the amount of energy or shaking that would occur at the specific location, determined by the magnitude of the seismic event, distance between the location of the event and structure, and how much energy is transferred to the location through rock (attenuation).

Human response to mining induced seismicity has the potential to be noticeable by campers, forest visitors, and cabin residents within a range of about 3,400 feet from full-extraction mining areas. With a possible frequency of one event that can be distinctly felt every 5 days on average, this is not considered to result in adverse impact. It should be possible to minimize any adverse impact by adequate warning, education, and the implementation of a suitable public relations program.

The range of seismicity predictions have been summarized in relation to their effects on the dams and presented in Table 4.2.

4.1.2.3 Alternative C

Disturbance from Surface Facilities

The effects would be the same as Alternative B.

Subsidence

Under this alternative the perennial drainages, Boulger Dam, Flat Canyon Campground, and SR-264 would be protected from subsidence by using a 23 to 30 degree angle-of-draw. As discussed Section 4.1.1, this would separate the mining and subsidence areas into three blocks separated by the protection zones for perennial streams. The maximum subsidence would be similar to that under Alternative B, at around 14 feet that could occur somewhere in the center area of each of the three subsidence blocks. The differential subsidence where maximum tensile strain is experienced would be basically the same in magnitude as discussed under Alternative B but the area affected would be larger, essentially surrounding each of the three subsidence blocks. Figures 4.3, 4.4, and 4.8 display the subsidence blocks and maximum differential areas for this alternative. The subsidence points shown on Figure 4.7 and discussed in Table 4.1 would not be subsided due to the required protection zones.

Seismicity

Subsidence-induced seismicity would be essentially the same as discussed for Alternative B, but there would be no subsidence directly below the protection zones. Since the subsidence protection zones are relatively small relative to the distances of concern regarding attenuation of the seismic wave energy, the differences would be negligible.

4.1.3 Facilities

4.1.3.1 Alternative A (No Action)

No mining would occur within the project area, but the mains in the existing permit area under or adjacent to Huntington Creek could still be driven to access existing lease areas. It is unlikely that the mains would cause subsidence of State Route 264 or the gas pipeline buried beneath the highway. If subsidence did occur, it would occur very slowly over hundreds of years. It is remotely possible that minor repairs of the highway would be required at isolated locations. The pipeline is no longer in service and is not likely to be reactivated. It could, however, be used as a water pipeline to discharge water from the underground mine workings to Electric Lake if this is approved at some time in the future. Because of the low potential of subsidence and the slow rate that it might occur, damage to the pipeline is not a concern, especially considering the relatively short mine life as compared to centuries for subsidence.

Since no subsidence would occur within the project area, no mining-induced seismic events would be triggered in the project area. The project area could, however, experience seismic-induced seismic events from mining in the existing Skyline Mine Permit Area to the east. Some of the larger seismic events could be perceived by humans in the project area but because of the distances involved, it is not likely that there would be any damage to structures.

4.1.3.2 Alternatives B and B'

Potential Subsidence/Seismicity Effects to Boulger Dam & Reservoir

The results for subsidence Prediction Point 6 indicate that cumulative vertical subsidence of up to about 13 feet could be expected from mining two seams below the dam. The dam is already estimated to be marginally stable and would not withstand major subsidence without failure. Due to the sensitivity of this structure, it is prudent to assume that stacked abutment or fire barrier pillars would not be located within the angle of draw from the dam, as they would result in High to Very High differential subsidence. Hence, the degree of differential subsidence is expected to vary from Low to Moderate and there is reasonable expectation that the dam could fail. The rate and extent of failure would depend upon the degree of differential subsidence imposed on the structure and whether or not the reservoir is drained. Since there is potential for the dam to fail, mitigative measures would be required of the lessee/operator under Alternative B' based on SCLSs #7, #9, and #13.prior to and/or during mining.

The main options for mitigation are listed below:

- Drain the reservoir prior to subsidence and repair/replace the dam afterwards. This would logically include replacing the dam to current requirements for construction and operations and dredging of the reservoir. This is estimated to cost about $390,000.

- Reinforce the structure by adding a buttress to the downstream face with the reservoir drawn down for short periods of active subsidence. This is estimated to cost about $150,000. This option would only be acceptable if the lessee/operator could demonstrate that the dam could withstand subsidence and seismicity without sustaining damage. Close monitoring of the dam would be required at additional cost to the lessee/operator.

The public safety risks will need to be addressed and other mitigative measures taken to limit the potential safety hazards if the dam were to fail. Under Alternative B', the dam would be taken out of service for the life of operations or potentially reconstructed or reinforced to prevent downstream hazards. This is a relatively small dam, with a limited ability to damage infrastructure or injure personnel downstream should it fail. With the ability to carry out full or partial draining of the dam and minimize downstream damage, it is likely that acceptable mitigation safety measures can be identified.

A Parametric Stability Analysis was carried out on the dam by NorWest Mine Services, Inc. (Appendix F, Technical Report on Geology, Mining, Subsidence, and Seismicity, October 19, 2000 maintained in the FS project file). The analysis indicates that the dam could withstand a seismic event with an equivalent horizontal ground acceleration of up to 0.1g. Any acceleration greater than this could induce failure of the downstream slope and a potential breach. A review of historical events included in the United States Geologic Survey and University of Utah databases, confirms that to date the structure has probably not experienced any seismic events, either natural or mining-induced, with an equivalent ground acceleration greater than about 0.08g. Based on an MCE of 3.3 or 3.45 the McGarr equation indicates that the dam could withstand this event at a distance of over 5,500 feet but not closer. Therefore, under this alternative the dam could experience damage from mining-induced seismicity and potentially breach. It is known that the McGarr equation overestimates that attenuation of seismic energy for sedimentary strata found in the project area. It is anticipated that current monitoring in the Trail Mountain area intended to refine the McGarr equation for areas in the Wasatch Plateau will result in much lower attenuation and horizontal distances relative to Table 4.2.

Under Alternative B' the mitigations described above would occur due to potential damage to the dam from seismicity.

The variation of peak particle acceleration with distance from events of magnitude 3.33 and a deeper event of 3.45 are presented in Table 4.2 and shown on Figure 4.9.

Table 4.2 Attenuation of Mining Induced Seismic Vibration with Distance for Magnitude 3.33 and 3.45 Events (after McGarr, 1981)

Horizontal Distance from a 3.3 Magnitude Event at Shallow Depth (Ft)	Horizontal Distance from a 3.45 Magnitude Event at 3000 ft Depth (Ft)	Peak Particle Acceleration (g)
1,000	-	0.4
1,600	-	0.3
2,600	0	0.2
5,500	5,500	0.1
6,900	7,200	0.08

It is estimated that the dam and reservoir would be out of service for up to 12 years if the dam is taken out of service or if it is damaged, considering two seams of mining and the length of time that mining-induced seismic events could occur.

Potential Subsidence/Seismicity Effects to State Highway 264

The section of the highway that passes alongside Upper Huntington Creek is protected by the requirement for protection of this perennial drainage. The results for Subsidence Prediction Points 5 and 6 in Flat and Boulger Canyons indicate that cumulative vertical subsidence from about 5 ft. in the west up to about 13 feet in the central and eastern section could be expected. The degree of differential subsidence is expected to range from Very Low to Moderate over the majority of the length of the road, with the possibility that it will be High at the east end where stacked barrier pillars will be located (NorWest, 2000).

Skyline has undermined SR 264 in the past without major problems. The road follows the valley floor with thick surficial soils, predominantly of glacial origin, and lateral constraint. The effect of subsidence is expected to result in flexure of the surface with induced gradient changes up to 3% for the majority of the area and some minor surficial cracking at the east end. Damage to drainage ditches and culverts could also occur.

Under Alternative B' (SCLS #13) and possible under Alternative B (conditions for permit approval) close monitoring of the highway during active subsidence and repairs would be required. Resurfacing of the road at the east end with re-grading of drainage ditches and the possibility of replacement of one culvert may be required. The total costs to the lessee/operator for this work are estimated to be in the order of $52,000 (NorWest, 2000). Additional costs would be incurred for monitoring.

No major safety concerns are anticipated based on the experience of the Skyline Mine, although safety is an important issue so warning signs and regular inspections of the road surface would be required during the periods of active subsidence and immediate repair of hazards would be required.

It is not anticipated that mining-induced seismicity would affect the highway or public safety.

Potential Subsidence/Seismicity Effects to Mainline #41 Gas Transmission Pipeline

The gas transmission pipeline runs along the Upper Huntington Creek valley floor alongside State Highway SR264. This structure will be protected due to the pillars left in the Main Development Corridor to protect this perennial drainage. In addition, the pipeline was taken out of service in 2000. Consequently, no subsidence is expected for this structure.

No effects of mining-induced seismicity are anticipated.

Potential Subsidence/Seismicity Effects to Flat Canyon Campground & Facilities

The results for subsidence prediction points 5 and 6 show that from 5 to 13 feet of subsidence may be observed at the main facilities and up to 13 feet may be observed at the spring collection system. The degree of differential subsidence is likely to range from Very Low to Moderate.

Damage to the restroom structure may be observed with cosmetic damage to the structure expected. It is also possible that damage to the toilet vault, septic tank, and drain field could occur. There is a minor potential for damage to the water supply pipeline, tank, and hydrant system. The spring collection system and pipeline have a very low driving head that might be eliminated under some subsidence conditions.

Hazards to campground users would not be high but would still be a major concern during periods of active subsidence. It is likely that the campground would be taken out of service for two seasons coinciding with the periods of active subsidence for each seam of mining.

Under Alternative B' the lessee/operator would be required to monitor damages and repair them as soon as possible. The total estimated cost of mitigation is in the order of $150,000.

Minor cosmetic damage could occur to structures from seismicity. The potential is relatively low. Under Alternative B' repairs would be required of the lessee/operator.

Potential Subsidence/Seismicity Effects to Private Cabins & Buildings

The results for subsidence prediction points 5 for Flat Canyon and 3 for Swens Canyon indicate that subsidence will range from 4 to 10 feet in these areas. The degree of differential subsidence in both areas is expected to be from Very Low to Low.

Subsidence is likely to result in minor distress and cosmetic damage to structures and the rupture of underground service connections. Where the cabins in Flat Canyon are located close to the limit of single seam mining there is the possibility that they may be exposed to permanent subsidence requiring major reconstruction. Occupancy during active subsidence should not be permitted. Repairs would probably be required under the Utah Coal Rules. The estimated costs for mitigation are estimated to be $360,000 for Flat Canyon and $360,000 for Swens Canyon. While there are safety concerns, these can be mitigated to acceptable levels.

A 3.3 or 3.45 seismic event within 5,500 feet would be perceived by occupants of these buildings. Unanchored items could be knocked over and minor cracking to rigid masonry or concrete foundations or chimneys could occur. Less than 1% of expected events are expected to be above 3.0. Reports differ regarding the potential for people to feel events in the range of 2.0 to 3.0 and would be dependant on the distance from the epicenter or origin location of the event.

Potential Subsidence/Seismicity Effects to Electric Lake Dam

No mining will take place within 2 miles of this structure, consequently no subsidence could occur.

Should the MCE occur at the closest location of mining to the dam, the dam would experience less than 0.1g of acceleration. If the largest known mining-induced seismic event (3.8 on Gentry Mountain caused by room-and-pillar mining in 1981) were to occur at the closest point, the dam would experience less than 0.1g. There are no anticipated effects to Electric Lake Dam.

Potential Subsidence/Seismicity Effects to Hunt Reservoir Dam

No mining would take place within approximately 0.5 mile of this structure, consequently no subsidence could occur.

The nearest mining could occur at a distance of approximately 0.5 mile or 2,600 feet. Mining-induced seismicity could cause damage and breach of this structure if the MCE of 3.3 or 3.45 would occur within 5,500 feet. Since there is potential for the dam to fail, the lessee/operator would be required under Alternatives B and B'to work with the landowners and develop mitigative measures prior to and/or during mining.

The main options for mitigation are listed below:

- Drain the reservoir prior to subsidence and repair/replace the dam afterwards. This would logically include replacing the dam to current requirements for construction and operations and dredging of the reservoir in cooperation with the landowner and State of Utah. This is estimated to cost about $390,000, including about 2 – 3 years of lost use.

The public safety risks will need to be addressed and other mitigative measures taken to limit the potential safety hazards if the dam were to fail. This is a relatively small dam, with a limited ability to damage infrastructure or injure personnel downstream should it fail. With the ability to carry out full or partial draining of the dam and minimize downstream damage, it is likely that acceptable mitigation safety measures can be identified.

Cumulative Effects

The project area is developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. The effects to existing structures/facilities are discussed in the previous section. Due to projected increased recreation use for the area, the Forest Service has plans to further develop the Boulger Reservoir area by reclaiming recreation disturbances directly adjacent to the reservoir and developing additional camp locations with gravel surfacing adjacent to the parking area. In addition, some minor expansion of the Flat Canyon Campground may be needed to accommodate use projections.

Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A. These improvements would probably be delayed until an opportune time relative to the mining, subsidence, and repairs needed to repair any damages. Reconstruction of Boulger Dam and dredging of the reservoir area following mining would probably result in a more stable dam constructed to current safety requirements.

It is likely that private landowners in the area would improve their existing facilities and construct new ones. It is also reasonably foreseeable that new roads on the private lands would be needed to access these facilities. The private landowners should work with the mining company to construct these facilities to avoid subsidence damage.

The anticipated mining could delay new developments in the project area for as much as 12 years because development during the active subsidence periods would be subjected to potential damages as discussed in previous sections. Human use of the area will probably continue to increase but the projected increased use of developments could be delayed up to 12 years until mining is completed and subsidence is substantially complete.

Lost use of the structures/facilities and delayed development could displace use to other facilities. It is projected that use of Benches Reservoir, Electric Lake, and Gooseberry Campground would increase because people would use these facilities instead of the closed facilities. This could require additional maintenance of these facilities due to the increased use.

Irreversible/Irretrievable Commitment of Resources

Any lost use of structures and facilities due to mining-caused damages would be irretrievable but not irreversible. The structures can be repaired and replaced.

Short-Term Use vs. Long Term Productivity

If new developments were delayed due to mining, the associated human activity and disturbance to natural resources would also be delayed. The decreased rate of development would decrease the rate that productivity of natural resources in the area would be affected until mining and subsidence are complete.

4.1.3.3 Alternative C

Underground mining would be restricted to methods that would not cause subsidence and/or to areas where subsidence would not occur at perennial streams or structures such as dams, pipelines, highways, and campgrounds, specifically discussed under Alternative B. However, subsidence of cabins and structures on non-federal lands with non-federal coal could occur, if allowed by the surface and mineral estate owners. The mining scenario is depicted on Figures 4.6 (upper seam) and 4.7 (lower seam).

Subsidence would occur only in the areas between perennial drainages as depicted on Figure 4.8.

The drainages, paved highways, campground, and Boulger Reservoir would be protected by preventing full-extraction mining within the area determined by projecting a line from the edge of the channel alluvium in the drainage downward to the coal seam using the angle-of-draw. This would split the mining area into major northern and southern blocks of recoverable coal in both mineable seams and a third smaller northernmost block of coal that could be mined only in the lower seam. Figure 4.8 depicts the relative differential subsidence and degree of effect for this mining scenario.

Two private cabins on the south side of Flat Canyon lie within the subsidence protection zone for Flat Canyon Creek. However, two private cabins on the north side of Flat Canyon and one private cabin in Swens Canyon could be subjected to subsidence. They would be subsided as described in Alternatives B and B' and shown on Table 4.1. The cabins north of Flat Canyon is located in a single seam abutment zone and the cabin in Swens Canyon is located in a double abutment zone.

The structures would be protected by preventing full-extraction mining in an area defined by projecting a 23-degree angle-of-draw from the structure down to the coal seam. No full-extraction mining would be allowed within the resulting protection zone. Where the structures lie within a protection zone for perennial drainages, the structures would already be protected. The cabins on the south side of Flat Canyon and the cabin in Swens Canyon would be affected as described under Alternative B.

Even though some of the structures would be protected from subsidence, full-extraction mining would occur within distances where the structures would be subjected to mining-induced seismicity. The effects would be the same as described in Alternative B'.

Cumulative Effects

The project area is heavily developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. The effects to existing structures/facilities are discussed in the previous section. Due to projected increased recreation use for the area, the Forest Service has plans to further develop the Boulger Reservoir area by reclaiming recreation disturbances directly adjacent to the reservoir and developing additional camp locations with gravel surfacing adjacent to the parking area. In addition, some minor expansion of the Flat Canyon Campground may be needed to accommodate use projections. Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A. These improvements would occur unimpeded by mining and subsidence.

It is likely that private landowners in the area would improve their existing facilities and construct new ones. It is also reasonably foreseeable that new roads on the private lands would be needed to access these facilities. For the structures in Flat Canyon, development would probably continue as projected. Any new construction in the Swens Canyon area could be delayed because subsidence could affect them. Most likely, the private landowners would work with the mining company to delay construction/improvement of facilities at a later time to avoid subsidence damage.

The projected rates of new development would continue unaffected by mining, with the possible exception of the private lands in Swens Canyon since this are would not be specifically protected from subsidence.

Irreversible/Irretrievable Commitment of Resources

Any lost use of structures and facilities due to mining-caused damages would be irretrievable but not irreversible. The structures can be repaired and replaced.

Short-Term Use vs. Long Term Productivity

If new developments in Swens Canyon were delayed due to mining, the associated human activity and disturbance to natural resources would also be delayed. The decreased rate of development would decrease the rate that productivity of natural resources in the area would be affected until mining and subsidence are complete.

4.1.4 Surface Water

This section discusses the effects of surface developments, underground mining, subsidence, and mine water discharge to surface water.

4.1.4.1 Alternative A (No Action)

No mining would occur within the project area. There would be no effects from mining-induced subsidence or seismicity. However, mine water discharge to Eccles Creek from the Skyline Mine portals in Eccles Canyon recently increased 5 fold and could continue to increase. The effects relative to this issue are discussed in this section.

Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir.

Scofield Reservoir and the Price River and its tributaries have been designated as protected by the Utah Division of Water Quality (UAC R317-2) for 1) domestic purposes with prior treatment, 2) secondary contact recreation such as boating, wading, or similar uses, 3) cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain, and 4) agricultural uses including irrigation of crops and stock watering.

The Skyline Mine currently discharges mine water into Eccles Creek just below the Forest boundary under a Utah Point Discharge Elimination System (UPDES) Permit. Currently, Skyline Mine is permitted to discharge 7.1 tons per day of dissolved solids. Discharge increased from approximately 500 gpm prior to September 2000 to the current discharge rate (February 2001) of approximately 2,600 gpm.

Mine water discharge has affected stream morphology in Eccles Creek and Mud Creek since the mine started operations in 1979. The water quality in the creeks and in Scofield Reservoir has been affected by the introduction of mine water discharge.

Chemical Water Quality

With the exceptions discussed below, the parameters monitored by Canyon Fuels have generally met the water quality standards established for the designated beneficial uses. Concentrations of total boron, cyanide, dissolved lead, total phosphorous, and TDS have on at least one occasion exceeded the concentration limits specified by one or more of the standards. Concentrations of cyanide from CS-12 on one occasion exceeded the standard for aquatic wildlife. On each of the other 12 monitoring events, no cyanide was detected. During the single cyanide-monitoring event from the UPDES outfall, the concentration of cyanide also slightly exceeded the standard. The concentration of total phosphorous has occasionally been exceeded in discharge from CS-12 and CS-14, and was exceeded in the single phosphorous-monitoring event from the UPDES outfall. The average concentration of total phosphorous from CS-12 discharge is within the beneficial use standards, while those standards are somewhat exceeded in the average CS-14 discharge. The concentration of total mercury also exceeded the standards during the single mercury-monitoring event from the UPDES outfall. Concentrations of phenol, an organic compound, have exceeded the standards on a few occasions at both CS-12 and CS-14, while on all other occasions, no phenol was detected in the discharge water. The causes of the occasional elevated phenol concentrations in the mine discharge water are not known.

Automated continuous monitoring equipment has recently been installed in the Skyline Mine discharge system that ensures that water that is excessively elevated in TDS, ph, turbidity, or oil and grease concentrations would not be discharged. If these parameters exceed a threshold determined by the company, water is automatically rerouted to underground storage areas within the Skyline Mine.

Sediment

Below the point of discharge Eccles Creek has a well defined, cobbly channel with a steep gradient, moderate sinuosity, and dense riparian vegetation. Much of the sediment observable in Eccles Creek seems to originate from SR 264 and other roads in the watershed. Mud Creek from Eccles Creek to Scofield Reservoir has a gentle gradient and high sinuosity. The stream channel is entrenched in the valley bottom with little to no floodplain and little riparian vegetation stabilizing the stream channel.

Based on USGS gage data for Mud and Eccles Creeks (project file), the increase in mine water discharge from 500 gpm to 2,600 gpm increased the average number of days with flows capable of transporting sediment from 28 to 32 in Mud Creek and from 23 to 32 days in Eccles Creek.

This increase in flow durations would transport additional sediment through Eccles Creek but should have little effect on the stream channel due to the cobbly substrate and streamside vegetation. The estimated change in flow duration in Mud Creek would transport additional sediment through the stream system into Scofield Reservoir but should have little effect on the stream channel. The adjustment processes already occurring in Mud Creek (channel widening, bank sloughing, occasional meander cut-offs) would continue with little change in rate.

Cumulative Effects

Construction of the Skyline Mine began in 1979. Concurrently SR 264 was constructed by the Utah Department of Transportation to provide all-season access to the mine from Utah, Sanpete, Carbon, and Emery Counties. Construction of the mine and highway caused morphological changes to the channel. The Main Fork and North Fork of Eccles Creek were diverted into 72 inch culverts and Eccles Canyon was filled to construct the portal facilities area. Surface water flow from the disturbed mine area is collected in the portal facilities sediment pond. Treated water from the sediment pond and mine water are discharged to Eccles Creek just below the Forest boundary. The increased flow to Eccles Creek has affected stream morphology and quality in Eccles Creek, Mud Creek, and Scofield Reservoir as discussed in the previous section. Cumulatively the mine and highway have caused changes to stream morphology and downstream waters. A major source of sediment introduced to Eccles Creek below the culvert outlet is from traction materials (sand and slag mixed with salt) used on SR 264 by UDOT during the winter months to keep the road open. The raw, steep roadcut through the mine area also contributes sediment.

Future actions discussed in Appendix A could increase sediment yields on a temporary basis, but Best Management Practices would be used to minimize effects to water flow and quality. Additional long-term effects should be negligible and in some cases existing effects can be mitigated with improved management practices.

Irreversible/Irretrievable Commitment or Resources

The effects described above are irretrievable lasting through the life of the mine and highway. Once the mine is closed and reclaimed the stream channel will be reclaimed and mine water discharge would cease. Flows and quality would return to near premining conditions but changes from the natural, undisturbed conditions are irreversible.

Short-Term Use vs. Long-Term Productivity

The mining activity and other uses and the associated benefits would continue for at least another 2 years and potentially beyond if the mine is extended to the north into the unmined lease area. Once the mining stops, mine water discharge would be discontinued, decreasing flow to Scofield Reservoir to pre-mine levels

4.1.4.2 Alternatives B and B'

Under Alternative B, the Special Coal Lease Stipulations (SCLS) would not be applied to the lease and no specific measures would be taken to protect surface waters from subsidence. Alternative B' differs only in that monitoring sufficient to detect effects would be required under SCLS #7 and mitigations may be required under SCLS #9, #13, and #17. Specific monitoring and mitigation plans would be made provisions for permit approval.

Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir.

Skyline Mine currently discharges between 500 and 2,600 gpm. Canyon Fuel estimates that discharges could be as high as 4,000 gpm as mining progresses in the existing permit area and into the project area. This rate would not be sustained continuously but represents a maximum occasional discharge, but discharge rates in excess of 2,500 gpm could be sustained. The actual discharge rate of water from mine workings would be dependant on the amount of water encountered, the amount of water that would be impounded underground, and cycles of the water handling system. Mine water discharge would be increased 9-12 years.

Chemical Water Quality

It is anticipated that the chemical quality of groundwater encountered during mining in the project area would be similar to that encountered in the Skyline Mine area (NorWest, 2000a). Therefore, if mine water discharge rates were to remain at current levels (approximately 2,600 gpm), and mine water were to continue to be discharged into Eccles Creek, there would be no new impacts to water quality or quantity beyond those currently occurring and described under Alternative A. Assuming that future discharge rates from the mine increase to 4,000 gpm, greater impacts to water quantity and quality in Eccles Creek and downstream watercourses would be anticipated.

Assuming that discharge increases to 3,000 gpm total mine discharge and the average mine discharge TDS concentration of 916 mg/l remains the same, there would be a salt loading of 16.5 tons per day, an increase of 9.4 tons per day. If discharge were to increase to 4,000 gpm, there would be a salt loading of 22 tons per day. Both of these rates may exceed the amount allowed in the UPDES permit.

The overall quality of Skyline Mine discharge water has been appreciably lower than that of Eccles Creek (Mayo and Associates, 1996). Therefore, there is a direct relationship between the percentage contribution of mine water to the creek and the overall quality of water below the mine discharge point.

The average solute concentrations of mine discharge water and Eccles Creek water are known for some parameters. A flow-weighted linear mixing model was used to estimate the anticipated water quality for some parameters at CS-2 (Eccles Creek below the mine discharge point) if additional mine discharge water enters the creek. At a discharge rate of 500 gpm, TDS concentrations average approximately 554 mg/l, and sulfate concentrations average 193 mg/l. The linear mixing model suggests that TDS concentrations at CS-2 on Eccles Creek would average approximately 877 mg/l with a total mine discharge of 3,000 gpm. A substantial portion of the TDS increase would result from increases in sulfate concentrations, which would average approximately 400 mg/l. With a discharge of 4,000 gpm, TDS would average approximately 1022 mg/l. These estimates are based on a continuous mine discharge. It is likely that pumping of mine water would occur intermittently; therefore the effects of mine discharges might be less than those estimated above.

Scofield Reservoir is listed in the State of Utah's 2000 list of impaired water bodies. The parameters of concern are dissolved oxygen and total phosphorus. The total maximum daily load allocation (TMDL) established by the State and approved by EPA targets a 28% reduction in total phosphorous loading. The TMDL is based on load allocations prepared for Clean Lakes Studies in 1983 and 1990 and additional water quality sampling in 1997 and 1998. It is predicated on the hydrologic conditions current at that time the mine discharge volume was less than 500 gpm (DEQ-DWQ, 2000, Denton, 1983). The recent change in hydrologic regime would require a review, and perhaps a revision, of the TMDL and UPDES permit by the State (DWQ - C.Adams, 2001 personal communication). There is very limited data about the concentration of total phosphorus in the mine discharge water. The single data point at the UPDES discharge point was 0.62 mg/l; the state standard is 0.05 mg/l.

In order to receive a new or modify an existing UPDES permit, it must be demonstrated that beneficial use standards would not be exceeded in the receiving water. When a UPDES discharge permit is issued or modified, the water quality of the proposed discharge water is evaluated by the Utah Division of Water Quality (DWQ - Mike Herkimer, personal communication, 2000). WET testing is performed to ensure that the water is not toxic (either chronic or acute) to aquatic organisms. If harmful constituents are identified in the proposed discharge water, then an approved water treatment plan must be implemented before any water may be discharged. If constituents are found in the water that are regulated under TMDL, such as phosphorus, or which may cause the receiving water to not meet the quality standards for the designated beneficial uses, specific discharge limits are placed on these constituents. Routine water quality monitoring of the discharge water by the company is required for all parameters requested by the Division of Water Quality to demonstrate compliance with the UPDES permit.

Sediment

Increasing the mine water discharges from 2,600 gpm to 4,000 gpm would have little additional effect on Eccles or Mud Creek. The duration of flows capable of transporting sediment on an average annual basis would increase from 32 days to 34 days in Mud Creek and from 32 to 38 days in Eccles Creek.

A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to Upper Huntington Creek in the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed.

The mine is currently discharging approximately 2,600 gpm (5.8 cfs) into the Price River Watershed. The discharge might increase to 4,000 gpm (8.9 cfs). A sustained discharge of 2,600 gpm is approximately 4,200 acre-feet per year; 4,000 gpm is approximately 6450 acre-feet per year. The average water yield for the Price River near Helper is 80,570 acre-feet per year. The average yield for Huntington Creek near Huntington is 59,190 acre-feet per year. The current discharge is approximately 5 percent of the Price River's annual yield and would add approximately 7 percent to Huntington Creek's yield if the discharge point were moved. The mine water discharge is not affected by climate, as are surface drainages. However, it is unknown how long the discharge might persist or what quantities might be produced. During dry years the addition to either reservoir would likely be considered a benefit by water users. During extremely wet years, when water is spilling from the reservoirs, the addition of this amount of water would be small relative to the 6,200 cfs capacity of the Scofield Reservoir spillway or the 2,300 cfs capacity of the Electric Lake spillway.

Mine water discharge would be extended for another 9-12 years.

Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies.

It is proposed in the RFDS that mine water might be discharged to Electric Lake at a location selected to minimize erosion or sediment disturbance in the lake. Mine water discharge would increase by another 9-12 years.

Huntington Creek and Electric Lake are protected for secondary contact recreation such as boating, wading, or similar uses. These waters are also protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain. The waters are also protected for agricultural uses including irrigation of crops and stock watering. Huntington Creek has been designated as protected for domestic purposes with prior treatment as required by the Utah Division of Water Quality.

The anticipated quality of mine discharge water is poorer than that of the tributaries supplying Electric Lake. Therefore, the chemical quality of Electric Lake could be affected by the proposed discharge. The magnitude of this impact is directly related to the volume of mine water discharged into the receiving water.

As described in the preceding section about water quality and Scofield Reservoir, the mine discharge water would be a significant new source of TDS, including sulfate, and may also be a substantial source of phosphorus and other pollutants not currently found in the watershed.

Phosphorus is of particular concern. In natural systems, available phosphorus is a limiting factor in the growth of phytoplankton. The human-caused addition of phosphorus to lake systems is widely accepted as a principle cause of accelerated eutrophication (Goldman, 1983). At this time there is no evidence of accelerated eutrophication in Electric Lake, unlike in Scofield Reservoir.

Before any mine water could be discharged into these waters, a UPDES discharge permit would be required. In order to receive this permit, it would need to be demonstrated that the beneficial use standards for these waters would not be exceeded. Water quality analyses for the Skyline Mine discharge for parameters monitored to date are included in Appendix E. As discussed above, all important water quality parameters would be controlled through the UPDES permitting process and are regulated by several Utah State regulatory agencies.

The temperature of groundwater from the Skyline Mine has averaged between about 11 and 16°C (Mayo and Associates, 1994). If this water is discharged directly into Electric Lake during the winter months when temperatures of the lake water are near 0°C, there would be an alteration of the thermal regime of the lake. This may locally result in the melting or thinning of the surface ice in the vicinity of the discharge point, may affect aquatic life in the immediate vicinity of the discharge point, and may affect lake thermodynamics and stratification.

Under Alternative B, no specific measures are likely to be required of the operator to monitor and mitigate any effects to the reservoir. Under Alternative B' monitoring and mitigations may be required in the mine permit, based on SCLS #7, #13, and #17.

Subsidence of perennial streams and Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology.

<u>Direct Effects</u>

Perennial streamflow could be affected if subsidence-related tension fractures caused diversion of surface water into the underlying bedrock. Based on area geology, low-permeability bedrock formations underlie all of the perennial streams in the project area. This is the case regardless of the surface geomorphology. For instance, although Boulger Canyon is wide with a low stream gradient whereas Swens Canyon is narrow and steep, the Blackhawk Formation underlies the unconsolidated sediments in each canyon. Canyon geomorphology in the study area is a function of erosional process (fluvial and glacial) not the underlying bedrock.

In order for water to be diverted from the stream channel and surrounding alluvium, the integrity of the perching layer(s) would need to be compromised such that downward migration of surface waters into deeper unsaturated rock horizons could occur. In the short-term, subsidence fractures through the Blackhawk Formation could divert surface or alluvial groundwater. However, subsidence fractures in this formation would heal rapidly as the fractures are wetted due to the expansion of hydrophilic clays. Thus, if subsidence fractures were to damage the perching layer beneath the stream and alluvium, these fractures would likely remain open for only a short period of time. In the long-term, the subsidence fractures must be extensive and interconnected to convey water from the surface system. It is expected that the integrity of the low-permeability bedrock horizons that support both streams and shallow groundwater systems in the project area would not be compromised (NorWest, 2000a). For these reasons, the potential for the direct interception and translocation of surface waters by subsidence fractures is considered remote.

The experience of Canyon Fuel performing longwall extraction beneath Burnout Creek (NorWest, 2000a) provides support for the idea that obvious detrimental effects to perennial streamflow are unlikely if these drainages were undermined. As reported by NorWest (2000a), there were no quantifiable effects on baseflow discharge attributable to mining in Burnout Creek. The geologic conditions in the project area (geologic formation, overburden thickness, and degree of fracturing and faulting) are sufficiently similar to those at Burnout Canyon (less than 1 mile from the project area) to justify extrapolation of the observed effects of undermining Burnout Creek to the project area. Thus, it is probable that no obvious losses of surface water would occur if surface water drainages in the project area are undermined.

Indirect Effects

There is a potential for localized shifting of groundwater discharge locations as a result of mining-related subsidence. This could result from minor alterations in the attitude of bedrock horizons (i.e. a change in the groundwater flow direction) or changes to fracture networks that may support groundwater discharge.

Under Alternative B, the mining regulations would require the lessee/operator to replace domestic water sources or State Appropriated Waters (Water Rights) that can be demonstrated to have been affected by mining. By not applying specific lease stipulations for replacement of non-domestic or unappropriated waters, there would not be a specific requirement for replacement of waters needed for ecosystems.

Under Alternative B', SCLS #17 would require replacement of water or appropriate mitigations if water that supports ecosystems is affected, as well as State Appropriated Water.

Cumulative Effects

The project area contains numerous developments including Boulger Reservoir, Flat Canyon Campground, Camp Shalom, SR 264, several private cabins, roads and trails, and encompasses several sheep allotments. Since Euro-American settlement, intense grazing and timber cutting, along with the developments described above, have altered vegetation types and densities. Due to these changes and loss of soil to erosion, runoff has increased. Stream morphology has changed due to the changed flows and changes in vegetation. Quality has undoubtedly been degraded relative to pre-settlement conditions by these changes. As displayed in the table of past, present, and reasonably foreseeable future actions in Appendix A, additional development of private lands is anticipated that would most likely result in similar effects. The planned improvements to the Boulger Reservoir area should be beneficial to water quality since the disturbed areas directly adjacent to the reservoir would be revegetated, traffic would be restrained to Forest System Roads, and dispersed campsites would be graveled to decrease erosion and sediment production. Improvement of sanitary facilities should decrease the potential for degradation of water quality. Potential improvements at Flat Canyon Campground would have similar effects.

Increased dispersed recreation use expected in the area due to population growth and recreation demand has the potential to degrade water quality.

Other future actions discussed in Appendix A could increase sediment yields on a temporary basis, but Best Management Practices would be used to minimize effects to water flow and quality. Long-term effects should be minimal, and in some cases, existing effects can be mitigated with improved management practices. The oil and gas exploration wells projected to occur would employ sediment control measures during construction, operations, and reclamation. Forest requirements for pad design use impermeable pits and berms to prevent fluids and precipitation from leaving the disturbed area. Operators are also required to prepare spill prevention and recovery plans to mitigate effects. Drill holes are cased to prevent escape of drilling and production fluids and are plugged on abandonment to prevent contamination and mixing of ground water aquifers. -

The effects discussed in this section relative to mining would be cumulative with those that have occurred since Euro-American settlement. The life of the mine would be extended another 9 to 12 years, as would the associated effects.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the period of mining. Once the mine closes and reclamation is completed the surface water flow and quality could return to near premining condition over the long-term.

Short-Term Use vs. Long-Term Productivity

The benefits of mining would continue for at least an additional 8-12 years. Once the mine is closed and reclamation is completed the surface water flow and quality would return to near premining condition.

4.1.4.3 Alternative C

Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir.

The effects would be the same as Alternative B and B'.

A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to Upper Huntington Creek in the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed.

The effects would be the same as those described for Alternative B', except that discharge of mine water would be extended for a shorter period of time 5-7 years.

Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies.

The effects would be the same as those described for Alternative B' but would be extended for a shorter time period (5-7 years).

Subsidence of perennial streams and Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology.

Direct Effects

There would be no direct effects to perennial streams with the possible exception of the Cunningham Drainage. This drainage has steep gradients and the effects would be similar to those encountered in Burnout Canyon; negligible effects to overall function of the ecosystem.

Indirect Effects

Creek discharge could be indirectly affected if there were a diminution of discharge from springs that contribute to baseflow. As discussed below in the groundwater section, the potential for diminution of discharge from shallow groundwater systems is considered negligible.

If there were a perceptible or quantifiable decrease in streamflow as an indirect result of subsidence, SCLS #17 would require that the operator replace, at his expense, any surface water identified for protection that may be lost or adversely affected with water from an alternate source in sufficient quality and quantity to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses.

Impairment Of Water Rights Resulting From Decreased Stream Flows

Numerous water rights for creeks are held in the project area by both private landowners and government agencies. Perceptible or quantifiable impacts to creek discharge rates, other than from mine water discharge changes, are not anticipated. If there are no impacts to creek discharge rates then there should be no impairment of water rights. In the event that there is a mining-related flow diminution of an appropriated surface water source, Utah Code 40-10-18 requires the mine operator to "promptly replace any state appropriated water in existence prior to the application for a surface coal mining and reclamation permit." Lease stipulations would also require replacement of other water sources affected by mining.

Cumulative Effects

The effects would generally be the same as discussed under Alternative B' except that the additional effects of mining would occur for a shorter time. The life expectancy of the mining operation in the project area under this alternative is 5 to 7 years rather than 9 to 12 years for Alternatives B and B'.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the period of mining. Once the mine closes and reclamation is completed the surface water flow and quality would return to near premining condition.

Short-Term Use vs. Long-Term Productivity

The benefits of mining would continue for at least an additional 5 to 7 years. Once the mine is closed and reclamation is completed the surface water flow and quality would return to near premining condition.

4.1.5 Ground Water

This section discusses the effects of underground mining, subsidence, and mine water discharge to ground water resources.

4.1.5.1 Alternative A (No Action)

There would be no effects to the project area.

4.1.5.2 Alternatives B and B'

Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems.

The mechanisms whereby mining-related subsidence could affect near-surface groundwater systems are, for the most part, analogous to the potential impacts to perennial creeks, described in the previous section. As with perennial creeks, the operation of near surface groundwater systems is fundamentally dependent on the presence of low-permeability bedrock horizons that create perched groundwater conditions.

The reaction of rock strata above longwall-mined areas is a function of overburden thickness. There are four zones of movement above subsided areas. These include the cave zone, fracture zone, flexure zone, and soil zone. In the project area the fracture zone is estimated to extend above the Lower O'Connor B seam up to 375 feet for single seam extraction and up to 675 feet above the Flat Canyon Seam for double seam extraction. The minimum overburden thickness in the project area where longwall mining could occur is about 900 feet for the Lower O'Connor B seam. Most of the surface is more than 1,200 feet above the Lower O'Connor B seam. Thus, both colluvial/shallow bedrock groundwater systems operate entirely with the flexure zone and soil zone.

The expected response in the flexure zone would be movement along existing joints and bedding planes, which could open up in zones of tension. Vertical movement along fractures typically remains within individual beds and is not vertically extensive unless massive strong beds are in the zone. Weaker rocks in the upper part of the zone may flex without causing failure along joints or tension cracks to form. In the soil zone materials are weak and generally do not fail due to the ability to flex. Tension crack formation does occur in the active tension zone but cracks close again when the compression zone reaches that point.

Based on the previous discussion, it is expected that the integrity of the low permeability bedrock horizons that are fundamental to the operation of colluvial/shallow bedrock groundwater systems generally would not be compromised. The exception would be the creation of tension cracks in high-strain zones as discussed below.

In zones of permanent tension that form above such features as panel ends, fire barrier pillars, and the outer edge of a block of panels, tension cracks are possible in shallow subsurface strata and may persist for a time. The degree to which these tension cracks impact shallow groundwater systems would be dependant on the degree of interconnectedness of fractures with other fractures or permeable horizons that are capable of receiving water. However, it is anticipated that because of lithologic heterogeneity and the abundance of swelling clays in the Blackhawk Formation, that tension fractures which do form would heal quickly.

Subsidence also has the potential to locally alter groundwater flow directions. This is caused by slightly altering the attitude of shallow bedrock or by subtle disturbances in unconsolidated material. While this could affect the discharge rate from an individual spring, the total discharge from the groundwater system would remain the same as groundwater is diverted to other nearby discharge locations.

Experience in the Skyline Mine area suggests that shallow bedrock horizons are not compromised to the degree that there is perceptible or quantifiable dewatering of springs. The response of springs and wells (NorWest, 2000a) to undermining and subsidence suggests that subsidence does not result in dewatering of groundwater systems. Lastly, exploration drill holes in the Blackhawk are very unstable, and when left open for a few days, slough badly (Vaughn Hansen Associates, 1982) suggesting that any subsurface openings created by subsidence would heal quickly.

It is estimated that there is a negligible probability of perceptibly or quantifiably dewatering near surface groundwater systems as a result of mining-related subsidence and fracturing. There is a possibility that there may be some local alterations in groundwater flow direction, which might affect the discharge from an individual spring but not diminish the total discharge from a groundwater system.

Under Alternative B, only State Appropriated Water would be required to be replaced if it is adversely affected by mining. Under Alternative B', SCLS # 17 would require replacement/mitigation of ecosystem waters as well as State Appropriated Waters if adversely affected by mining.

Impacts to Water Rights Resulting From Changes in Spring Locations or Flows

Numerous water rights for springs are held in the project area by both private landowners and the U.S. Forest Service. A water right has a specified point of diversion. It is possible that if a spring discharge location shifted as a result of subsidence, this could affect a water right because water could no longer be diverted at the specified point. If such a situation were to occur, the water right holder would need to consult with the State Engineer to determine what response would be appropriate. Perceptible or quantifiable impacts to spring discharge rates are not anticipated. Under Alternative B, in the event that there was a mining-related flow diminution of an appropriated spring, Utah Code 40-10-18 requires the mine operator to "promptly replace any state appropriated water in existence prior to the application for a surface coal mining and reclamation permit." Under Alternative B' the lessee/operator would be required to replace/mitigate any loss of water needed for ecosystems as well as State Appropriated Waters.

Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems.

Direct interception of groundwater by mine workings results in the local dewatering of deep groundwater systems. Groundwater that is encountered in underground workings at the Skyline Mine and groundwater that may be encountered in the project area issues from either deep Blackhawk Formation groundwater systems or Star Point Sandstone groundwater systems (NorWest, 2000a). Discharge of mine water would be increased by 9-12 years.

The potential for diversions between watersheds exists if water encountered underground is discharged to a drainage other than the one where the water would naturally discharge. The Skyline Mine area and mine workings straddle the surface water divide between two major watersheds, the Price River and the San Rafael River. Most of the surface area in the Project area is within the San Rafael River Basin. The southwest corner of the Project area is within the Gooseberry Creek drainage, which is tributary to the Price River Basin.

As described above, mining at the Skyline Mine does not appear to have created pathways for the downward migration of water from the surface or near surface to the mine. Mining in the project area also would not divert surface flows or near-surface groundwater into deeper formations.

Deep Blackhawk Formation groundwater systems do not have good hydraulic communication with the surface as indicated by radiocarbon ages that are many thousands of years old, the lack of tritium, and the rapid decline of inflow rates after a water-bearing feature is encountered. What this suggests is that the dewatering of these horizons should not induce renewed recharge to these systems and therefore there should be no impact to the hydrologic balance in the recharge areas. Because deep Blackhawk Formation groundwater systems drain quickly when encountered, it is doubtful that these systems support perceptible or quantifiable discharge to the surface.

Star Point Sandstone groundwater systems also discharge water to mine workings that is many thousands of years old. Because of the lateral continuity of the Star Point Sandstone, it is possible that there may be hydraulic continuity from the recharge zone to where water is encountered in mine workings. However, pump test analysis (Mayo and Associates, 1997a; Bills, 2000) indicates that the hydraulic conductivity of unfractured Star Point Sandstone is low, and thus recharge to the Star Point Sandstone is largely constrained by the low permeability of the unit. Thus it is unlikely that dewatering of the sandstone would perceptibly or quantifiably impact the hydrologic balance in the recharge area. Due to the antiquity of water in the Star Point Sandstone, it is unlikely that discharge from the Star Point Sandstone, wherever that may occur, is important to the hydrologic balance of that area.

The probability of impacting developed groundwater systems that exist above the mined horizon decreases with increasing overburden thickness. As noted by NorWest (2000a), subsidence causes water level perturbations in deeper groundwater systems but there is no indication that the groundwater systems monitored by wells have been dewatered. If a saturated horizon in the deeper bedrock were dewatered, it is unlikely that there would be a perceptible or quantifiable impact to the surface hydrologic balance because of the limited recharge and discharge of these systems.

In summary, although mine workings could encounter large amounts of groundwater, more than 1,000 gpm, this water is derived from storage in the groundwater system. Where groundwater naturally discharges to the surface from deep bedrock groundwater systems, it is surmised that the discharge rate is several orders of magnitude less than the rate that water inflows to mine workings. It is estimated that there is a remote probability that direct interception of groundwater by mine workings would cause perceptible or quantifiable impacts to the hydrologic balance at either the recharge or discharge areas of deep groundwater systems.

Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems

The quality of water that passes through the mine environment may be degraded by chemical interactions with naturally occurring minerals or materials and equipment introduced into the mine. Potential environmental effects can occur if degraded water discharges from the mine workings either during active mining or after mining activities cease. These potential effects are discussed below.

Some materials used in mining operations, when brought into contact with groundwater, have the potential to adversely impact the quality of water discharged from the mine. Mayo and Associates (1994) report that in the late 1980s gypsum rock dust was used in the Skyline Mine. This practice resulted in exceeding TDS limits for mine discharge water because of the high solubility of gypsum. In March 1991, Skyline Mine began using carbonate rock dust, which is considerably less soluble in water. As a result of this change water quality of mine discharge water eventually improved. Mayo and Associates (1994) also note that part of the increase in TDS of mine discharge waters relative to mine inflow waters is a result of the oxidation of longwall emulsion fluid. When fugitive longwall emulsion fluid comes in contact with mine waters, the organic molecules in the fluid are readily oxidized by bacterial action resulting in the production of carbon dioxide gas. Carbon dioxide gas reacts with water to form carbonic acid (H_2CO_3), which dissociates into hydrogen ions and bicarbonate. The liberated hydrogen ions are rapidly consumed in reactions with naturally occurring carbonate minerals, resulting in increased calcium ion, magnesium ion, and bicarbonate concentrations in mine water.

During the course of mining operations, many tons of ferrous metals are utilized. Some of the metal objects are removed after mining ceases and, as a necessity, others are left in place. The largest permanent use of metal in mining operations is in roof-support. Thousands of metal roof-bolts are installed at regular spacing in the mine roof to prevent roof collapse. In some locations, wire mesh is also installed. For safety reasons, it is not possible to remove the roof-bolts or wire mesh after mining in an area has ceased. Additionally, metal is used in stoppings and man-doors, overcasts, cribbing, well casings, pipes, and miscellaneous items such as hangers and signs. There is the potential for the metal in these objects to oxidize (rust) as it comes in contact with water in the mine environment.

Oxidation of ferrous materials results in the release of iron into the water. The magnitude and rate of the potential oxidation is constrained by a complex variety of factors, including the temperature, Eh (reduction-oxidation potential), and pH of the water, the pressure on the system, the presence or absence of bacteria, and the solute chemistry of the mine water. As a result, this potential impact is difficult to quantify. However, discharge water from Wasatch Plateau coal mines has not been degraded by elevated iron concentrations. To what extent the iron concentration in mine discharge water may change after mining operations cease is difficult to determine. However, the concentration would likely remain low because dissolved iron is rapidly precipitated as iron hydroxides as noted previously.

Under Alternatives B and B', the operator would not be specifically required to remove equipment that is not incorporated into the mine. However, Section 7 of the BLM lease form requires lessees to remove equipment and materials "as required by the authorized officer." Equipment could be left underground only upon obtaining approval through an approved mine permit or permit amendment. Under Alternative B', the effects would probably be the same but the requirement would be reinforced by SCLS #19.

If equipment were left underground, it is unlikely that corrosion of abandoned equipment would degrade the quality of water in the mine environment. Mining equipment, such as longwall mining machines, roof bolters, and continuous miners, is made of high quality steel alloy containing chromium. The metal is highly resistant to corrosion. Calculations of the corrosion potential of the steel used in longwall mining machines have been performed by the University of Utah Metallurgy Department (BLM, 1998). They determined that it would take thousands of years for the metal to corrode away, and that the metal would need to be ground to a fine particulate for chromium to be dissolved. The University of Utah (BLM, 1998) report indicates that the general conditions required to hasten the corrosion of this metal do not exist in the Utah coal mining environment.

Minor water quality impacts could occur if lubricants were not drained from the equipment prior to abandonment. The magnitude of this impact would depend on the amount of organic materials, the volume of water in a flooded section, and the rate of bioremediation. Computerized controls on equipment may contain lead, cadmium, mercury, and chromium and could cause water quality impacts if located in a flooded section. However, the magnitude of this impact is estimated to be minimal because of the small amount of controls relative the volume of water likely to be impounded and the slow oxidation rates of these materials in the mine environment.

Petroleum, oils, and lubricants are regularly used in mining operations. These materials may degrade discharge water quality if they are mishandled or abandoned underground and exposed to water passing through the mine. There have been several spills or leaks at the mine which resulted in contamination of Eccles and Mud Creeks. The probability of additional releases to surface water systems has not been assessed. Any toxic or hazardous materials which are used underground would have to be removed from the mine prior to closure.

Cumulative Effects

The project area is considered developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. Due to projected increased recreation use for the area, the Forest Service has plans to further develop the Boulger Reservoir area by reclaiming recreation disturbances directly adjacent to the reservoir and developing additional camp locations with gravel surfacing adjacent to the parking area. In addition, some minor expansion of the Flat Canyon Campground may be needed to accommodate use projections. Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A.

Cumulatively, expansion of facilities and construction of new facilities in the area and increased human use/activity has the potential to degrade the quality of shallow alluvial ground water systems in the area. Any spills of petroleum products, sewage, or other materials due to subsidence, vehicle use, pipeline leaks, and other uses could reach the shallow aquifer systems. If more springs are developed on private lands for use at private facilities, water usage would increase and available water to the shallow ground water systems would decrease. The potential for effects to deep, perched ground water systems is negligible due to the low permeability of the rock layers exposed in the project area.

Flow in surface drainages and shallow alluvial ground water systems has probably increased due to human-caused changes to vegetation densities and types since Euro-American settlement. Conversion of grass/forb vegetation to mountain brush types and soil loss from resulting erosion has decreased the ability of the land to absorb and hold water. Historic timber cutting has decreased the forested area, thereby decreasing transpiration and increasing runoff. Observation of current vegetation types and environments in the project area indicates that conifer invasion of aspen stands, generally causing increased transpiration, is probably not an important factor in the project area (personal communication, Robert Thompson, Forest Botanist).

Deep perched water aquifers (sandstone channels) will be dewatered during the mining process and water will continue to be discharged to surface drainages for the life of the mining operations. Since this stored mine water has been aged at 10,000 years and greater and hydrologic connection to surface waters is through low permeability rock layers, it would take thousands of years to replenish this water. Dewatering of these deep aquifers would not cause direct effects to other resources, but discharge of ground water to surface drainages would cause effects (see Surface Water).

The oil and gas exploration wells projected in Appendix A would employ sediment control measures during construction, operations, and reclamation. Forest requirements for pad design use impermeable pits and berms to prevent fluids used during drilling and precipitation from leaving the disturbed area. Operators are also required to prepare spill prevention and recovery plans to mitigate effects. Drill holes are cased to prevent escape of drilling and production fluids and are plugged on abandonment to prevent contamination and mixing of ground water aquifers.

Irreversible/Irretrievable Commitment of Resources

No effects to the overall amount and quality of ground water available to surface water systems are anticipated, but changes in the location of ground water emergence at springs could occur due to subsidence. No irreversible or irretrievable commitments to the resource are anticipated.

Cumulatively the changes in surface and ground water and flow and quality since Euro-American settlement are irretrievable. The current trends could be reversed with intensive management.

Short-Term Use vs. Long-Term Productivity

Anticipated mining activities are not expected to cause changes to overall ground water flow. No long-term changes to productivity from mining are anticipated. Current activities and trends discussed under cumulative effects would most likely continue.

4.1.5.3 Alternative C

The effects would be generally the same as discussed for Alternative B' even though perennial drainages would not be subsided. The only difference is that a smaller area would be subject to subsidence and the resulting effects.

In the event that there were a perceptible or quantifiable mining-related diminution of groundwater discharge at a developed spring location in the area, the application of the coal mining regulations would require replacement of State Appropriated Waters. Special Coal Lease Stipulation #17 (Appendix C) would require the lessee to replace any water lost from developed groundwater sources with water of similar quality.

Although the impacts to water quality are expected to minimal, the application of SCLS #19 would require that the operator remove mine equipment and materials that are not needed for continued operations, roof support, and mine safety from underground workings prior to abandonment of mine sections, unless specifically approved by the authorized officer in consultation with the Surface Management Agency.

Cumulative Effects

Same as Alternatives B and B'.

Irreversible/Irretrievable Commitment of Resources

Same as Alternatives B and B'

Short-Term Use vs. Long Term Productivity

Same as Alternative B and B'.

4.1.6 Vegetation

The effects to vegetation would generally be caused by the construction of surface facilities, changes in stream morphology due to subsidence, and changes in mine water discharge to surface drainages.

Forest Plan direction and EO 11990 provide the basis for evaluating whether projected changes in riparian areas and wetlands are acceptable or unacceptable. The Forest Plan direction includes the following, "Give preferential consideration to riparian area dependent resources in cases of unresolvable resource conflicts". EO 11990 requires Federal agencies to minimize the destruction, loss, or degradation of wetlands; to preserve or enhance the natural and beneficial values of wetlands; and to consider maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources.

4.1.6.1 Alternative A (No Action)

Under this alternative, no underground coal mining or associated facilities construction would occur in the Flat Canyon Tract. Mining related impacts to vegetative resources in the area would not occur.

4.1.6.2 Alternatives B and B'

Potential effects to vegetation under this alternative include those associated with changes in stream and spring morphology caused by subsidence and those associated with the construction of surface facilities.

<u>Disturbance from Surface Facilities</u>

Exploratory drilling would temporarily disturb an estimated 9.2 acres of vegetation. Disturbance of riparian vegetation for road crossings would be minimized by requiring a bridge or bottomless arch. Disturbance for any individual drill hole would be for one season. The disturbance would be recontoured and planted after completion of the hole. It is estimated that revegetation standards would be met within 3 to 5 years after reclamation and seeding.

Construction of the two ventilation shafts, access roads, and the water pipeline would temporarily disturb approximately 2.9 acres of grass and shrub vegetation. The temporary roads to the vent shafts and most of the vent shaft pads would be reclaimed during the same season as constructed. The unreclaimed portions of the vent hole pads (less than 1 acre) would remain for the life of operations; approximately 12 years. When no longer needed for operations, the reclaimed access roads would be opened again to plug the holes and reclaim the remaining disturbance. Again it would take approximately 3 to 5 years to meet reclamation vegetation standards. It would take additional time, estimated at 5-10 years for the disturbed area to blend with adjacent vegetation and no longer be apparent to the casual visitor.

Revegetation with native species is stressed. Non-natives can be used in some cases if needed to establish vegetative cover as soon as possible to control erosion or to meet management objectives for the area.

These ground disturbing activities could increase the potential for noxious weed infestation in the Swens Canyon and Upper Huntington drainages. Mitigation activities including revegetation of disturbed areas and monitoring/eradication of noxious weeds prior to bond release would reduce the potential for erosion and weed related impacts.

Subsidence

Subsidence induced changes are described in Sections 4.1.1, 4.1.3, 4.1.4, and 4.1.7. They include sequential lowering of surface features by up to 14 feet in affected drainages. These surface changes would likely influence stream morphology; however, water volume in the stream/alluvial groundwater system is not expected to change.

As the stream channel reacts to changes in longitudinal profile, lateral adjustments, such as stream channel widening and bank erosion, and vertical adjustments (entrenching) are likely. Established stream-side riparian vegetation could be lost due to these channel adjustments and to the dewatering associated with channel entrenchment. Since there are two seams of mining, there could be two separate episodes of subsidence and stream channel morphology changes resulting in two separate episodes in loss of riparian vegetation. Depending of the timing, recovery from the mining of the first seam may not occur before the second seam is mined. Stream-side riparian vegetation is primarily two species of willows, and several species of sedges and rushes. This variety in species improves the probability that the riparian community contains species suited for immediate occupancy of disturbed sites and species adapted to more stable conditions. With Alternative B, reestablishment of vegetation along eroded stream banks would be relatively rapid (5 to 8 years) if the channel does not meander into the valley toe slopes and if channel entrenchment does not occur. If the channel does meander into the valley toe slopes, reestablishment of riparian vegetation may not occur. With Alternative B', stream channel stabilization and revegetation would be required; therefore, most adverse effects associated with lateral channel adjustments would be mitigated.

Vertical channel adjustments may result in straightening of the stream channel, increased runoff rates, and lowering of the alluvial water table. While established vegetation might survive the change in water table, new seedlings from natural reproduction or planted stock would have a reduced likelihood of survival. The effects of dewatering may extend beyond the immediate streamside zone into the valley floor. Therefore, with both Alternatives B and B', streamside vegetation would likely be lost in areas of vertical adjustment.

Subsidence may cause some local alterations in groundwater flow direction, which may cause spring discharge locations to shift. The existing wetland communities surrounding these springs would be lost. Reestablishment of similar wetland communities at new spring locations would likely take 10 to 20 years as existing vegetation is replaced by hydrophilic species. The actual locations of springs and/or seeps which may be impacted is not known. Commercially available planting stock is not generally available for the species characterizing these wetlands; therefore, the possible effects of Alternatives B and B' are similar.

There are two locations in the Boulger Creek sub-basin with larger wetlands: the headwaters of the left fork and a portion of the right fork upstream of the confluence of the two tributaries. These wetlands are maintained by precipitation and their inherent "sponge" effect, by springs along the margins of the wetlands, and by groundwater from upstream alluvium or upwelling. The wetland in the left fork does contain peat, which is a remnant of the glacial epochs. The wetland in the right fork has not been evaluated in detail. Possible effects from subsidence would be similar to those described above due to relocation of springs and vertical adjustments in the stream channels and dewatering through the wetlands. Peat wetlands are very sensitive to hydrologic changes, especially reductions in flow and typically do not recover. Alternatives B and B' could affect wetland characteristics and result in a loss in the peatland component of these wetlands.

Cumulative Effects

The project area is heavily developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. Continued development of private lands in the project area and the coal drilling activities are expected to affect vegetation. Loss of vegetation for coal drilling activities and drilling of the vent holes are short-term. Vegetation removal for expanded or new development of private lands would be long-term. Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A.

Cumulatively, livestock grazing, expansion of facilities and construction of new facilities in the area and increased human use/activity has the potential to affect vegetation. Human-caused changes to vegetation densities and types since Euro-American settlement have occurred. Conversion of grass/forb vegetation to mountain brush types and soil loss from resulting erosion has decreased the ability of the land to absorb and hold water. Historic timber cutting has decreased the forested area, thereby decreasing transpiration and increasing runoff. Observation of current vegetation types and environments in the project area indicates that conifer invasion of aspen stands, generally causing increased transpiration, is probably not an important factor in the project area (personal communication, Robert Thompson, Forest Botanist).

The projected four wildcat oil and gas wells could disturb approximately 2.5 acres each for pads and access roads for a total of 10 acres of disturbance. If the wells become producers this disturbance would last for approximately 20 years. If the wells do not produce, they would be reclaimed and revegetated as described for the coal exploration well pads.

Irreversible/Irretrievable Commitment of Resources

The disturbance to vegetation from the anticipated mining activities would be short-term (3-5 years) and irretrievable. Historic changes are irretrievable and irreversible.

Short-Term Use vs. Long-Term Productivity

Anticipated mining activities are not expected to cause any long-term changes to vegetation productivity. Current activities and trends discussed under cumulative effects would most likely continue.

4.1.6.3 Alternative C

Disturbance from Surface Facilities

The effects would be the same as Alternatives B and B'.

Subsidence

Subsidence of perennial stream channels would not occur with the possible exception of the Cunningham Drainage. No effects to riparian vegetation in the vicinity of the stream channels are anticipated. The majority of the springs maintaining wetlands are adjacent to the valley bottom and would be within the unsubsided zone. Therefore, no adverse effects to wetlands are anticipated.

Cumulative Effects

Same as Alternatives B and B', except that there would be no effects to vegetation from subsidence of perennial drainages.

Irreversible/Irretrievable Commitment of Resources

Same as Alternatives B and B', except that there would be no effects from subsidence of subsidence of perennial drainages.

Short-Term Use vs. Long-Term Productivity

Same as Alternatives B and B'.

4.1.7 Wildlife

Terrestrial wildlife species could be affected by changes in riparian habitat as discussed above and by the activity and loss of vegetation associated with surface facilities.

Effects to aquatic wildlife involve changes to stream morphology from subsidence and changes to surface water quantity and quality in Eccles Creek, Scofield Reservoir, and Electric Lake related to mine water discharge. The impacts to aquatic wildlife associated with mine water discharge could include local increases in aquatic habitat (based on higher flow and longer duration of flow), though the possibility that increased flow could influence sedimentation and erosion in some stream reaches also exists. The extent and duration of these impacts are difficult to predict due to the likelihood that mine water would only be pumped on an intermittent basis.

4.1.7.1 Alternative A (No Action)

Since no leasing or mining would take place, there would be no effects.

4.1.7.2 Alternatives B and B'

TERRESTRIAL WILDLIFE

Disturbance from Surface Facilities

These activities are short-term, temporary activities. Big game and small animals would probably avoid the activity areas until activities are completed. The loss of vegetation and habitat is small and temporary with little consequence to populations. Some shifting of spring locations used for watering could cause animals to water at alternative locations. With the abundance of perennial springs and streams in the project area, this is not of consequence to populations.

Potential impacts to goshawks, flammulated owls, and three-toed woodpeckers could occur under Alternative B if operations occur during periods of nesting. Activities could cause territory abandonment and/or reproductive failure. These effects would relate to the disturbance associated with exploratory drilling activities the construction and maintenance of the ventilation shaft(s), the associated road(s), and the pipeline from Swens Canyon to Electric Lake.

Under Alternative B', SCLS #14 would restrict operations to times that would not adversely affect species in important seasonal habitat areas. Intensive activities such as construction and drilling would generally take place during the summer and early fall months (after July 15th and before November 1). The time restrictions in individual areas would be dependant on species present, habitat types, and weather conditions. Mitigations to protect goshawks, flammulated owls, and three-toed woodpeckers would be required. Mitigations specific to these species includes site-specific surveys following USFS protocols to locate breeding or juvenile birds and avoidance of occupied breeding territories during the breeding/nesting season. If nesting individuals are found, operations in areas that could affect them would not be allowed between late April and the end of September.

Subsidence

Subsidence is not expected to cause any direct effects to terrestrial species. Surface cracks and minor changes to spring emergence locations could affect individual animals but should not affect populations.

Mine Water Discharge

No affects to terrestrial wildlife are anticipated.

Threatened and Endangered Species

No effects to wintering or migrating bald eagles are anticipated under either alternative.

AQUATIC WILDLIFE

Forest Plan direction, standards and guidelines provide the basis for evaluating whether projected changes in aquatic habitat and fish populations are acceptable or unacceptable. The Forest Plan direction includes the following, "Give preferential consideration to riparian area dependent resources in cases of unresolvable resource conflicts" and "Manage waters capable of support self-sustaining fish populations to provide for those populations". Plan standards include the following, "Coal leases maybe denied or limited by special stipulations where (5)operations would result in unacceptable or unmitigable impact on wildlife or fisheries" and "Proposed management activities which may cause unfavorable conditions in existing fisheries will include mitigation measures".

Any changes in stream gradient/morphology, water flow and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species.

Disturbance from Surface Facilities

Exploratory drilling would disturb an estimated 9.2 acres within the project area. Construction of the ventilation shaft, access road, and pipeline in the lower reach of Swens Canyon and along the highway in Upper Huntington Creek, would disturb approximately 2.9 acres of native grass and shrub vegetation in the road/pipeline corridor. This could potentially cause sediment to enter adjacent streams, either during construction or due to post-construction erosion. These temporary impacts could occur with both action alternatives. Required sediment control measures and use of Best Management Practices would reduce or eliminate the potential for adverse effects due to short and long-term sedimentation into these streams to a negligible level.

Subsidence

Longwall mining commonly results in differential subsidence of the land surface. Longwall mining under a stream channel would cause localized changes in channel gradient. Between the outer edges of individual panels, the stream channel would be lowered by subsidence but the gradient would generally not change. Differential subsidence and associated gradient changes would occur at the outer panel edge in the area defined by the angle-of-draw. Therefore, the greatest potential for major alterations in stream morphology occurs above panel ends or above longwall gate roads. The amount of gradient change would depend on the panel orientation relative to the channel and the stream gradient, whether only one or two seams would be mined, and how the panel edges would be aligned for the overlying panels. Based on two seams of mining, with stacked fire barriers, the maximum slope change expected from subsidence under perennial drainages is approximately 3% (Table 4.1, Subsidence Point 6, Boulger Dam).

In the Burnout study (Sidel, et. al. 2000), surface changes due to subsidence were expressed mainly as increases in the extent of pools. Many of the channel attributes studied produced inconclusive results, but subsidence effects generally did not cause major detrimental impacts. Subsidence-induced changes in channel gradient at Burnout Canyon, even in the areas of maximum differential subsidence, were not great enough to cause barriers to fish movement in the stream. Extrapolation of this study must be confined to stream systems with similar gradients in the range of 5 to 7 percent. This would include the upper portions of Swens and Little Swens Canyons, Boulger Creek in the vicinity of the confluence of the left and right forks, the lower portion of the left fork of Boulger Creek, the lower portion of the South Fork of Boulger Creek, and Cunningham Creek.

The Burnout study should not be extrapolated to stream segments with gradients flatter than approximately 5%. This would include Flat Canyon (1.5 miles), the majority of Boulger Creek (4.0 miles), and the lower portions of Swens (0.5 mile) and Little Swens Canyons (0.5 mile). These systems have gradients flatter than the maximum slope change expected from subsidence of approximately 3%. Subsidence could cause areas of entrenchment (increased positive gradient) and pooling (negative gradient) in the vicinity of maximum differential subsidence, and increased lateral stream movement in other subsided areas.

Stream systems adjust to increased positive gradients by entrenching and by a combination of channel widening and increased lateral movement (Rosgen, 1996). This would increase the sediment load in the affected stream segments and downstream and could result in loss of some habitat features. While areas of negative gradient would result in pooling, the deposition of sediment from upstream entrenchment would reduce the habitat quality of existing pools and those created by subsidence. Some pools may be effectively lost if filled with enough sediment. New pools created by subsidence could breach at locations other than the original channel. This new channel would scour through the temporary pool and continue eroding upstream, contributing even more sediment and habitat loss. Increased lateral movement of the stream channel between zones of positive/negative gradient would result in additional sediment produced by stream bank erosion. If the channel should migrate to the edge of the valley bottom, undercutting of valley side slopes could occur, also resulting in additional sediment.

Because the majority of the fish habitat in Boulger Creek is in areas of relatively flat gradient, the possible effects of subsidence would affect the entire stream system. With Alternative B, stream channel adjustments and the consequent loss of habitat features could significantly reduce the productivity of the currently very productive fishery. Effects in the other stream systems in the project area would be less pervasive because there are fewer miles of flat gradient and the flat gradient segments are in the downstream portions of the stream system. Return to equilibrium conditions could require 10 to 30 years and may not occur in all stream segments. Alternative B and B' differ in their effects in that remedial measures would be required in B'. These measures could include temporary and permanent stream channel stabilization, grade control structures, planting of streamside vegetation, or reconstruction of segments of stream channel. The measures associated with B' would partially offset the effects of Alternative B, but would not fully mitigate the potential loss of habitat features and the effects of sedimentation.

Loss of population viability for the fish populations in Electric Lake and the connected tributaries is not expected due to the effects of subsidence. The effects described above would affect individual fish. These fish that are impacted are likely to be displaced and move to more suitable habitat, perhaps in other stream systems connected through Electric Lake. As described in the Surface Water section, there is a very low probability that subsidence would affect the quantity of water in the stream systems. If total dewatering of any of these streams should occur from bedrock fracturing, population viability would be impacted.

Under Alternative B', Boulger Reservoir Dam would be breached and a new stream channel would be established and armored with riprap and gravels to avoid potential safety concerns and prevent erosion of the reservoir sediments. The existing reservoir habitat and new stream channel through the reservoir area would be lost as effective aquatic habitat for the duration of mining and subsidence estimated at approximately 12 years. Fish and macroinvertebrate passage would be provided for in the channel design.

Changes to mine water discharge would affect flow and affect aquatic and terrestrial wildlife species and habitat

Change in location of mine water discharge would affect Eccles Creek and Mud Creek. That portion of Eccles Creek on National Forest Systems lands potentially affected does not support a fishery. The effects on aquatic organisms and habitats on private lands have not been evaluated. The possible water quality effects of mine water discharge are described in the Surface Water section. Nutrient increase in Electric Lake from mine water discharge may increase fish productivity, but not likely to the point where there are viability risks to the lake populations. Eutrophic conditions in Scofield Reservoir have resulted in periodic fish kills. If eutrophic conditions were to occur as a result of increases phosphorous in Electric Lake, individuals would be impacted but there would not likely be effects to the population viability.

Cumulative Effects

Due to historic vegetation changes, development, and the high human use of the project area, habitat types have changed considerably since Euro-American settlement. The number of species, populations, and distribution of species have changed accordingly to the current condition described in Chapter 3 for terrestrial and aquatic wildlife. The effects described in this section relative to leasing/mining would occur in addition to those that have already occurred in the project area.

The north-facing slopes of Flat, Cunningham, and Swens Canyons have recently experienced considerable logging activities on non-Federal lands, including the associated road construction and soil and vegetation disturbances. These disturbances may contribute additional sediment to the stream systems, but to a lesser extent than that expected from stream channel adjustments.

Construction and operation of the projected oil and gas wells on Trough Springs Ridge could cause temporary avoidance by terrestrial wildlife species in the summer and fall during construction, drilling, and reclamation operations. Timing restrictions on these operations would prevent effects to species during use of important seasonal habitats. Gravel surfacing of the road could increase traffic and recreation use along the ridge during the summer and fall seasons. The Trough Springs Ridge road is gated during the winter and spring months to prevent road damage and disturbance to wildlife.

Irreversible/Irretrievable Commitment of Resources

The effects described above relative to surface facilities and mine water discharge would be irretrievable but not irreversible.

The effects described above relative to subsidence would be irretrievable. Measures could be taken to mitigate the effects.

Short-Term Use vs. Long-Term Productivity

The effects of these alternatives relative to surface facilities would be short-term and would not affect long-term wildlife productivity. The effects to aquatic habitat from mine water discharge would be temporary (12 years). The effects of subsidence would be long-term.

4.1.7.3 Alternative C

TERRESTRIAL AND AQUATIC WILDLIFE

Disturbance from Surface Facilities

The effects would be the same as discussed for Alternatives B and B'.

Subsidence

Under this alternative, subsidence of perennial drainages, Boulger Dam, and Boulger Reservoir would not occur, and morphological changes to instream habitat parameters (changes in distribution of pools, riffles, glides, and runs) and any corresponding water related impacts to bank vegetation resulting from stream subsidence would not be expected to occur.

Undermining and subsidence related impacts to springs and seeps throughout the tract would however, be expected under this alternative, and the potential for reductions or other changes in surface recharge to wetlands and seeps would exist. Drawdown related impacts to riparian and wetland associated plant communities throughout the tract could occur but are expected to be negligible.

Mine Water Discharge

The effects would be the same as discussed for Alternative B'.

Threatened and Endangered Species

The bald eagle is the only federally listed species with potential to occur in the project area. No effects to wintering or migrating bald eagles are anticipated.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable but not irreversible.

Short-Term Use vs. Long-Term Productivity

The effects of this alternative relative to surface facilities would be short-term and would not affect long-term wildlife productivity. There would be no long-term effects to productivity from subsidence and seismicity.

Cumulative Effects

Due to historic vegetation changes, development, and the high human use of the project area, habitat types have changed considerably since Euro-American settlement. The number of species, populations, and distribution of species have changed accordingly to the current condition described in Chapter 3 for terrestrial and aquatic wildlife. The effects described in this section relative to leasing/mining would occur in addition to those that have already occurred in the project area.

4.1.8 Lands and Special-Uses

4.1.8.1 Alternative A (No Action)

There would be no effects.

4.1.8.2 Alternatives B and B'

Upon leasing, land uses would essentially remain the same. No changes in Forest Plan management unit designations or management emphasis would result. Grazing permits and other special-use permits would not be affected.

The Questar gas pipeline that lies under SR-264 was authorized by a Forest Service Special-Use Permit. The segment of this pipeline in the project area has been relocated and is no longer in service. The special-use permit has been revised accordingly.

4.1.8.3 Alternative C

Same as Alternative B

4.1.9 Recreation

Effects to recreation could result from surface disturbance for facilities, subsidence, and seismicity.

4.1.9.1 Alternative A (No Action)

There would be no effects. No mining related surface disturbance or subsidence would occur, although mining-induced seismicity from the existing mining operation would continue. People recreating in the project area may perceive some of the larger events (2.0 or greater within 3,400 feet of the location of mining) generated from mining in the existing permit area to the east. The level of perception and concern appears to be different for individuals. However, it is unlikely that the vibrations would be strong enough to cause concern. Over the last 13 years, approximately 1,000 events greater than 2.0 have been recorded and attributed to mining at the Skyline Mine. This is equivalent to an average of about one event every 5 days. Based on a distinctly perceptible limit for short duration events of 1 in/sec PPV, and event of magnitude 2.0 can be distinctly felt for a radius of about 3,400 feet from the location of mining. The Forest has not received complaints or inquiries about these events over any of the extensive areas of mining on the Wasatch Plateau. Even though some may have been perceived, they did not appear to generate concern from the general public.

4.1.9.2 Alternatives B and B'

Disturbance from Surface Facilities

The anticipated coal drilling associated construction and traffic could temporarily degrade the recreation experience of people using the project area. These activities would occur during the summer season or fall seasons. The sights and sounds of the heavy equipment and drill rigs could be perceived by sight-seers, hikers, fishermen, and hunters. This activity is temporary, lasting only a couple weeks for individual holes. Drilling could continue for several seasons, but the activity would shift to different locations.

The construction of access roads for the vent shafts and the drilling operations would be seen and heard by people recreating in the canyon areas. During operations, the vent shaft in Swen's Canyon could be seen and potentially heard by people as they drive by the mouth of Swen's Canyon along SR-264 for a distance of approximately 150 feet. Drilling of the Boulger Canyon vent shaft would be visible and audible only from the Boulger Canyon road well above Boulger Reservoir at the upper forks. This would be a concern for fishermen and sightseers in this area. Construction of the roads and drilling of the holes could take up to 2-3 weeks. Once the shafts are completed and the roads reclaimed the disturbance from the activity and noise would cease, but the roads would be visible until vegetation grows in and blends with the surrounding area (probably 3-5 years). The ventilation shafts would exhaust air from underground workings. On infrequent occasions, when the wind currents are very calm exhaust air can move down canyon. During these conditions low-level diesel exhaust fumes could be apparent to recreation users in the general vicinity. There would be no mechanical noise but the sound of the rush of air could be perceived at short distances from the shafts.

The chain link fences at the shafts would pose a safety hazard to snowmobilers. Contributing to the hazard are the high-speed capabilities of snowmobiles and bright snow reflective conditions that often impede vision of the operators. This would be mitigated by placing high visibility signs on the fence near the top, above the snow.

Subsidence

Boulger Reservoir

Boulger Reservoir Dam could be damaged and fail as described in Section 4.1.3.2. This could result in downstream hazards to fishermen and sight-seers in the downstream channel. The dam and related facilities would remain out of service indefinitely, at least 12 years.

Alternative B' would require measures to avoid the associated downstream effects and hazard. It would be necessary to breach the dam and take the facility out of service until subsidence is complete. Considering that mining would take place in two separate seams at different times, the reservoir could be out of service by up to 12 years. The lessee/operator would be required to reconstruct the facility after mining and subsidence are complete. Reinforcing the dam sufficient to prevent damage is also an option but would probably not be effective considering the magnitude of expected subsidence.

Boulger Reservoir is a very popular day use fishing area during the freeze free months, with highest use between July 4 and Labor Day. Under both Alternatives B and B' there would be lost use of the still fishing recreation opportunity at the reservoir for this time period. Current use is approximately 5,000 RFDs per year (freeze free season). Multiple this by twelve years, this would be a loss of 60,000 RVDs. People would be displaced to other facilities such as Beaver Dam Reservoir, Electric, and Gooseberry Campground and Reservoir that provide similar fishing experiences.

Flat Canyon Campground

Structures at Flat Canyon Campground could be damaged by subsidence as discussed in Section 4.1.3.2. Structures that are necessary to the usability of the campground include the spring collection system/retaining wall, water tank/faucet delivery system, and the toilet, including septic tank and drain field. The related safety hazard is not considered high but is a concern. Potential safety hazards include shifting and cracks to structures while in use and falling trees. Some trees in the area are already weakened due to camping related effects. Cracks to the toilet vault could occur and raw sewage could leak to the surrounding area.

Due to potential safety hazards regarding use of the Flat Canyon Campground during active subsidence, the campground would be closed. Active subsidence generally lasts 6 months after mining beneath a specific point or area on the ground surface. Since there are two seams of potential mining, it is estimated that the campground would be closed for two seasons, probably separated by at least 2 years. The campground is closed during the winter from mid-September until about the last week of June, depending on snow conditions. Closing of the campground for two summer-use seasons represents a loss of approximately 6,000 Recreation User Days (RVDs). This could involve a loss of $4,000 per year to the concessionaire with a potential total of $8,000.

Under Alternative B', the lessee/operator would be required to monitor these systems during active subsidence and to repair any damages.

Summer Homes

The summer homes on non-Federal lands within the project area could be damaged by subsidence and it is not recommended that they be occupied during active subsidence. Potential damages are described in Section 4.1.3.2. This could cause a loss of use in two separate episodes of mining and subsidence up to approximately a year each for each seam of mining. If damages to the structures occur that render them unsafe for occupancy, there would be additional periods of lost use until repairs are made. Determinations regarding occupancy during active subsidence would be up to the property owners and arrangements for repairs of damages would be negotiated between private and mineral estate owners and the mining company.

Hunt Reservoir

There would be no subsidence damage or lost use from subsidence.

Dispersed Recreation

No safety hazards are expected other than those described above relative to potential failure of Boulger Dam.

Seismicity

Boulger Reservoir

Mining-induced seismicity could damage Boulger Reservoir Dam as described above in the subsidence section. Under both Alternatives B and B' the facility could be out of service for approximately 12 years.

Flat Canyon Campground/Summer Homes/Dispersed Recreation

Mining-induced seismic events could be felt by people using the campground and the summer homes, as well as other people in the project area. The seismic events are not anticipated to cause a safety hazard but could be felt by recreationists, especially campers sleeping on the ground. Under Alternative B', signs would be posted in the campground warning campers of the potential seismic activity to reduce concern.

The period of greatest potential for seismic events to cause effects to dispersed recreation, campers, and summer home users would be during the summer use season during the period of active subsidence. Since the campground would be closed during active subsidence, the effects would be minimized. Use of the summer homes decreases during the winter months.

Hunt Reservoir

Hunt Reservoir Dam could be damaged by mining-induced seismic events. If it is damaged or taken out of service, use of this small reservoir at Camp Shalom during the summer season could be lost for up to 12 years.

Cumulative Effects

As described in Chapter 3 and displayed on the table of past, present, and reasonably foreseeable future actions in Appendix A, increased recreation use of the project area is expected due to increasing population and demand for recreation opportunities. Plans to improve Flat Canyon Campground and facilities at Boulger Reservoir are intended to increase use capabilities.

The effects of mining described in the previous section would occur in addition to the projected recreation demand. The long-term (9 to 12 years) lost use of Boulger Reservoir and short-term (2 seasons) lost use of Flat Canyon Campground could displace recreation use to other facilities in the area, increasing usage rates.

The projected oil and gas exploration operations on Trough Springs Ridge could temporarily degrade the dispersed recreation experience along the ridge and SR-264 during construction, drilling, and reclamation operations due to the noise, traffic, and activity. If the wells become producers, the visibility of the wells could degrade some peoples dispersed recreation experience for many years along Trough Springs Ridge, depending on their attitude toward this type of operation. Gravel surfacing of the road could increase traffic and recreation use along the ridge during the summer and fall seasons. The Trough Springs Ridge road is gated during the winter and spring months to prevent road damage and disturbance to wildlife.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the periods of lost use but would not be irreversible.

Short-Term Use vs. Long-Term Productivity

The lost use of facilities due to leasing/mining would be both short and long-term as described above. Use of the facilities would be restored upon replacement/repair.

4.1.9.3 Alternative C

Disturbance from Surface Facilities

The effects would be the same as described under Alternatives B and B'.

Subsidence

The structures described above under Alternatives B and B' would not be subsided, therefore there would be no damage. The summer homes north of Swen's Canyon on non-Federal lands and non-Federal mineral estate could potentially be damaged by subsidence as described under Alternatives B and B'.

There would be no need to close Flat Canyon Campground so there would be no loss of use.

Seismicity

The effects would be essentially the same as described under Alternatives B and B' except that the severity of mining-induced seismic events perceived at the Flat Canyon Campground and at the protected private summer homes in the subsidence protection zones could be reduced because mining would not occur directly beneath these areas.

Cumulative Effects

Increased recreation demand and use would occur as described under Alternative B. No lost use would occur at Flat Canyon Campground. Recreation use of Boulger Reservoir and the associated facilities would occur for a shorter period of time. Lost use would be for 5 to 7 years rather than for 9 to 12 years.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the periods of lost use but would not be irreversible.

Short-Term Use vs. Long-Term Productivity

The lost use of facilities due to leasing/mining would be both short and long-term as described above. Use of the facilities would be restored upon replacement/repair.

4.1.10 Visual Quality

The only anticipated effects to visual quality would be the result of surface facilities. There would be no apparent visible effects of mining-induced subsidence and seismicity.

4.1.10.1 Alternative A (No Action)

There would be no effects, therefore no change to visual quality..

4.1.10.2 Alternatives B and B'

The roads and drill pads for the exploration holes and vent shafts would degrade visual quality but would be consistent with visual quality objectives for the area.

The anticipated coal drilling associated construction and traffic could temporarily degrade the visual quality but the exact locations of exploration drill holes can't be accurately predicted at this time. These activities would occur during the summer and/or fall seasons. The sights and sounds of the heavy equipment and drill rigs could be perceived by sightseers, hikers, fishermen, motorists and hunters. Based on the topography of the project area it is likely that some of the drilling operations would be visible from SR-264 that is part of the Huntington and Eccles Canyons National Scenic Byway. Since there are no special restrictions on activities that would be visible from Scenic Byways, this would be consistent with management direction and Forest Plan direction. This activity is temporary, lasting only two to three weeks for individual holes. It is possible that not all of the holes would be drilled in a single season but could be spread out over several seasons. Once operations are complete and the pads and access roads are returned to approximate original contour and reclaimed, the disturbance would be visible because of the lack of vegetation. It is anticipated that it would take approximately 3-5 years for vegetation to become established consistent with ground cover in the adjacent undisturbed area. It could take 5-10 years before the disturbed area would completely blend with adjacent vegetation and not be noticeable as a former disturbance.

The construction of access roads for the vent shafts and the drilling operations would be seen and heard by people recreating in the canyon areas. During operations, the vent shaft in Swen's Canyon could be seen and potentially heard by people as they drive by the mouth of Swen's canyon along SR-264 in the foreground. Drilling of the Boulger Canyon vent shaft would be visible and audible only from the Boulger Canyon road well above Boulger Reservoir at the upper forks in the middleground and foreground. This would be a concern for fishermen, hunters, and sightseers in this area. Construction of the roads and drilling of the holes could take up to 3-4 weeks. Once the shafts are completed, the unused portion of the pad and the road would be recontoured and reclaimed. At this point the disturbance from the activity and noise would cease, but the pad and roads would be very apparent until vegetation grows in consistent with ground cover in the adjacent undisturbed areas. It is likely that differences in vegetation would be apparent only to those familiar with the past disturbance for an additional 5-10 years, until species combinations merge. A 6-8 foot tall chain link fence around each of the vent shafts and a concrete foundation at the top of the shafts would be visible. The shaft in Swen's Canyon would be screened by a ridge as viewed from SR-264 and not apparent to passing motorists. The shaft could be visible from the Swen's Canyon road for a distance of approximately 150 feet but would not be readily apparent due to the use of colors that blend with the background. The shaft in Boulger Canyon would be visible along the upper reaches of the Boulger Canyon roads. The ventilation shafts would exhaust air from underground workings. On infrequent occasions, when the air is still and the outside air temperature is considerably colder than the vented air, a plume of water vapor could be visible from SR-264 and the adjacent area for considerable distance. There would be no mechanical noise but the low-level sound of the rush of air could be perceived only immediately at the shaft locations.

Upon completion of mining, approximately 12 years from construction, the vent holes would be backfilled. In order to backfill the shafts and reclaim the disturbance it would be necessary to again construct the temporary access roads. Backfilling of the vent holes would take approximately 2-3 weeks. The associated traffic and activity would temporarily degrade visual quality for this period of time. Dump trucks (end-dump, 10 cubic yard capacity) would most likely used to haul rock fill material to the site. Approximately 20 -25 loads would be required to fill each hole. Once backfilling is completed the pads and roads would again be recontoured, reclaimed and revegetated. It would take 3-5 years for vegetation to become established to standard but 5-10 years for vegetation to blend with the surrounding area before the disturbed area would no longer be noticeable by the casual visitor.

The Boulger Canyon Dam would be breached and taken out of service for the life of operations (up to 12 years). This would leave a dry reservoir area with little vegetation that would be very noticeable by motorists on SR-264 the Boulger Canyon Road. This would be an obvious human activity. The reservoir would be replanted to decrease visibility but it would take 3-5 years before the reservoir bed would become vegetated. It would take up to 10 years for vegetation to blend with the surrounding area and the dam and depression would still be somewhat visible. Once mining is completed and subsidence is substantially complete, the reservoir would be dredged and the dam would be rebuilt and refilled.

Cumulative Effects

The visual landscape of the project area has been highly modified. Man's activities dominate the foreground and middleground as viewed from SR 264. Additional improvements of private lands are projected that would increase visual modifications to the landscape. The visual effects described above regarding mining would be short-term and consistent with visual quality objectives considering all past, present, and reasonably foreseeable future actions.

The projected oil and gas wells on Trough Springs Ridge could further degrade visual quality, but would generally not be seen from the project area. Operations on the ridge would be consistent with visual quality objectives for the area.

Irreversible/Irretrievable Commitment of Resources

The effects to visual quality would be irretrievable during their duration of effect but would not be irreversible. Disturbances would be removed after use and the disturbed areas would be recontoured and reclaimed.

Short-Term Use vs. Long-Term Productivity

Disturbance for exploration drilling and construction/reclamation of vent holes would be short-term. The fences around the vent holes would be visible for only short distances for the long-term.

4.1.10.3 Alternative C

The effects would be the same as described for Alternatives B and B'.

Cumulative Effects

Same as Alternatives B and B'

Irreversible/Irretrievable Commitment of Resources

Same as Alternatives B and B'.

Short-Term Use vs. Long-Term Productivity

The effects would be the same as Alternatives B and B' except that the vent holes would remain in use for 5 to 7 years as compared to 9 to 12 years for Alternative B.

4.1.11 Transportation

Effects could result from the construction and operation of surface facilities, subsidence, and from the extended period of mine operations by increasing the mine life.

4.1.11.1 Alternative A (No Action)

There would be no effects.

4.1.11.2 Alternatives B and B'

Disturbance from Surface Facilities and Extended Mine Life

Construction and drilling traffic for exploration holes and the vent shafts will use SR-264 and Forest Roads for access to the project area. This would consist of the truck mounted drill rig, compressor/generator truck, drill pipe truck, two or three frac-tank trucks (if conditions don't allow digging a reserve pit), a low-boy for transport of a backhoe and a dozer, a water truck, a utility truck with fuel tank, and several pickup trucks for crew transport. This temporary increase in traffic on SR-264 is not expected to cause traffic or safety concerns, or damage to the pavement, beyond normal levels. Some damage from heavy vehicle loads could occur to native surface Forest Development Roads, especially when they are wet. The lessee/operator would be required to suspend operations when roads are wet and susceptible to damage, obtain a road-use permit for this commercial use, maintain the roads as necessary to assure safe access, and repair damages upon completion of operations. A performance bond would be required under the road-use permit to assure maintenance and repairs. Approximately 2.3 miles of temporary roads would be needed for coal drilling. Another 1,000 feet of temporary roads would be required for access to the vent shaft sites. Each individual road would only be in service for one field season prior to reclamation.

Existing mine related traffic levels on SR-264 and SR-31, including haul trucks, support vendors, and employee traffic would continue for an additional 9-12 years. Since the majority of coal is conveyed to the unit train loadout then shipped via rail, and production levels are not expected to increase, this would be a negligible effect.

Subsidence

Subsidence and damage to SR-264 is discussed in Section 4.1.3.2. Short duration traffic delays could occur as repairs to the road surface and drainage structures occur. Monitoring of the road during active subsidence and repair of hazardous cracks immediately, if they occur, would abate any potential safety hazard.

The native surface Forest Development Roads in the project area could be subsided up to 14 feet. Maximum tension is likely to occur on the roads at the ends of longwall panels near their intersections with SR-264. Most cracks that are known to occur are narrow with no vertical offset and are not likely to even be noticed or require repairs. Since the larger cracks (greater than 2 inches in the Skyline Mine Permit Area occurred on ridge tops where slopes are actively moving through soil creep, it is unlikely that cracks large enough to cause safety problems would occur on the roads. Under Alternative B' (SCLS #13, the lessee/operator would be required to patrol the roads on a daily basis during active subsidence to discover any cracks and repair them to avoid safety problems. The cost of repairs is estimated at approximately $12,000.

Two private roads cross Flat Canyon Creek providing access to private cabins and buildings. Subsidence of the stream could cause the roads to become submerged and the saturated zones could expand laterally. The roads may become unusable until repairs can be made to properly raise the running surface to above the water level and provide adequate drainage. It is assumed that repairs would be required in the mine permit. These roads could be out of service for a couple weeks before repairs are completed.

Cumulative Effects

Traffic volumes on SR 264 are currently generally below design capacity. Timber cutting on the private lands just west of the project area and the associated hauling on SR 264 has occurred during 200 and 2001. Hauling is expected to continue through 2002. Logs are hauled on SR 264 to the west then down Fairview Canyon on SR 31. Projected increases in recreation demand and use would result in increased traffic, especially during holiday weekends and the regular big-game hunts. The increased traffic related to construction and drilling of coal exploration holes and the two vent holes would be temporary and not expected to cause significant conflicts with existing traffic. It is Forest policy to not allow mobilization of drill rigs and heavy equipment during holiday weekends or the opening weekends of the general big-game hunts. However, operations and support traffic are allowed during these times.

Existing traffic levels associated with the Skyline Mine on SR 264 and SR 31 would continue for an additional 9 to 12 years.

Traffic could be delayed on Forest System Roads and private roads during construction and drilling operations for short periods of time during mobilization of equipment.

Any subsidence caused cracks in SR 264 or to Forest System Roads and private roads would be repaired immediately upon discovery and are not expected to cause safety hazards or significant traffic delays during repair. Short delays could be required during repair similar to regular road maintenance activities.

Oil and gas exploration traffic along SR-264 would be heavy (approximately 50 truck loads to mobilize drill rigs) for about two weeks during rig mobilization. This traffic would be cumulative with existing traffic and mine related traffic and could cause traffic backup for these short time periods. There is potential for this to happen for each of the four wells. About one well per year is projected with one or two years between wells.

Irreversible/Irretrievable Commitment of Resources

No irreversible or irretrievable commitments are expected.

Short-Term Use vs. Long-Term Productivity

Currently existing traffic levels associated with the Skyline Mine would be extended for another 9 to 12 years.

4.1.11.3 Alternative C

Disturbance from Surface Facilities and Extended Mine Life

The effects would be the same as discussed under Alternative B except that the mine life and existing mine related traffic levels would increase by fewer years (less than 12 years).

Disturbance from Surface Facilities and Extended Mine Life

Since the highways and Forest Roads lie with the protection zones for perennial drainages they would not be subjected to subsidence and the related damages discussed under Alternative B.

Cumulative Effects

The effects would be the same as discussed under Alternative B, except that SR 264 would not be subjected to subsidence.

Irreversible/Irretrievable Commitment of Resources

Same as Alternative B.

Short-Term Use vs. Long-Term Productivity

Existing traffic levels on SR 264 and SR 31 associated with the Skyline Mine would be extended for 5 to 7 years.

4.1.12 Cultural and Historic Resources

4.1.12.1 Alternative A (No Action)

There would be no effects.

4.1.12.2 Alternatives B and B'

Cultural resource surveys are required by the National Historic Preservation Act and regulations. They would be required under both Alternatives B and B'.

Surveys would be conducted prior to approval for construction of the drill holes, vent holes, and associated roads. If archaeological/historic resources are found, appropriate measures would be taken to protect significant sites. On private lands, the responsible Federal and State agencies must assure that reasonable efforts are made to identify and protect sites. However, the Federal and State agencies do not have the authority to require protection of sites on private lands. These sites are under private ownership and subject to the desires of the private landowners.

Little, if any, damage to significant historic roads and trails is expected from subsidence. Any cracks up to 12 inches in width would naturally heal over one to two years. Any cracks larger than this or that would pose a safety hazard would be filled-in by the lessee/operator in such a way as to protect the integrity of these linear features, after consultation with the Utah State Historical Preservation Office (SHPO). If vehicular equipment use over the road or trail would impact them, the repairs would be made by hand crews with access by foot or horseback.

Historic wood and log structures in the project are not likely to be damaged by subsidence. However, any stone or masonry foundations could be cracked by subsidence under certain conditions that are difficult to predict.

Lithic scatters are the only prehistoric Native American sites are known to occur the project area. They are not located in areas of projected high tensile strains, causing surface cracks, so they are not likely to be affected by subsidence.

Cumulative Effects

Historic sites on Forest System and private lands would continue to degrade with time due to exposure to erosion, sheep grazing, and human visitation. The potential effects discussed above could also occur.

Irreversible/Irretrievable Commitment of Resources

Effects to cultural resources which are considered to be non-renewable would be irretrievable but not necessarily irreversible. Restoration and repair could occur to preserve the historic significance. Recovery by excavation would preserve the scientific information for further study.

Short-Term Use vs. Long-Term Productivity

Mining operations and subsidence could occur for a period of 9 to 12 years.

4.1.12.3 Alternative C

The effects would be the same as discussed under Alternatives B and B'. Less of the project area would experience subsidence, therefore there is a slightly decreased chance of affecting sites and/or structures.

Cumulative Effects

The effects would be generally the same as Alternative B, except that a smaller and fewer sites would be subjected to subsidence.

Irreversible/Irretrievable Commitment of Resources

Same as Alternative B.

Short-Term Use vs. Long-Term Productivity

Same as Alternative B, except that a smaller area would be subjected to mining and subsidence and for a shorter time (5 to 7 years).

4.1.13 Paleontological Resources

Paleontological resources could be disturbed by subsidence and destroyed by the mining process. Damage from disturbance for construction of surface facilities is not expected because surveys would be required prior to approval of operations. If sites are found, they would be protected or excavated in accordance with plans approved by the Forest Service.

4.1.13.1 Alternative A (No Action)

No effects are anticipated

4.1.13.2 Alternatives B and B'

Fossil Sites and Footprints

Subsidence cracks could expose fossil sites that have been previously undiscovered, but no damages to fossil sites are expected from subsidence.

Continuous miners and longwall shearers cut through the coal at a rapid pace and the process does not provide an opportunity to look into the coal material before the coal is pulverized by the mining process. Fossils in the coal are destroyed in the process. As mining progresses, casts of footprints are often exposed in sandstone roof materials. Only when this occurs do they become visible. Studies by the College of Eastern Utah and other Universities have determined that these prints are common and have limited scientific significance. Underground mining could destroy dinosaur footprints, some fossilized bone, and plant imprints.

Pleistocene Mammals

Surface-disturbing activities could expose and damage Pleistocene fossils. The potential for this to occur would be minimized by requiring surface surveys and clearance prior to conducting operations. However, there is some potential for undiscovered buried fossils to be unearthed once operations begin. Lessees/operators are required to stop operations if fossils are discovered and report them to the Forest Service for inspection. Once they are recognized, they would be either protected or excavated under a plan approved by the Forest Service, but initial damage may be irreparable.

Pleistocene mammal skeletons or individual bones that could be buried beneath the deep glacial deposits in the canyons could be disturbed by subsidence. There is potential for damage to articulated skeletons if they exist if cracks form at the site location. Cracks would probably not damage individual buried bones.

Cumulative Effects

Construction and development activities discussed in the table of past, present, and reasonably foreseeable future actions have the potential to unearth previously undiscovered fossils, especially in the glacial materials. If found on National Forest System lands and potentially on private lands they would be protected from damage and potentially excavated by qualified paleontologists. Information and fossils obtained during excavation would be curated in accordance with Federal requirements. If discovered on private lands, their disposition would be subject to the desires of the owners. The effects discussed above for this alternative could occur in addition to those discussed in this section.

Irreversible/Irretrievable Commitment of Resources

Paleontological resources are nonrenewable. Any losses would be irreversible and irretrievable.

Short-Term Use vs. Long-Term Productivity

Mining and subsidence would occur in the majority of the project area for a period of 9 to 12 years.

4.1.13.3Alternative C

The effects would be the same as discussed under Alternatives B and B', except there would be less chance of exposing or damaging Pleistocene mammal skeletons or bones because they are most likely to occur within the subsidence protection zones.

Cumulative Effects

Construction and development activities discussed in the table of past, present, and reasonably foreseeable future actions have the potential to unearth previously undiscovered fossils, especially in the glacial materials. If found on National Forest System lands and potentially on private lands they would be protected from damage and potentially excavated by qualified paleontologists. Information and fossils obtained during excavation would be curated in accordance with Federal requirements. If discovered on private lands, their disposition would be subject to the desires of the owners. The effects discussed above for this alternative could occur in addition to those discussed in this section.

Irreversible/Irretrievable Commitment of Resources

Paleontological resources are nonrenewable. Any losses would be irreversible and irretrievable.

Short-Term Use vs. Long-Term Productivity

Mining and subsidence would occur in a smaller area of the project area than under Alternative B and for a shorter time period (5 to 7 years).

4.1.14 Socioeconomics

The socioeconomic benefits would differ considerably by alternative.

4.1.14.1 Alternative A (No Action)

The project area contains in excess of 36 million tons of coal that can be mined and recovered. The majority of the coal is in Federal ownership but some of the reserves on adjacent privately owned non-Federal lands are privately owned. If the tract is not leased, none of the reserves could be recovered and it is unlikely that it would be mined in the future once bypassed by the Skyline Mine. Access from any other location would not be economical due to the costs of developing alternative portal facilities on the adjacent lands and the small amount of coal that is contained under these lands. The coal would not be made available for energy production.

A competitive coal lease sale would not be made and there would be no bonus bid for the tract. The bonus bid cannot be predicted at this time but would amount to several million dollars. The Federal Treasury would not receive the bonus bid amount. The value of the estimated 36 million tons of recoverable coal reserves at the current mine-mouth value (does not include shipping costs) of $17.00 per ton is approximately $612 million. Approximately $49 million would not be paid to the Federal Treasury (8% of the mine-mouth value). The State of Utah would not receive a 50% share of the bonus bid and coal royalty and the counties would not receive their proportionate share.

The life of the Skyline mine would not be extended beyond current projections. Canyon Fuel indicated that, without the Flat Canyon Tract, the Skyline Mine could close in the year 2003. This does not consider the potential for moving into the Federal Coal Lease (U-67939) that lies directly to the north of the existing permit area. This lease contains at least 24.1 million tons of recoverable coal reserves. If mined, the life of the mine could be extended at least by 6-8 years to at least the year 2009.

When the mine closes 220 jobs will be lost at the mine. In addition, an undetermined significant number of support services jobs would be lost.

Cumulative Effects

Total direct coal mine employment has been on a downward trend since 1997, decreasing from 2,091 to 1,843 in 1999 (Utah Office of Energy & Resource Planning, July 2000).

If Skyline Mine closes in 2003, the associated loss of jobs would occur during a period of cumulative mine closures in the Wasatch Plateau and Book Cliffs Coal Fields. Two local mines closed during 2000 and 2001 and 4 additional mines are projected to close by 2003. It is also possible that one new mine could open and for an existing mine to reopen. In addition to potential job losses associated with the Skyline Mine, an additional 300 direct mining jobs and an unknown number of mine support jobs could be lost. This is having a significant economic impact to the Carbon and Emery County areas and to a lesser degree to Sanpete, Utah, Salt Lake, and Sevier Counties.

Due to the mine closures discussed above, Utah coal production and royalties received are on a downward trend and will decrease markedly over the next 5 years, decreasing revenue to the Federal, State, and local governments.

Irreversible/Irretrievable Commitment of Resources

Coal is a nonrenewable resource. Energy and materials expended during the mining process and the coal reserves mined and consumed represent both irretrievable and irreversible commitments of resources. Coal reserves left unmined as discussed under this alternative would be considered irretrievable and irreversible considering current mining technology and economics.

The socio-economic effects discussed in this section are irretrievable. Some economic recovery or reversal of the downward trend regarding the economic benefits of mining could occur by opening/reopening area mines, but the reserves available in Utah for mining are finite and rapidly dwindling. The Bureau of Land Management estimates that remaining mineable coal reserves in the Wasatch Plateau and Book Cliffs Coal Fields are available for less than 40 years of mining.

Short-Term Use vs. Long-Term Productivity

Reserves bypassed in the project area would be unavailable for future production considering current mine technology and economics. The life of the Skyline Mine under this alternative would not be extended and the associated socio-economic benefits would not occur.

4.1.14.2 Alternatives B and B'

As compared with Alternative A, the mine life could be extended up to 12 years. Approximately 36 million tons of coal could be recovered at a total value of approximately $612 million, based on the current average mine-mouth value (does not including shipping costs) of $17.00 per ton. Royalties would amount to approximately $49 million (8% if total value) paid to the Federal Treasury. The State of Utah would receive a 50% share of the royalties and the counties would receive a proportionate share.

Under Alternative B', the cost of coal production would be increased by the costs of monitoring potentially affected resources and improvements and by the cost of mitigations and repair. No total estimates of this cost have been made. The costs would include those estimated and discussed in Section 4.1.2.3 for repair of facilities.

Cumulative Effects

Under this alternative the reserves and socio-economic benefits discussed above would be produced, partially relieving the current mining related decline discussed under Alternative A.

Irreversible/Irretrievable Commitment of Resources

Coal is a nonrenewable resource. Energy and materials expended during the mining process and the coal reserves mined and consumed represent both irretrievable and irreversible commitments of resources. Coal reserves left unmined for roof support and their economic value as discussed under this alternative would be considered irretrievable and irreversible considering current mining technology and economics.

Short-Term Use vs. Long-Term Productivity

The coal reserves and economic benefits produced from the project area would be added to the cumulative benefit/economic base of the Federal government, State, and affected counties for 9 to 12 years.

4.1.14.3 Alternative C

The amount of coal that could be mined would be reduced by approximately one-third due to requirements for the protection of surface resources and structures. The mine life could be extended by approximately 5 to 7 years.

The recoverable reserves are estimated at approximately 18 to 20 million tons at a total value of $306 to $340 million. Royalties would be approximately $24 to $27 million. However, if extensive acreage is blocked from full-extraction due to surface resource protection, the operating cost associated with the extensive development required to extract each longwall panel could lower overall mine efficiency and coal recovery (BLM, 1999). This decrease of coal mined during longwall mining relative to coal mined for development (LDR-Longwall Development Ratio) could make the overall economics of mining the tract marginal.

The overall cost of coal production would also be increased compared to Alternatives B for resource monitoring and mitigation.

Cumulative Effects

Under this alternative the reserves and socio-economic benefits discussed above would be produced, partially relieving the current mining related decline discussed under Alternative A.

Irreversible/Irretrievable Commitment of Resources

Coal is a nonrenewable resource. Energy and materials expended during the mining process and the coal reserves mined and consumed represent both irretrievable and irreversible commitments of resources. Coal reserves left unmined for roof support and their economic value as discussed under this alternative would be considered irretrievable and irreversible considering current mining technology and economics.

Short-Term Use vs. Long-Term Productivity

The coal reserves and economic benefits produced from the project area would be added to the cumulative benefit/economic base of the Federal government, State, and affected counties for 5 to 7 years.

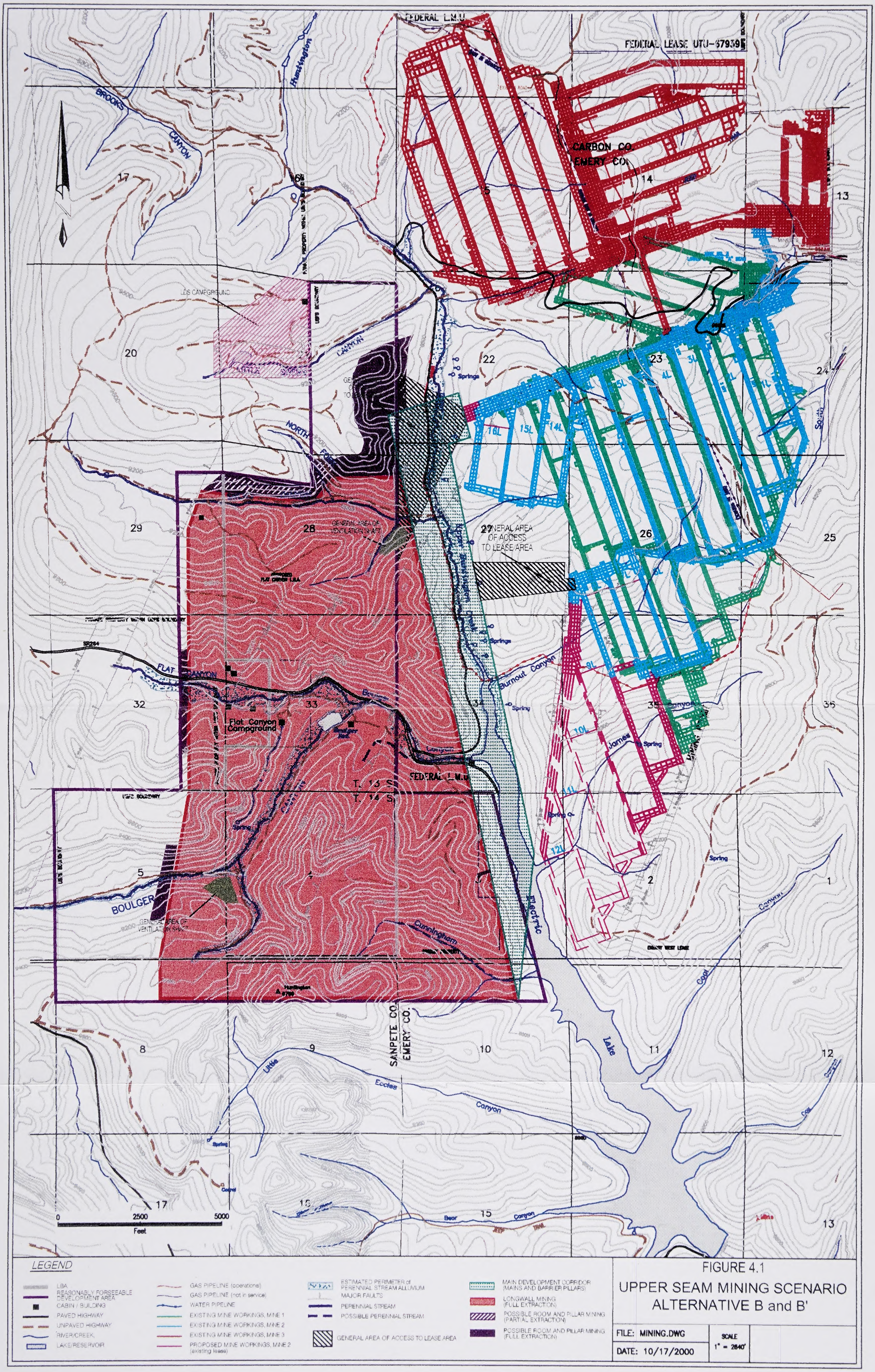


FIGURE 4.1
UPPER SEAM MINING SCENARIO
ALTERNATIVE B and B'

FILE: MINING.DWG | SCALE 1" = 2640'
DATE: 10/17/2000

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

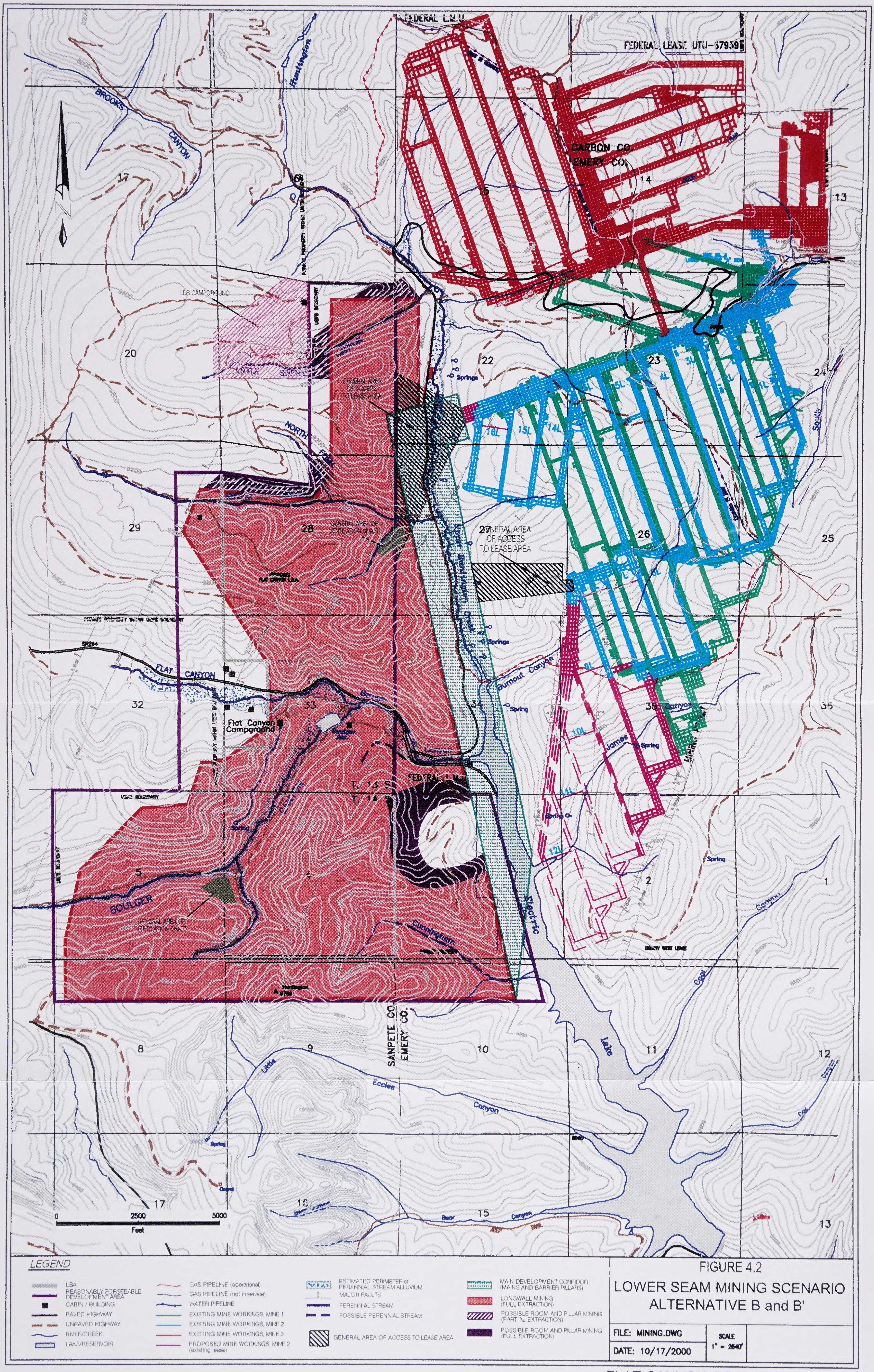


FIGURE 4.2
LOWER SEAM MINING SCENARIO
ALTERNATIVE B and B'

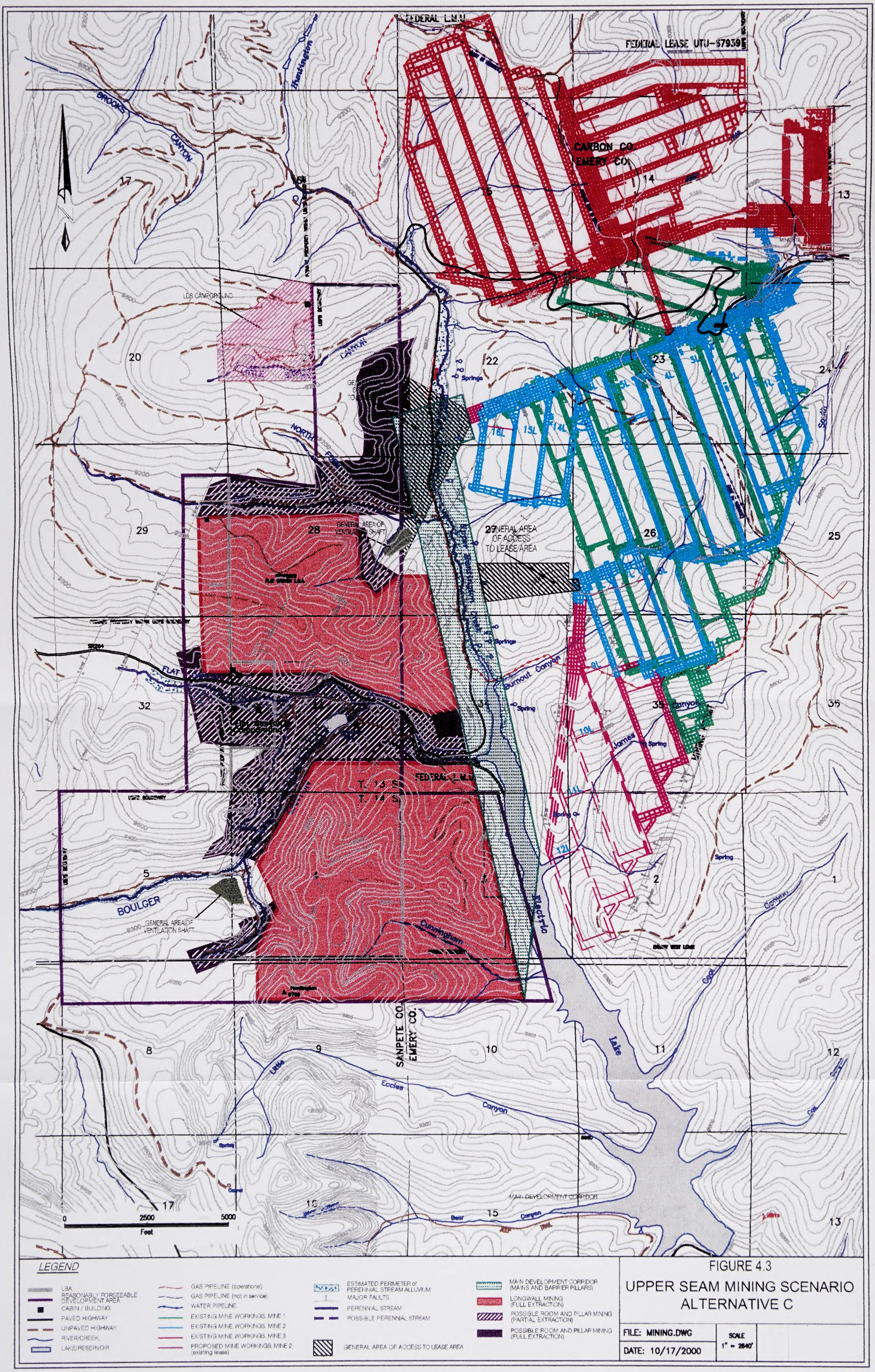


FIGURE 4.3
UPPER SEAM MINING SCENARIO
ALTERNATIVE C

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

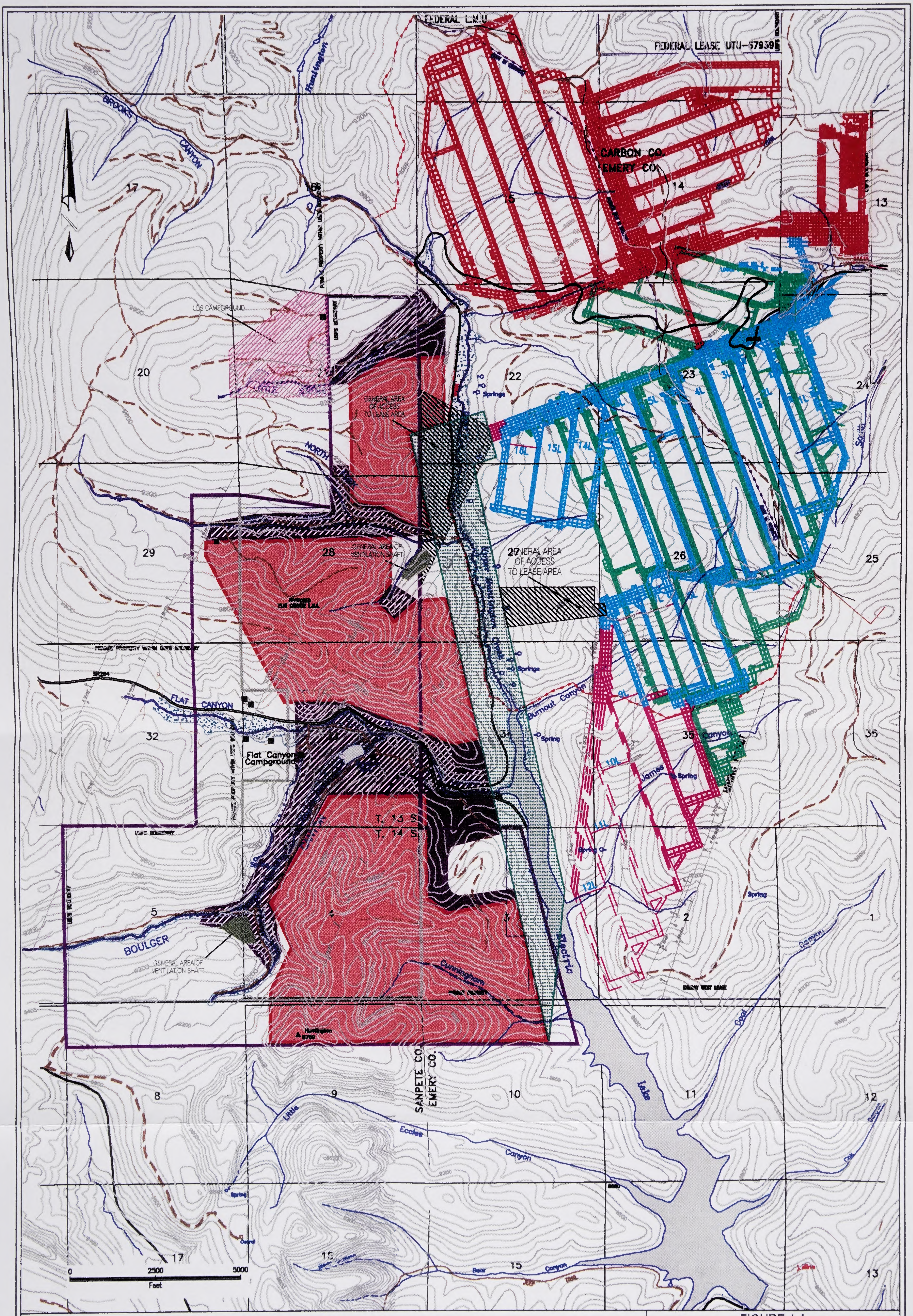
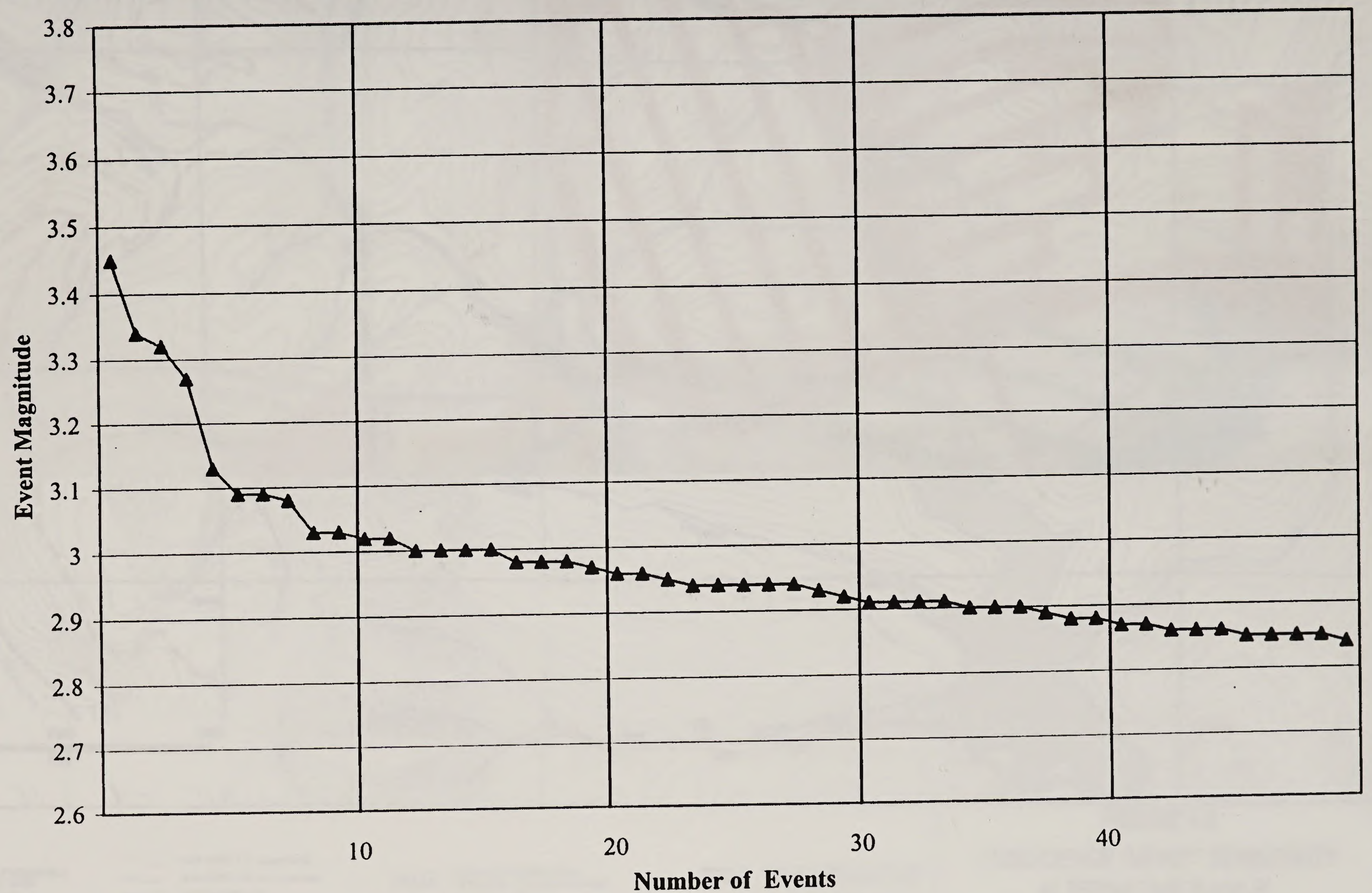


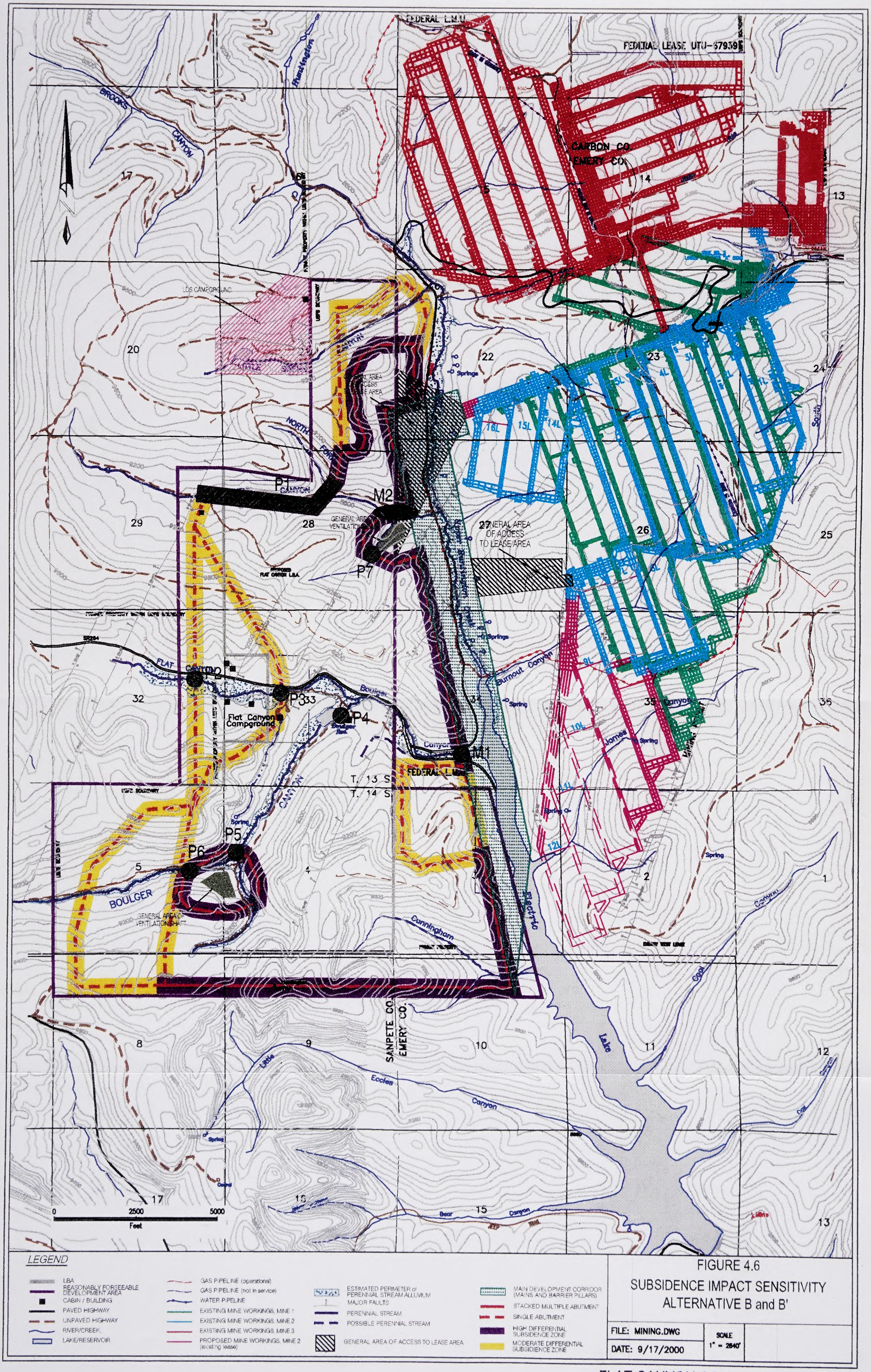
FIGURE 4.4
LOWER SEAM MINING SCENARIO
ALTERNATIVE C

FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2640'

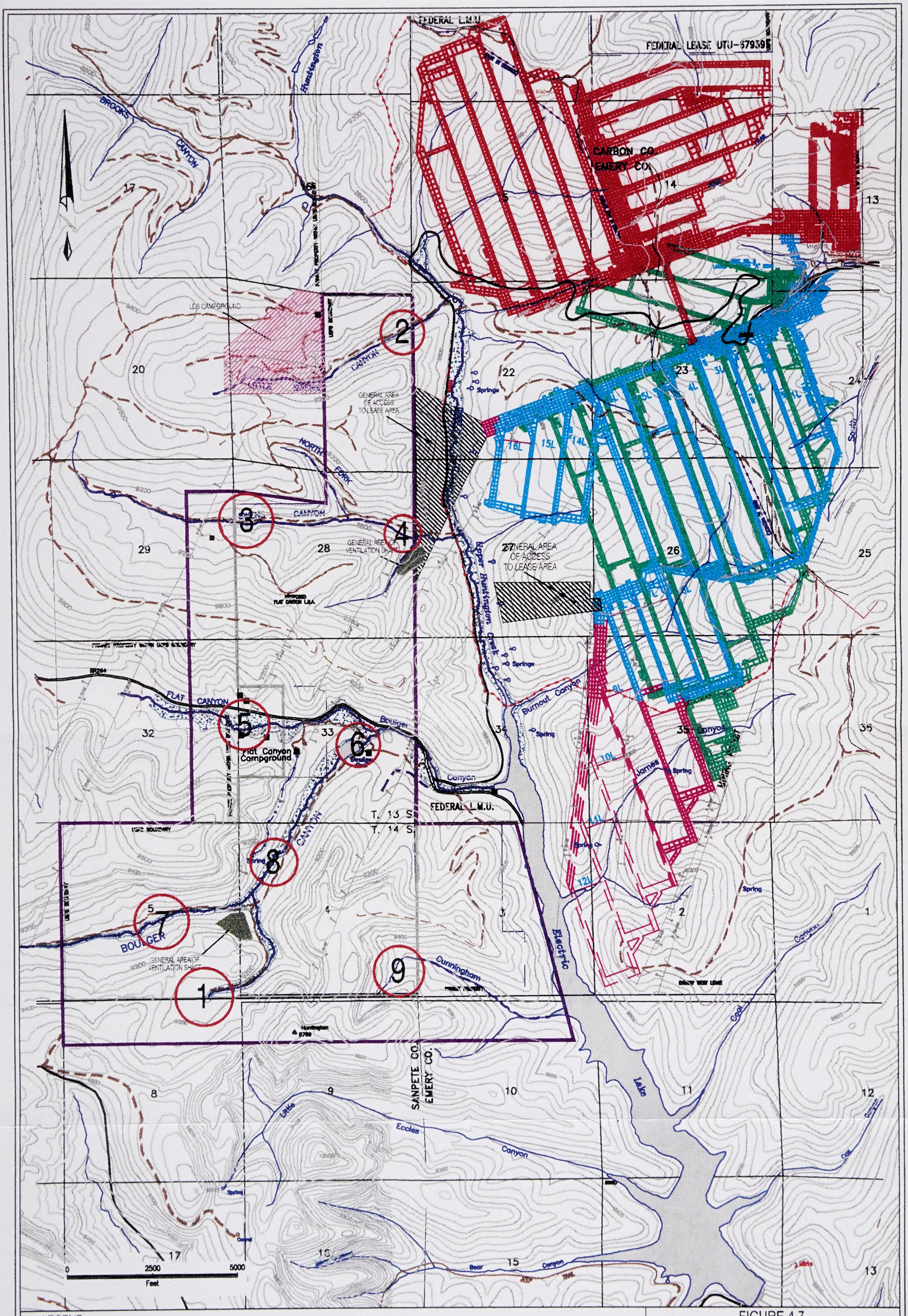
FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Figure 4.5
Plot of Cummulative Number of Events Versus Event Magnitude for Skyline Mine





FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT



LEGEND

- LBA
- REASONABLY FORSEEABLE DEVELOPMENT AREA
- CABIN / BUILDING
- PAVED HIGHWAY
- UNPAVED HIGHWAY
- RIVER/CREEK
- LAKE/RESERVOIR
- GAS PIPELINE (operational)
- GAS PIPELINE (not in service)
- WATER PIPELINE
- EXISTING MINE WORKINGS, MINE 1
- EXISTING MINE WORKINGS, MINE 2
- EXISTING MINE WORKINGS, MINE 3
- PROPOSED MINE WORKINGS, MINE 2 (existing lease)
- GENERAL AREA OF ACCESS TO LEASE AREA
- ESTIMATED PERIMETER of PERENNIAL STREAM ALLUVIUM
- MAJOR FAULTS
- PERENNIAL STREAM
- POSSIBLE PERENNIAL STREAM
- (1) SUBSIDENCE PREDICTION POINT WITH AREA OF MINING INFLUENCE

FIGURE 4.7
SUBSIDENCE
PREDICTION POINTS
ALTERNATIVE B and B'

FILE: MINING.DWG	SCALE 1" = 2640'
DATE: 10/17/2000	

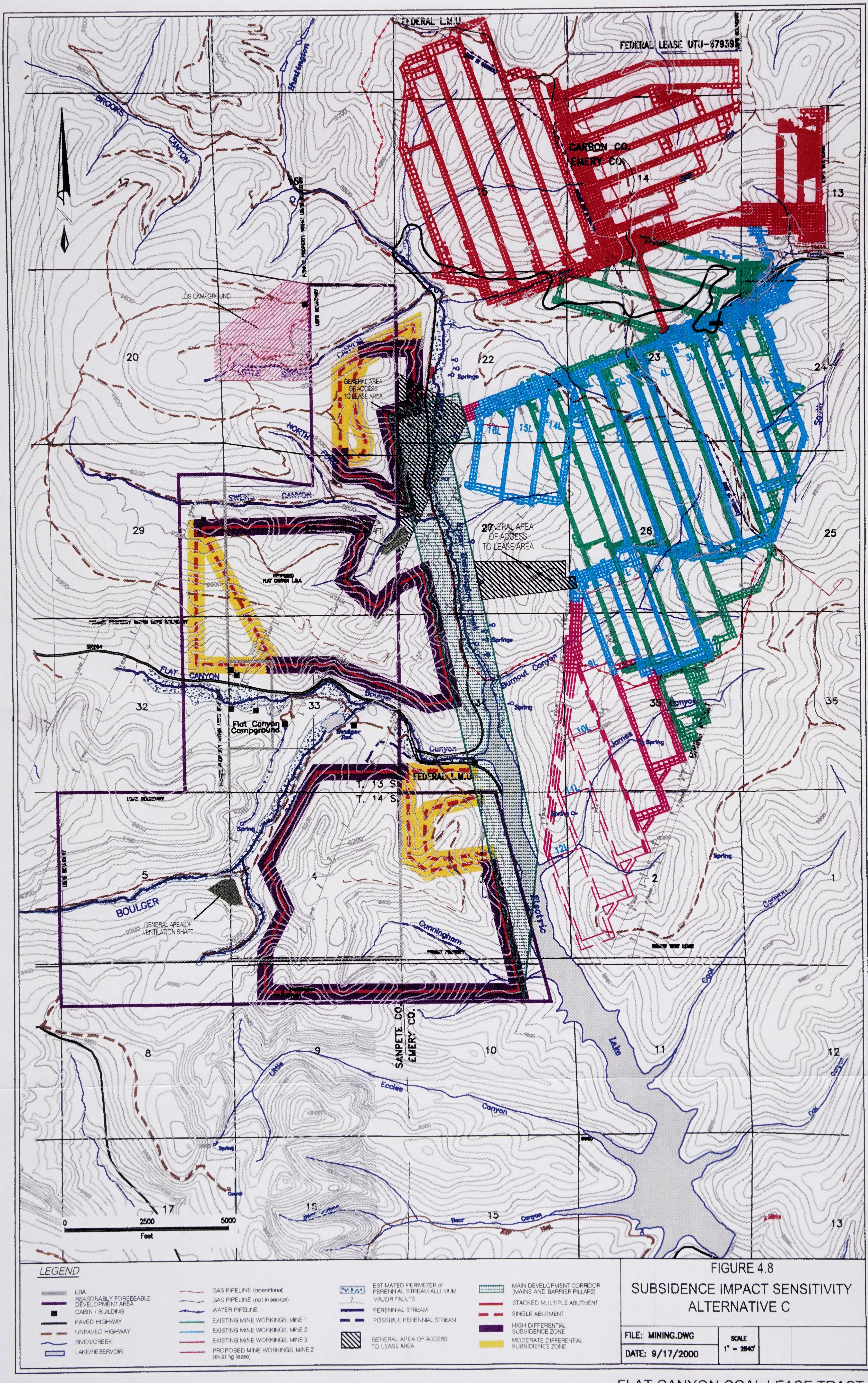


FIGURE 4.8
SUBSIDENCE IMPACT SENSITIVITY
ALTERNATIVE C

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

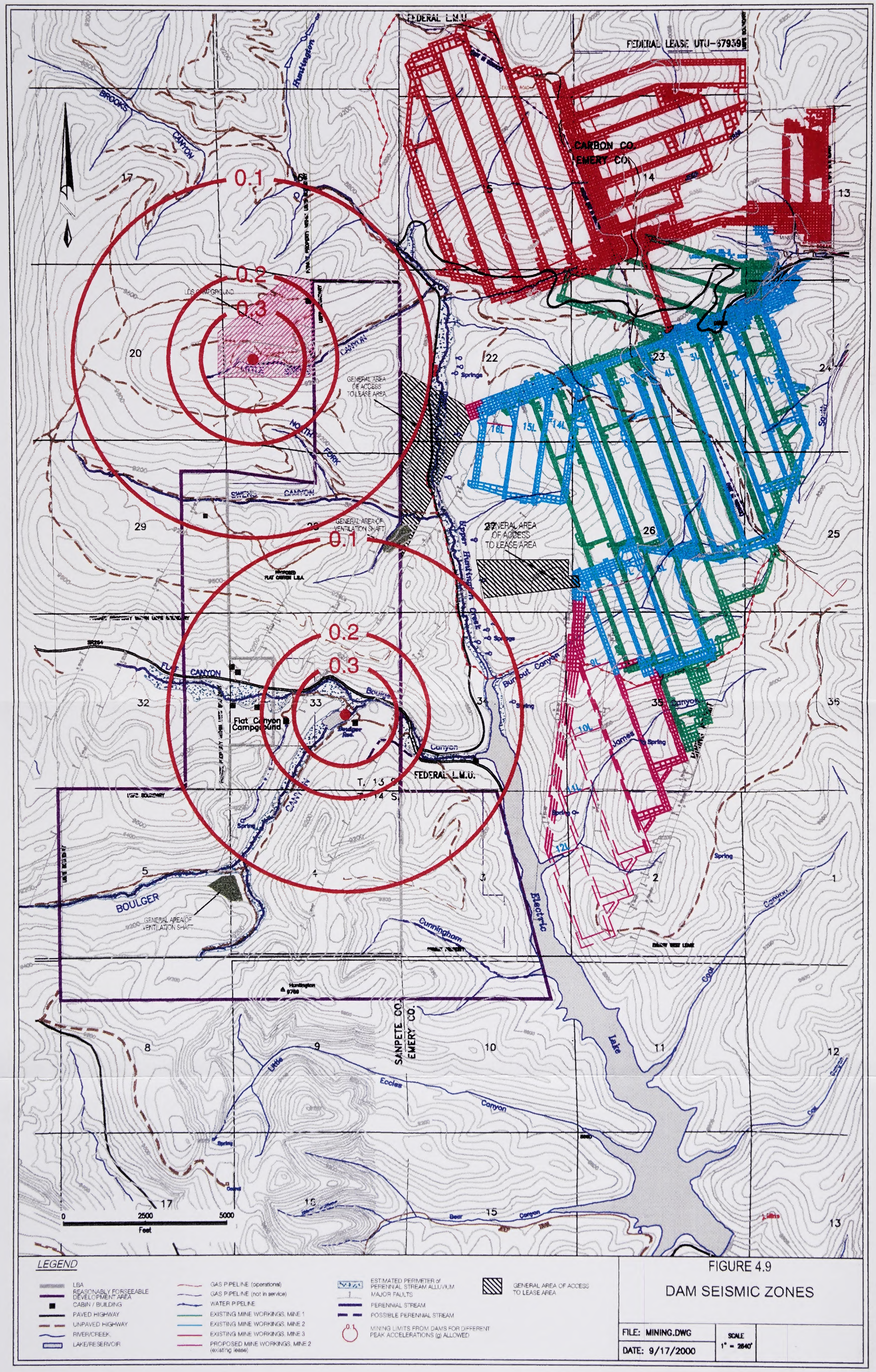


FIGURE 4.9
DAM SEISMIC ZONES

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

5.0 CONSULTATION

This section will be completed in the Final Environmental Impact Statement. It will include Draft EIS comments and responses.

Project scoping and responses are described in Chapter 2 of the DEIS.

6.0 LIST OF PREPARERS AND REVIEWERS

6.1 LIST OF PREPARERS

The following is a list of personnel from the responsible agencies and cooperating agencies included on the project Interdisciplinary Team (IDT):

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Kelly Payne – Hydrogeologist – NorWest;
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Advance Mining: Exploitation in the same direction, or order of sequence, as development.

Affected Environment: Surface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by proposed activities. The environment of the area to be affected by the alternatives under consideration.

Air Quality Classes: Classifications established under the Prevention of Significant Deterioration portion of the Clean Air Act that limits the amount of air pollution considered significant within an area. Class I applies to areas where almost any change in air quality would be significant, Class II applies to areas where the deterioration normally accompanying moderate, well-controlled growth would be permitted, and Class III applies to areas where industrial deterioration would generally be allowed.

Alluvial Material: Material transported and deposited by running water in riverbeds, lakes, alluvial fans and valleys. Includes clay, silt, sand, gravel, and mud.

Alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of several policies, plans, or projects proposed for decision making. One alternative need not substitute for another in all respects.

Analysis Area: A delineated area of land subject to analysis.

Angle of draw: The angle of inclination from the vertical of the line connecting the edge of the workings and the edge of the subsidence area.

Animal Unit Month (AUM): The amount of forage necessary to sustain one cow and one calf or its equivalent for one month.

Aquatic Ecosystem: All organisms in a water-based community plus the associated environmental factors.

Aquatic Wildlife or Species: Animal species that inhabit and/or depend on the aquatic ecosystems for their life processes.

Aquifer: A layer of geologic material that contains water.

Attenuation: The ability of rocks and soils to transmit ground vibrations over distance. The energy or amount of vibration transmitted through rock decreases with increasing distance from the source. The amount of energy or vibration at a specific distance from the source is dependant on the magnitude of the source event, ability of specific materials to transmit the vibrations, and the distance from the source.

Authorized Officer: Any employee of the Bureau of Land Management delegated the authority to perform the duty described in the section in which the term is used.

Barrier: A large pillar of coal designed to isolate production areas, including longwall or room-and- pillar panels.

Beneficial Use Standards:

Best Available Control Technology: The best available air pollution control technology for a given purpose as stipulated by the U.S. EPA.

Big Game Winter Range: The area available to and used by big game (large mammals normally managed for sport hunting) through the winter season.

Big Game: Larger species of wildlife that are hunted such as elk, deer, moose, and mountain lion.

Biological Diversity: The diversity or numbers of species that collectively represent the living plants and animals within a local, regional, or continental landscape.

Biological Evaluation (BE): A documented Forest Service activities in sufficient detail to determine how an action or proposed action may affect any threatened, endangered, proposed, or sensitive species.

Bleeders: A series of parallel interconnected development entries partially surrounding longwall panels which provide ventilation and secondary access.

Bonus: That value in excess of the rentals and royalties that accrues to the United States because of coal resource ownership that is paid as part of the consideration for receiving a lease.

Browse: That part of the current leaf and twig growth of shrubs, wood vines, and trees available for animal consumption.

Buffer: A large block of coal left unmined to isolate the effects of underground workings.

Bureau of Land Management: The U.S. Department of the Interior agency responsible for managing most Federal government subsurface minerals. It has surface-management responsibility for Federal lands designated under the Federal Land Policy and Management Act of 1976.

Bypass Coal: An isolated coal deposit that cannot, for the foreseeable future, be mined economically and in an environmentally sound manner either separately or as part of any mining operation other than that of the applicant for either an emergency lease under the provisions of 43 CFR 3425.1-4, or a lease modification.

Candidate Species: Any species not yet officially listed but that are undergoing a status review or are proposed for listing according to the *Federal Register* notices published by the Secretary of the Interior or the Secretary of Commerce.

Casual Use: Activities which do not ordinarily lead to any appreciable disturbance or damage to lands, resources or improvements, for example, activities which do not involve use of heavy equipment or explosives and which do not involve vehicle movement except over already established roads and trails.

Caving: The collapse of roof strata into mined workings.

CEQ: See Council on Environmental Quality.

Certificate of bidding rights: A right granted by the Secretary to apply the fair market value of a relinquished coal or other mineral lease or right to preference right coal or other mineral lease as a credit against the bonus bid or bids on a competitive lease or leases acquired at a lease sale or sales, or as a credit against the payment required for a coal lease modification.

Compression crack: A closed crack in the ground formed in an area of compressional stress.

Compression: Stress resulting in the contraction or "squeezing" of ground strata; opposite of tension.

Continuous miner method: A mining method which uses a single "continuous miner" machine to mechanically break and load coal for transportation. Single entries are mined at a time and are separated by pillars; used for development and room-and-pillar mining.

Contrast: The effect of a striking difference in the form, line, color, or texture of an area being viewed.

Council on Environmental Quality: An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their affect on the environment, conducts environmental studies and advises the President on environmental matters.

Critical Habitat: Specific areas within the geographical area occupied by the species on which are found those physical and biological features (1) essential to the conservation of the species; and (2) which may require special management considerations or protection. Critical habitat shall not include the entire geographic area which can be occupied by the threatened and endangered species.

Critical Subsidence: At some extraction width, the maximum depth of a critical subsidence basin no longer increases. The critical subsidence basin will have a pointed bottom similar to that of a subcritical subsidence basin.

Crucial Habitat: A biological feature that, if lost, would adversely affect the species.

Cultural Resources Inventory Classes:

Class I - An existing data survey. This is an inventory of a study area to (1) provide a narrative overview of cultural resources by using existing information; and (2) compile existing cultural resource site record data on which to base the development of the Forest's site record system.

Class II - A sampling field inventory designed to locate, from surface and exposed profile indications, all cultural resource sites within a portion of an area so that an estimate can be made of the cultural resources for the entire area.

Class III - An intensive field inventory designed to locate, from surface and exposed profile indicators, all cultural resource sites within a portion of an area.

Cultural Resources Inventory: A survey of existing data.

Cultural Resources: Those fragile and nonrenewable remains of human activity, occupation, or endeavor reflected in districts, sites, structures, buildings, objects, artifacts, ruins, works or art, architecture, and natural features that were or importance in human events.

Cumulative Impact: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

Depth of cover: The thickness of ground from a coal seam to surface.

Developed Recreation Sites: Relatively small, distinctly defined areas where facilities are provided for concentrated public use (i.e., campgrounds, picnic areas, and swimming areas).

Developed Recreation: Recreation that occurs a man-made developments such as campgrounds, picnic grounds, resorts, ski areas, trailheads, etc.

Development: The mining of initial entries for access, ventilation, etc. prior to full-scale production mining.

Differential subsidence: The difference in vertical subsidence between two locations.

Director: Director of the Bureau of Land Management.

Dispersed Recreation: That portion of outdoor recreation use that occurs outside of developed sites in the unroaded and roaded Forest environment (i.e., hunting, backpacking, and camping).

Displacement: As applied to wildlife, forced shifts in the patterns of wildlife use either in location or timing of use.

Distance Zone: The divisions of a landscape being viewed. Three zones are used to describe a landscape: foreground, middleground, background.

Diversity: (1) The relative abundance of wildlife species, plant species, communities, habitats, or habitat features per unit of area; or (2) The distribution and abundance of different plant and animal communities and species within the area covered by a Land Resource Management Plan (36 CFR Part 219.3).

Duration: The length of time the management activity and its impacts will be taking place.

Ecosystem: All organisms in a community plus the associated environmental factors.

Effects (also see Impacts):

Direct Effects - Caused by the action and occur at the same time and place.
Indirect Effects - Caused by the action later in time or farther removed in distance but still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related affects on air and water and other natural systems, including ecosystems.

Endangered Species: Any species in danger of extinction throughout all or a significant portion of its range.

Entry: An underground passage used for haulage or ventilation.

Environmental Analysis: An analysis of alternative actions and their predictable short and long-term environmental effects that include physical, biological, economic, social, and environmental design factors and their interactions.

Environmental Assessment (EA): A concise public document prepared to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a FONSI. It includes a brief discussion of the need for the proposal, alternatives considered, environmental impact of the proposed action and alternatives, and a list of agencies and individuals consulted. Prepared by the responsible Federal agency consistent with 40 CFR 1508.9.

Environmental Impact Statement (EIS): A formal public document prepared to analyze the impacts on the environment of the proposed project or action and released for comment and review. An EIS must meet the requirements of NEPA, CEQ guidelines, and directives of the agency responsible for the proposed project or action.

Erosion Hazard Ratings:

Slight - Potential soil loss rates do not exceed tolerance soil loss. Loss in soil production potential from erosion is of low probability.

Moderate - Potential soil loss rates exceed tolerance soil loss. Loss in soil production potential from erosion is probable and significant if unmitigated. On-site investigation by watershed specialists may be needed for activities in such areas.

High - Potential soil loss rates exceed tolerance soil loss. Loss in soil production potential from erosion is inevitable and irreversible if unmitigated. These soils may require expensive measures to control erosion and sedimentation when activities are planned for such areas. On-site investigation by watershed specialists is highly recommended.

Erosion Hazard: The probability of soil loss resulting from complete removal of vegetation and litter. It is an interpretation based on potential soil loss in relation to tolerance values. Soil loss tolerance rate: an estimate of erosion that could occur over a short period of time (one year) without causing irreparable damage to long-term productivity of the soil.

Erosion: (1) The wearing away of the land surface by running water, wind, ice, or other geological agents including such processes as gravitational creep; or (2) Detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Exotic: Foreign, not native

Exploration License: A license issued by the Authorized Officer to permit the licensee to explore for coal on unleased Federal lands.

Exploration plan: A detailed plan to conduct exploration; it shows the location and type of exploration to be conducted, environmental protection procedures, present and proposed roads, and reclamation and abandonment procedures to be followed upon completion of operations.

Exploration: Drilling, excavating, and geological, geophysical or geochemical surveying operations designed to obtain detailed data on the physical and chemical characteristics of Federal coal and its environment including the strata below the Federal coal, overburden, and strata above the Federal coal, and the hydrologic conditions associated with the Federal coal.

Extraction ratio: The ratio of mined to unmined area within a defined area.

Face: The location of the longwall mining machine and active production mining within a longwall panel.

Fair Market Value: An amount in cash, or on terms reasonably equivalent to cash, for which in all probability the coal deposit would be sold or leased by a knowledgeable owner willing but not obligated to sell or lease to a knowledgeable purchaser who desires but is not obligated to buy or lease.

Federal Land Policy and Management Act of 1976 (FLPMA): Public Law 94-579 signed by the President on Management October 21, 1976. Established public land policy; to establish guidelines for its administration; to protect for the management, protection, development, and enhancement of the public lands; and for other purposes.

Federal Lands: Lands owned by the United States, without references to how the lands were acquired or what Federal agency administers the land, including surface estate, mineral estate and coal estate, but excluding lands held by the United States in trust for Indians, Aleuts or Eskimos.

First-pass mining: First stage room-and-pillar production mining at a lower extraction ratio than subsequent second-pass mining; larger pillars are left than after second-pass mining.

Floodplain: The lowland and relatively flat area adjoining inland waters including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

Forage: All browse and herbaceous foods that are available to grazing/browsing animals.

Forest Service (FS): The agency of the United States Department of Agriculture responsible for managing National Forests and Grasslands under the Multiple Use and Sustained Yield Act of 1960.

Fossil: The remains or traces of an organism or assemblage of organisms that have been preserved by natural processes in the earth's crust exclusive of organisms that have been buried since the beginning of historical time.

Full-extraction mining: Complete extraction of the coal seam in the horizontal extent over a particular area; no pillars are left after mining.

Full-support mining: Mining that takes place leaving unmined pillars that adequately support the overburden and prevent subsidence from occurring.

Game Species: Any species of wildlife or fish for which seasons and bag limits have been prescribed and that are normally harvested by hunters, trappers, and fishermen under State or Federal laws, codes, and regulations.

Gateroad: A series of parallel development entries along both long sides of a longwall panel; entries are separated by either yield- and/or rigid-type pillars.

Gob: The term applied to that part of the mine from which the coal has been removed and the space has been filled up with waste rock.

Government Entity: A Federal or State agency or a political subdivision of a State, including a county or a municipality, or any corporation acting primarily as an agency or instrumentality of a State, which produces electrical energy for sale to the public.

Gradient: The slope (rise/run) of a surface or stream profile.

Habitat Type Group: A logical grouping of habitat types to facilitate resource planing and public presentations.

Habitat Type: An aggregation of all land areas potentially capable of producing similar plan communities at climax.

Habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Horizontal strain: The change in length per unit of length of ground in the horizontal plane.

Human Environment: The factors that include, but are not limited to, biological, physical, social, economic, cultural, and aesthetic factors that interrelate to form the environment.

Impact (See Effects): The effect, influence, alteration, or imprint caused by an action.

Indicator Species: A species of animal or plant whose presence is a fairly certain indications of a particular set of environmental conditions. Indicator species serve to show the effects of development actions on the environment.

Indirect Effects: Secondary effects that occur in locations other than the initial action or significantly later in time.

Intake: The passage through which fresh air is drawn or forced into a mine or to a section of a mine.

Interest in a lease, application or bid: Any record title interest, overriding royalty interest, working interest, operating rights or option, or any agreement covering such an interest; any claim or any prospective or future claim to an advantage or benefit from a lease; and any participation or any defined or undefined share in any increments, issues, or profits that may be derived from or that may accrue in any manner from the lease based on or pursuant to any agreement or understanding existing when the application was filed or entered into while the lease application or bid is pending. Stock ownership or stock control does not constitute an interest in a lease within the meaning of this definition. Attribution of acreage to stock within the meaning of this definition.

Invertebrate: An animal lacking a spinal column.

Irretrievable: Not retrievable, irrecoverable, incapable of being recovered or regained; not capable of being restored remedied or made good.

Irreversible: Not reversible; incapable of being reversed or altered. Not having the ability to change and then revert to the original state.

Key Wildlife Area: Any area that is critical to wildlife during at least a portion of the year. This importance may be due to vegetative characteristics such as residual nesting cover or behavioral aspects of the animals such as fawning/calving areas. Key areas included: winter ranges, lambing/fawning/calving areas, dancing/strutting grounds, nesting areas, breeding grounds, elk wallows, riparian and woody draws, and roosting areas.

Leasable Minerals: Minerals acquired only by lease and generally include oil, gas, coal, oil shale, sodium, potassium, phosphate, native asphalt, solid and semi-solid bitumen, and deposits of sulfur.

Lease Bond: The bond or equivalent security given the Department to assure payment of all obligations under a lease, exploration license, or license to mine, and to assure that all aspects of the mining operation other than reclamation operations under a permit on a lease are conducted in conformity with the approved mining or exploration plan.

Lease Modification Area: A proposed 150-acre lease modification to the Quitchupah Lease U-63214. Specifically located within Section 10, SE¼ NW¼, E½ SW¼, E½ E½ SW¼ SW¼, E½ E½ NW¼ SW¼, E½ E½ SW¼ NW¼, Township 21 South, Range 5 East (SLM).

Lease Stipulations: Additional specific terms and conditions that change the manner in which an operation may be conducted on a lease or modify the lease rights granted.

Lease: A Federal lease, issued under the coal leasing provisions of the mineral leasing laws, which grants the exclusive right to explore for and extract coal. In provisions of this group that also refer to Federal leases for minerals other than coal, the term Federal coal lease may apply.

License to mine: A license issued under the provisions of 43 CFR Part 3440 to mine coal for domestic use.

Licensee: The holder of an exploration license.

Logical Mining Unit Reserves: Recoverable coal reserves means the sum of estimated Federal and non-Federal recoverable coal reserves in the LMU.

Logical Mining Unit: An area of land in which the recoverable coal reserves can be developed in an efficient, economical, and orderly manner as a unit with due regard to conservation of recoverable coal reserves and other resources. An LMU may consist of one or more Federal leases and may include intervening or adjacent lands in which the United States does not own the coal. All lands in an LMU shall be under the effective control of a single operator/lessee, be able to be developed and operated as a single operation, and be contiguous.

Long-Term: Describes impacts that would occur over a 20-year period or more.

Longwall mining: A mining method in which large blocks of coal (panels), outlined by gateroad entries, are completely extracted in a single, continuous operation using a longwall mining machine.

Longwall move: The disassembly, transportation, and reassembly of a longwall mining machine at the end of a mined panel to the beginning of a new unmined panel.

Longwall panel: A rectangular block of coal bounded by development entries and fully mined (no pillars left) by a longwall mining machine.

Main Entry: A main haulage road.

Mains: A series of parallel interconnected development entries providing primary access to production areas, ventilation, and transportation of mined coal.

Maximum Credible Event (MCE): The greatest mining-induced seismic event or earthquake expected to be caused by mining in the project area.

Maximum Economic Recovery (MER): Based on standard industry operating practices, all profitable portions of a leased Federal coal deposit must be mined. At the times of MER determinations, consideration will be given to: existing proven technology; commercially available and economically feasible equipment; coal quality, quantity, and marketability; safety, exploration, operating, processing, and transportation costs; and compliance with applicable laws and regulations. The requirement of MER does not restrict the authority of the authorized officer to ensure the conservation of the recoverable coal reserves and other resources and to prevent the wasting of coal.

Mineable or Minable Coal: That portion of a coal seam that can be mined considering the physical and economic limitations of the mining method used. Estimates of mineable reserves consider all of the in-place coal that can be mined, but not necessarily produced from the mine. It is contrasted by the term "recoverable coal" which is the amount of coal that can be physically mined and removed from the mineable coal seam or area.

Mineral Leasing Laws: The Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.), and the Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351-359).

Mining height: The extracted height of a coal seam.

Mining-Induced Seismicity: Earthquakes or ground vibrations caused by underground coal mining and the resulting subsidence.

Mining Plan: A resource recovery and protection plan.

Mining Supervisor: The Authorized Officer.

Mining Unit: An area containing technically recoverable coal that will feasiblely support a commercial mining operation. The coal may either be Federal coal or be both Federal and non-Federal coal.

Mitigation: Includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.
(b) Minimizing impacts by limiting the degree of magnitude of the action and its implementation.
(c) Rectifying the impact of repairing, rehabilitating, or restoring the affected environment.
(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.

Multiple-use: Management of the surface and subsurface resources so that they are jointly used in the manner that will best meet the present and future needs of the public without permanent impairment of the productivity of the land or the quality of the environment.

National Environmental Policy Act of 1969 (NEPA): Public Law 91-190. Established environmental policy for the nation. Among other items, NEPA requires Federal agencies to consider environmental values in decision-making processes.

National Forest Management Act (NFMA): A law passed in 1976 as amendments to the Forest and Rangeland Renewable Resources Planning Act that requires the preparation of Regional and Forest plans and the preparation of regulations to guide that development.

National Forest System: All National Forest Systems lands reserved or withdrawn from the public domain of the United States; all National Forest System lands acquired through purchase, exchange, donation, or other means the National Grasslands and land use projects administered under Title III of the Bankhead-Jones Farm Tenant Act (7 U.S.C. 1010 et seq.); and other lands, waters, or interests therein which are administered by the U.S.D.A. Forest Service or are designated for administration through the U.S.D.A. Forest Service as a part of the system (16 U.S.C. 1609).

National Register of Historic Places (NRHP): A listing of architectural, historical, archaeological, and cultural sites of local, state, or national significance established by the Historic Preservation Act of 1966.

NEPA: See National Environmental Policy Act of 1969.

No Action Alternative: No action or activity would take place. Another definition is where ongoing programs described within the existing Land Management Plan continue. No decision would be made and no leases would be offered.

Nongame Species: Species of animals that are not managed as a sport hunting/fishing resource.

Nonpoint Source Pollution: Sources from which the pollutants discharged are:

(1) induced by natural processes, including precipitation, seepage, percolation, and runoff;
(2) not traceable to any discrete or identifiable facility; and
(3) better controlled through the use of Best Management Practices, including process and planning techniques. This includes natural pollution sources not directly or indirectly caused by man.

Noxious Weeds: Rapidly spreading plants that cause a variety of major ecological impacts to both agriculture and wild lands.

Numerical (subsidence) model: A mathematical description of subsidence phenomena solved by computer, used for the prediction of ground surface deformation from mining.

Off-Road Vehicle (ORV): Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, swampland or other natural terrain. It includes, but is not limited to, four-wheel drive or low-pressure-tire vehicles, motorcycles and related two-wheel vehicles, amphibious machines, ground-effect or air-cushion vehicles.

Operator: A lessee, exploration licensee or one conducting operations on a lease or exploration license under the authority of the lessee or exploration licensee.

Overburden: The geologic strata overlying a coal seam.

Overstory: The portion of a plant community consisting of the taller plants on the site; the forest or woodland canopy.

Panel centerline: The horizontal line running central and parallel to the long axis of a longwall panel.

Panel: A coal mining block that generally comprises one operating unit.

Partial-extraction mining: Incomplete extraction of the coal seam where pillars are left after mining.

Particulates: Small particles suspended in the air and generally considered pollutants.

Peak Particle Acceleration (g): A measure of ground vibration at a specific point, measured in gravity units (g). Conversion from Peak Particle Acceleration (PPA) in gravitational units to Peak Particle Velocity (PPV) for sinusoidal vibrations can be carried out using the formula (Dowding, 1985): PPV = (PPA x 386.4)/(2 x π x Frequency in Hz).

Peak Particle Velocity (PPV): A measure of ground vibration at a specific point, measured in inches per second.

Permanent strain: Ground strain that remains after the completion mining.

Permit Amendment Area: The area that is represented by Box Canyon that, if mined, has the potential for escarpment failure and may result in the damage or alteration of the perennial stream. Also referred to as the Proposed Subsidence Area. Specifically located in a portion of Section 15, W½, Township 21 South, Range 5 East (SLM).

Pines Tract Project Area: Encompasses three separate areas; the Pines Coal Lease Tract (7,311 acres), Lease Modification Area (150-acre), and Box Canyon Area (Permit Amendment Area).

Portal: The structure surrounding the immediate entrance to a mine.

Prehistoric Site: Archaeologic sites associated with American Indians and usually occurring before contact with Europeans.

Prevention of Significant Deterioration (PSD): A classification established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of National significance while ensuring economic growth can occur in a manner consistent with the preservation of existing clean air resources. Specific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875, et seq.).

Production mining: Full-scale mining following the initial mining of access (development) entries; in contrast to development mining.

Project Area: The area of analysis including the Flat Canyon Tract area and adjacent non-Federal surface and coal estates that could be mined as a result of potential leasing and mining of the Flat Canyon Coal Lease Tract.

Public Bodies: Federal and State agencies; political subdivision of a state, including counties and municipalities; rural electric cooperatives and similar organizations; and nonprofit corporations controlled by any such entities.

Range Allotment: A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under an allotment management plan. It is the basic land unit used to facilitate management of the range resource on National Forest System lands administered by the U.S.D.A. Forest Service.

Rare Plants: A plant species, or subspecies, that is limited to a restricted geographic range or one that occurs sparsely over a wider area.

Reasonably Foreseeable Development Scenario (RFDS): The prediction of the most likely future coal mining actions in the project area that would likely result from the proposed action.

Reclamation: Returning disturbed lands to a form and productivity that will be ecologically balanced and in conformity with a predetermined land management plan.

Record of Decision (ROD): A document separate from, but associated with, an environmental impact statement that publicly and officially discloses the responsible official's decision on the proposed action.

Recoverable Coal: The amount of coal that can actually be mined and transported from a coal seam or area after leaving pillars for support of operations.

Recreation Opportunity Spectrum (ROS): Land delineations that identify a variety of recreation experience opportunities in six classes along a continuum from primitive to urban. Each class is defined in terms of natural resource settings, activities and experience opportunities. The six classes are: Urban, Rural, Roaded, Natural, Semiprimitive Motorized, Semiprimitive Nonmotorized, and Primitive.

Reserves: Recoverable Coal Reserves.

Restore: To bring back landscape to a former or original condition or appearance.

Retreat: Production mining following initial development of access entries in a coal seam.

Retreating Mining: Exploitation in the direction opposite from development.

Return: The air of ventilation that as passed through all the working faces of a split.

Revegetation: The reestablishment and development of self-sustaining plant cover. On disturbed sites, this normally requires human assistance such as seed bed preparation, reseeding, and mulching.

Richter Scale: A scale by which the magnitude of earthquakes or ground vibrations are measured, generally ranging from 0 to 10 with 10 being the highest magnitude.

Rigid (abutment) pillar: A coal pillar designed to remain intact and provide complete load-bearing capacity throughout the course of mining.

Riparian Ecosystem: A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.

Riparian: Riparian areas consist of terrestrial and aquatic ecosystems, those lands in a position to directly influence water quality and water resources, whether or not free water is available. This would include all lands in the active flood channel and lands immediately upslope of stream banks. These areas may be associated with lakes, reservoirs, estuaries, potholes, marshes, streams, bogs,, wet meadows, and intermittent or permanent streams where free and unbound water is available.

Roaded, Natural (RN): A recreation opportunity classification term describing a land area that has been predominately a natural appearing environment with moderate evidence of sights and sounds of humans. Concentration of users is moderate to low. Roads of better than primitive class are usually with 0.5 mile. A broad range of motorized and nonmotorized activity opportunities are available. Management activities, including timber harvest, are present and harmonize with the natural environment.

Roadless: Refers to the absence of roads that have been constructed and maintained by mechanical means to ensure regular and continuous use.

Room-and-pillar mining: A mining method by which coal is extracted over large areas from a network of entries separated by pillars.

Rosgen Classification System: A method for classifying different stream types.

Scenic Quality Classes: The designation (A, B, or C) assigned a scenic quality rating unit to indicate the visual importance or quality of a unit relative to other units within the same physiographic province.

SCLS (Special Coal Lease Stipulations). Statements included in Section of Section 15 of BLM's standard coal lease form (Form 3400-12) that require specific actions or measures to be met by the lessee regarding actions for lease administration or development.

Scoping Process: An early and open public participation process for determining particular issues to be addressed in an environmental document and for identifying the significant issues related to a proposed action.

Second-pass mining: Final stage room-and-pillar production mining following first-pass mining; higher extraction ratios than first-pass mining are achieved by partial to full mining of remnant first- pass coal pillars.

Secretary: Secretary of the Interior.

Seismicity: The degree to which a region of the earth is subject to earthquakes.

Sensitive Species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations and have been identified for monitoring and measures to prevent them from being listed as Threatened or Endangered.

Significant: An effect that is analyzed in the context of the proposed action to determine the importance of the effect either beneficial or adverse. The degree of significance is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment and when the affects on the quality of the human environment are likely to be highly controversial.

Small Game: Birds and small mammals normally hunted or trapped.

Sole Part in Interest: A party who is and will be vested with all legal and equitable rights under a lease, bid, or an application for a lease. No one is a sole party in interest with respect to a lease or bid in which any other party has any interest.

Special Coal Lease Stipulations: Statements included in Section of Section 15 of BLM's standard coal lease form (Form 3400-12) that require specific actions or measures to be met by the lessee regarding actions for lease administration or development.

Split Estate: Land in which the ownership of the surface is held by persons, including governmental bodies, other than the Federal government and the ownership of underlying coal is, in whole or in part, reserved to the Federal government.

Sterilization: Rendering coal resources unmineable.

Stipulation: A provision that modifies standard lease right and is attached to and made a part of the lease.

Strain: Change in length per unit of length; a measure of ground deformation.

Stress: The force per unit area (also pressure), or intensity of forces distributed over a given area, responsible for deforming and fracturing ground strata.

Subcritical Subsidence: Refers to the subsidence basin that occurs when the width of the extraction area is relatively small compared to the depth of cover. For a subsidence basin of subcritical width the bottom of the basin is pointed and the maximum subsidence at the center of the basin increases with increasing width of extraction.

Subsidence: The deformation of the ground mass above an underground mine and the resulting lowering of the ground surface. This occurs as the rock immediately above the void left by mining caves and the overlying rock layers adjust to the loss of support.

Substantial legal and financial commitments: Significant investments that have been made on the basis of a long-term coal contract in power plants, railroads, coal handling and preparation, extraction or storage facilities and other capital intensive activities. Cost of acquiring the coal in place or of the right to mine it without an existing mine are not sufficient to constitute substantial legal and financial commitments.

Supercritical Subsidence: Refers to the subsidence basin that occurs when the width of the extraction area becomes so large that the bottom of the subsidence basin becomes flat. The maximum subsidence in a supercritical basin is equal to the maximum subsidence in a critical basin.

Surface coal mining operations: Activities conducted on the surface of lands in connection with a surface coal mine or surface operations and surface impacts incident to an underground mine.

Surface Management Agency: The Federal agency with jurisdiction over the surface of federally owned lands containing coal deposits, and, in the case of private surface over Federal coal, the Bureau of Land Management, except in areas designated as National Grasslands, where it means the Forest Service.

Tension crack: A crack (typically open) in the ground formed in an area of tensional stress.

Tension: Stress resulting in the elongation or "stretching" of ground strata; opposite of compression.

Threatened And Endangered Species: Definitions: Federal codes are defined as follows:

Endangered (E): Any species that is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the ESA would present an overwhelming and overriding risk to man.

Threatened (T): Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Candidate Species (C): Status review taxa for which the USFWS currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list the taxa as an endangered or threatened species.

Forest Service Sensitive: Those plant and animal species identified by a Regional Forester for which population viability is a concern as evidenced by:. (a) significant current or predicted downward trends in population numbers or density or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Total Dissolved Solids (TDS): Salt or an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, manganese, sodium, potassium, and other cations that form sales that are dissolved or present in water.

Transient strain: Ground strain of a temporary or ephemeral duration, as opposed to permanent strain.

Valid existing rights: (a) Except for haul roads, that a person possesses valid existing rights for an area protected under section 522(e) of the Act on August 3, 1977, if the application of any of the prohibitions contained in that section to the property interest that existed on that date would effect a taking of the person's property which would entitle the person to just compensation under the Fifth and Fourteenth Amendments to the United States Constitution; (b) For haul roads, (1) A recorded right of way, recorded easement or a permit for a coal haul road recorded as of August 3, 1977, or (2) Any other road in existence as of August 3, 1977; (c) A person possesses valid existing rights if the person proposing to conduct surface coal mining operations can demonstrate that the coal is both needed for, and immediately adjacent to, an ongoing surface coal mining operation which existed on August 3, 1977. A determination that coal is ``needed for'' will be based upon a finding that the extension of mining is essential to make the surface coal mining operation as a whole economically viable; (d) Where an area comes under the protection of section 522(e) of the Act after August 3, 1977, valid existing rights shall be found if-- (1) On the date the protection comes into existence, a validly authorized surface coal mining operation exists on that area; or (2) The prohibition caused by section 522(e) of the Act, if applied to the property interest that exists on the date the protection comes into existence, would effect a taking of the person's property which would entitle the person to just compensation under the Fifth and Fourteenth Amendments to the United States Constitution. (e) Interpretation of the terms of the document relied upon to establish the rights to which the standard of paragraphs (a) and (d) of this section applies shall be based either upon applicable State statutory or case law concerning interpretation of documents conveying mineral rights or, where no applicable State law exists, upon the usage and custom at the time and place it came into existence.

Vertebrate: An animal having a spinal column.

Visual Quality Objectives (VQO): Based upon variety class, sensitivity level, and distance zone determinations. Each objective describes a different level of acceptable alteration based on aesthetic importance. The degree of alteration is based on contrast with the surrounding landscape.

> Preservation: In general, human activities are not detectable to the visitor.
> Retention: Human activities are not evident to the casual Forest visitor.
> Partial Retention: Human activities may be evident, but must remain subordinate to the characteristic landscape.
> Modification: Human activity may dominate the characteristic landscape, but must, at the same time, use naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in middleground or background.
> Maximum Modification: Human activity may dominate the characteristic landscape but should appear as a natural occurrence when viewed as background.
> Enhancement: A short-term management alternative that is completed with the express purpose of increasing positive visual variety where little variety now exists.

Visual Resource: The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal of the unit.

Wetlands: Lands where saturation with water is the primary factor determining the nature of soil development and the kinds of animal and plant communities living under or on it surface.

Written Consent: The document or documents that a qualified surface owner has signed that: 1) permit a coal operator to enter and commence surface mining of coal, 2) describe any financial or other consideration given or promised in return for the permission, including in-kind considerations, 3) describe any consideration given in terms of type or method of operation or reclamation for the area, 4) contain any supplemental or related contracts between the surface owner and any other person who is a party to the permission, and 5) contain a full and accurate description of the area covered by the permission.

Yield pillar: A coal pillar design to crush controllably under loading.

TABLE
OF
PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

APPENDIX A
Table of Past, Present, and Reasonably Foreseeable Future Actions

Table A-1 Summary of Past Actions

PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
MINERALS Coal Exploration Drill Holes. All old holes with the exception of water monitoring wells in the current permit area have been plugged and reclaimed. Drill hole access roads have been reclaimed.	1900-present	Vegetation well established but slight benches on slopes still visible. All modern roads (1980 to present) have been recontoured and revegetated. Roads and pads reclaimed within the last 5 years still visible because of more grasses and less brush.
Oil and Gas Drilling. Several wells drilled in 1950s. All pads and roads reclaimed.	1950s	Pads and roads reclaimed and revegetated. Slight topographic change apparent.
Anschutz Ridge Runner #13-18 Wildcat Well pad constructed in 1998 and South Trough Springs Ridge Road (FR 50018) reconstructed and graveled. Pad was reclaimed in 2000 without drilling.	1998-2000	Site reclaimed and being monitored for revegetation success

PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
Questar Mainline 41 Gas Transmission Pipeline This 18 inch buried pipeline traverses the Skyline Mine Permit Area in a northwest-southeast direction along Trough Springs Ridge. Constructed in the 1950s. A segment was relocated to the southwest in 1990 to avoid mine subsidence areas. This segment followed Burnout Canyon to Upper Huntington Creek, crosses the creek, then turns north under State Route 264. It turns east near the head of the Canyon and climbs the slope back to Trough Springs Ridge. This segment was deactivated in 2000 and the original segment on Trough Springs Ridge was replaced.	1950 to present	Original pipeline corridor is visible due to removal of overstory vegetation. Understory vegetation has been restored. Replaced segment of old corridor has been seeded and is being monitored for success. Segment constructed in 1990 is not abandoned. All areas recontoured and revegetated to standard. Slightly visible in Burnout Canyon and Upper Huntington Canyon slope due to immature sagebrush and more grasses.
TIMBER Several historic timber cutting operations have occurred on the private lands in the area. Several historic sawmill sites are located on the private lands in the canyons..	1880 to 1960	Several historic sawmill sites located in the canyons.
A conifer timber sale occurred at the head of the North Fork of Boulger Creek. In addition, aspen were cut in an effort to reactivate growth of the decadent stand. Approximately 10,000 board-feet of timber was cut.	Early 1960s	The road constructed for the sale has been retained on the road system as a Forest Road open to use by the public. Understory vegetation reestablished but aspen have not regrown as hoped.

PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
RANGELAND/WATERSHED		
Livestock Grazing Historic Dairy sites on private lands in Flat Canyon within project area.	1850 – present	Changes in species compositions. Non-native species introduced.
Unclassified spur roads on South Trough Springs Ridge reclaimed (approx. 3 miles).	1998	Roads being monitored for closure and revegetation success.
Watershed revegetation project (200 acres) in the area between Flat Canyon and Boulger Canyon near the confluence.	1990	Vegetation has been reestablished in accordance with standards/objectives.
WILDLIFE		
None	NA	NA
TRANSPORTATION		
Forest Roads and private roads developed for grazing, timber operations, and access to private lands.	1890 to present	Removal of vegetation and establishment of disturbed roadway. Sediment production continues on native surface roads. Human activity during summer seasons when roads are open. Snowmibile activity in the winter months.
South Trough Springs Ridge Road (FR 50018) reconstructed for oil and gas activity (see Minerals)	1998	Road closed until after July 4 weekend. Roadway stabilized and decreased sediment. Increased use during fall hunting seasons due to gravel.

PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
RECREATION See Present Actions		

Table A-2 Summary of Present Actions

PRESENT ACTIONS	DATE	CURRENT EFFECTS
MINERALS Skyline Mine. Portal facilities located in Eccles Canyon and Permit Area lies directly east of the project area. Permit Area – T.13 S., R. 6 E., SLM Sections 10, 11, 13, 14, 22-27, 34, and 35. Portal Facilities – T.13 S., R. 6 E., SLM Sections 13 and 24. Loadout Facilities – T.13 S., R. 7 E., SLM Section 17	Mine construction began in 1980. Coal production from 1981 to present	Portal facilities have disturbed 47 acres in Eccles Canyon on National Forest System lands. Loadout facilities and the waste rock disposal area have disturbed approx. 24 acres of private lands at mouth of Eccles Canyon and near Scofield. The Permit Area subject to underground mining encompasses approx. 6,400 acres.

PRESENT ACTIONS	DATE	CURRENT EFFECTS
TIMBER Salvage timber cutting occurring on private lands west of the Flat Canyon Tract	Present	Increased sediment in perennial drainages due to road construction, skid roads, and timber cutting.
RANGELAND Continued sheep grazing on allotments. No developed range facilities.	Present	Continued grazing and associated limitation of vegetation densities. Continued effects to riparian vegetation densities in canyon bottoms.
WILDLIFE	None	None
TRANSPORTATION Continued use and maintenance of Forest Roads and private roads. See Future Actions	Present	See Future Actions
RECREATION Dispersed recreation activities include hiking, motorized sight-seeing, camping, hunting, snowmobiling, and cross-country skiing.	Present	Year-round human activity.
Recreation facilities include Boulger Reservoir, Flat Canyon Campground, and summer homes/cabins on private lands. See Recreation Section in Chapter 3 of EIS.		Surface disturbance and human activity and occupation. Includes year-round use of buildings on private lands.

Table A-3 Summary of Future Actions

FUTURE ACTIONS	DATE	ANTICIPATED EFFECTS
MINERALS		
Oil and Gas Exploration – Two to four wildcat wells anticipated along South Trough Springs Ridge Road (FR 50018).	2001-2005	Construction of 4 drill pads and short pad access roads from FR 50018 to drill sites. Anticipated disturbance is 1.5 acres per site for a total of 6 acres of disturbance. Reconstruction and gravel surfacing of an additional 2 miles of FR 50018. Slight increase in dispersed camping during summer months and during the fall hunting seasons. Road closed from December to July 5th.
Natural Gas Pipelines – Questar and Kern River have proposed to construct new natural gas pipelines along the existing corridor of the existing Questar Mainline #41 18 inch pipeline along Trough Springs Ridge approximately 1 mile east of the Flat Canyon Tract. It is reasonably foreseeable that only one pipeline would be constructed with a diameter of 20 to 24 inches.	2001-2002	Existing pipeline corridor would be widened from 75 feet to 125 feet. Overstory vegetation would be removed and understory vegetation would be reestablished after the pipeline is constructed. Human activity would occur for 1 field season. It would take up to 5 years to reestablish vegetation. Visibility of the existing corridor would be increased because of the increased width.
Liquid Petroleum Products Pipeline – Williams has proposed to construct a 10 inch pipeline to transfer gasoline, diesel fuel, and jet fuel across the Wasatch Plateau. The proposed corridor is along the same corridor as the Questar Gas Pipeline. Alternative routes are being considered in the EIS.	2002-2003	If approved the existing Mainline #41 pipeline disturbed corridor could be widened from 75 feet to 125. If both the proposed gas pipeline and the liquid fuels pipeline are constructed in the existing corridor the disturbed corridor could be increased from 75 feet to 175 feet. The construction activity would take place during the 2002 and/or 2003 field seasons. If both pipelines are constructed in this corridor, the associated human activity would occur from the 2001 field season through the 2002 and/or 2003 field seasons.

FUTURE ACTIONS	DATE	ANTICIPATED EFFECTS
TIMBER	None	None
RANGELAND Continued grazing in Sheep and Goat Allotments. Approximately 2000 Animal Unit Months. Managed under Deferred Grazing System.	Indefinite	Continued effects to vegetation including riparian vegetation in canyon bottoms. Monitoring of vegetation conditions is used to determine grazing use so effects are minimized but some reduction of riparian vegetation densities occurs.
TRANSPORTATION Road maintenance	Indefinite	Continued sediment production from native surface roads even with annual maintenance.
Potential construction of new roads on private lands for access to new cabins. (See Recreation).	Indefinite	See Recreation
Reconstruction and gravel surfacing of South Trough Springs Road (FR 50018). See Minerals Section	2001-Indefinite	Decreased erosion and sediment production from roadway. Road surface stabilized by gravel surface. Road closed from December 1 through July 5th.
RECREATION Improvement and maintenance of existing developed recreation sites such as Flat Canyon Campground and Boulger Dam.	Indefinite	Increased use of facilities due to population growth and demand for recreation opportunities. Increased human activity in the area year-round.

FUTURE ACTIONS	DATE	ANTICIPATED EFFECTS
Improvement of existing cabins and construction of new cabins on private lands. Potential for construction of new private roads for access to these facilities.	Indefinite	Increased land disturbance, sediment production, and year-round human presence and activity.

BUREAU OF LAND MANAGEMENT
COAL LEASE FORM 3400-12

The terms and conditions on this form would be used on all coal leases, including Alternatives B, B', C, and others if designated and selected.

Form 3400-12
(April 1986)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Serial Number

COAL LEASE

PART I. LEASE RIGHTS GRANTED

This lease, entered into by and between the UNITED STATES OF AMERICA, hereinafter called lessor, through the Bureau of Land Management, and *(Name and Address)*

hereinafter called lessee, is effective *(date)*, for a period of 20 years and for so long thereafter as coal is produced in commercial quantities from the leased lands, subject to readjustment of lease terms at the end of the 20th lease year and each 10-year period thereafter.

Sec. 1. This lease is issued pursuant and subject to the terms and provisions of the:

☒ Mineral Lands Leasing Act of 1920, Act of February 25, 1920, as amended, 41 Stat. 437, 30 U.S.C. 181-287, hereinafter referred to as the Act;

☐ Mineral Leasing Act for Acquired Lands, Act of August 7, 1947, 61 Stat. 913, 30 U.S.C. 351-359;

and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Sec. 2. Lessor, in consideration of any bonuses, rents, and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the following described lands:

SEE ATTACHED DESCRIPTION

ntaining acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliances d the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject to e conditions herein provided.

ART II. TERMS AND CONDITIONS

Sec. 1. (a) RENTAL RATE - Lessee shall pay lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $ for each lease year.

(b) RENTAL CREDITS - Rental shall not be credited against either production or advance royalties for any year.

Sec. 2. (a) PRODUCTION ROYALTIES - The royalty shall be per-cent of the value of the coal as set forth in the regulations. Royalties are due to lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the lessee, the authorized officer may accept, for a total of not more than 10 years, the payment of advance royalties in lieu of continued operation, consistent with the regulations. The advance royalty shall be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the lessee requests approval to pay advance royalties in lieu of continued operation.

Sec. 3. BONDS - Lessee shall maintain in the proper office a lease bond in the amount of $. The authorized officer may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE - This lease is subject to the conditions of diligent development and continued operation, except that these conditions are excused when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee. The lessor, in the public interest, may suspend the condition of continued operation upon payment of advance royalties in accordance with the regulations in existence at the time of the suspension. Lessee's failure to produce coal in commercial quantities at the end of 10 years shall terminate the lease. Lessee shall submit an operation and reclamation plan pursuant to Section 7 of the Act not later than 3 years after lease issuance.

The lessor reserves the power to assent to or order the suspension of the terms and conditions of this lease in accordance with, inter alia, Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

Sec. 5. LOGICAL MINING UNIT (LMU) - Either upon approval by the lessor of the lessee's application or at the direction of the lessor, this lease shall become an LMU or part of an LMU, subject to the provisions set forth in the regulations.

The stipulations established in an LMU approval in effect at the time of LMU approval will supersede the relevant inconsistent terms of this lease so long as the lease remains committed to the LMU. If the LMU of which this lease is a part is dissolved, the lease shall then be subject to the lease terms which would have been applied if the lease had not been included in an LMU.

Sec. 6 DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as lessor may prescribe, lessee [illegible] furnish detailed statements showing the amounts and quality o[illegible] products removed [illegible]old from the lease, the proceeds therefrom, and the amount used [illegible]duction purposes or unavoidably lost.

[illegible]ee shall keep open at all reasonable times for the inspection of any duly authorized officer of lessor, the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands.

Lessee shall allow lessor access to and copying of documents reasonably necessary to verify lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section shall be closed to inspection by the public in accordance with the Freedom of Information Act (5 U.S.C. 552).

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee shall comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources.

Lessee shall not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area shall be submitted to the authorized officer.

Lessee shall carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation to any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users. Lessee shall take measures deemed necessary by lessor to accomplish the intent of this lease term. Such measures may include, but are not limited to, modification to proposed [illegible]iting or design of facilities, timing of operations, and specification of [illegible]im and final reclamation procedures. Lessor reserves to itself the [illegible] to lease, sell, or otherwise dispose of the surface or other mineral [illegible]osits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor shall condition such uses to prevent unnecessary or unreasonable interference with rights of lessee as may be consistent with concepts of multiple use and multiple mineral development.

Sec. 8. PROTECTION OF DIVERSE INTERESTS, AND EQUAL OPPORTUNITY - Lessee shall: pay when due all taxes legally assessed and levied [illegible]der the laws of the State or the United States; accord all employees [illegible]mplete freedom of purchase; pay all wages at least twice each month [illegible] lawful money of the United States; maintain a safe working [illegible]vironment in accordance with standard industry practices; restrict [illegible] workday to not more than 8 hours in any one day for underground [illegible]orkers, except in emergencies; and take measures necessary to protect [illegible]e health and safety of the public. No person under the age of 16 years shall be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply.

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1966, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither lessee nor lessee's subcontractors shall maintain segregated facilities.

Sec. 15. SPECIAL STIPULATIONS -

Se[illegible] [illegible] (a) TRANSFERS - [illegible]

☒ This lease may be [illegible]ferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

☐ This lease may be transferred in whole or in part to another public body or to a person who will mine the coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

☐ This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest *must* be approved in accordance with the regulations.

(b) RELINQUISHMENT - The lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations. Upon lessor's acceptance of the relinquishment, lessee shall be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC. - At such time as all portions of this lease are returned to lessor, lessee shall deliver up to lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, lessee shall remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the authorized officer. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, shall become the property of the lessor, but lessee shall either remove any or all such property or shall continue to be liable for the cost of removal and disposal in the amount actually incurred by the lessor. If the surface is owned by third parties, lessor shall waive the requirement for removal, provided the third parties do not object to such waiver. Lessee shall, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. PROCEEDINGS IN CASE OF DEFAULT - If lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease shall be subject to cancellation by the lessor only by judicial proceedings. This provision shall not be construed to prevent the exercise by lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver shall not prevent later cancellation for the same default occurring at any other time.

Sec. 12. HEIRS AND SUCCESSORS-IN-INTEREST - Each obligation of this lease shall extend to and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 13. INDEMNIFICATION - Lessee shall indemnify and hold harmless the United States from any and all claims arising out of the lessee's activities and operations under this lease.

Sec. 14. SPECIAL STATUTES - This lease is subject to the Clean Water Act (33 U.S.C. 1252 et. seq.), the Clean Air Act (42 U.S.C. 4274 et. seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et. seq.).

SPECIAL COAL LEASE STIPULATIONS

These stipulations apply to Alternative B' and C, and potentially to any other alternatives designated as D or beyond. They would be attached under Section 15 of the BLM Coal Lease Form 3400-12 shown in Appendix B.

SPECIAL COAL LEASE STIPULATIONS

Federal Regulations 43 CFR 3400 pertaining to Coal Management make provisions for the Surface Management Agency, the surface of which is under the jurisdiction of any Federal agency other than the Department of Interior, to consent to leasing and to prescribe conditions to insure the use and protection of the lands. All or part of this lease contain lands the surface of which are managed by the United States Department of Agriculture, Forest Service, Manti-La Sal National Forest.

The following stipulations pertain to the Lessee responsibility for mining operations on the lease area and on adjacent areas as may be specifically designated on National Forest System lands.

Stipulation #1
Before undertaking activities that may disturb the surface of previously undisturbed leased lands, the Lessee may be required to conduct a cultural resource inventory and a paleontological appraisal of the areas to be disturbed. These studies shall be conducted by qualified professional cultural resource specialists or qualified paleontologists, as appropriate, and a report prepared itemizing the findings. A plan will then be submitted making recommendations for the protection of, or measures to be taken to mitigate impacts for identified cultural or paleontological resources.

If cultural resources or paleontological remains (fossils) of significant scientific interest are discovered during operations under this lease, the Lessee prior to disturbance shall immediately bring them to the attention of the appropriate authority. Paleontological remains of significant scientific interest do not include leaves, ferns or dinosaur tracks commonly encountered during underground mining operations.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the Lessee.

Stipulation #2
If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations for the protection of these species or action necessary to mitigate the disturbance.

The cost of conducting the inventory, preparing reports and carrying out mitigating measures shall be borne by the Lessee.

Stipulation #3
The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and

demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

Stipulation #4
Powerlines used in conjunction with the mining of coal from this lease shall be constructed so as to provide adequate protection for raptors and other large birds. When feasible, powerlines will be located at least 100 yards from public roads.

Stipulation #5
The limited area available for mine facilities at the coal outcrop, steep topography, adverse winter weather, and physical limitations on the size and design of access roads, are factors which will determine the ultimate size of the surface area utilized for the mine. A site-specific environmental analysis will be prepared for each new mine site development and for major improvements to existing developments to examine alternatives and mitigate conflicts.

Stipulation #6
Consideration will be given to site selection to reduce adverse visual impacts. Where alternative sites are available, and each alternative is technically feasible, the alternative involving the least damage to the scenery and other resources shall be selected. Permanent structures and facilities will be designed, and screening techniques employed to reduce visual impacts and, where possible, achieve a final landscape compatible with the natural surroundings. The creation of unusual, objectionable, or unnatural landforms and vegetative landscape features will be avoided.

Stipulation #7
The Lessee shall be required to establish a monitoring system to locate, measure and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

Stipulation #8
The Lessee shall provide for the suppression and control of fugitive dust on haul roads and at coal handling and storage facilities. On Forest Development Roads (FDR), Lessees may perform their share of road maintenance by a commensurate share agreement if a significant degree of traffic is generated that is not related to their activities.

Stipulation #9
Except at specifically approved locations, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. The Lessee shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created.

Stipulation #10
In order to avoid surface disturbance on steep canyon slopes and to preclude the need for surface access, all surface breakouts for ventilation tunnels shall be constructed from inside the mine, except at specific approved locations.

Stipulation #11
If removal of timber is required for clearing of construction sites, etc., such timber shall be removed in accordance with the regulations of the surface management agency.

Stipulation #12
The coal contained within, and authorized for mining under this lease shall be extracted only by underground mining methods.

Stipulation #13
Existing Forest Service owned or permitted surface improvements will need to be protected, restored, or replaced to provide for the continuance of current land uses.

Stipulation #14
In order to protect big-game wintering areas, elk calving and deer fawning areas, sagegrouse strutting areas, and other key wildlife habitat and/or activities, specific surface uses outside the mine development area may be curtailed during specified periods of the year.

Stipulation #15
Support facilities, structures, equipment, and similar developments will be removed from the lease area within two years after the final termination of use of such facilities. This provision shall apply unless the requirement of Section 10 of the lease form is applicable. Disturbed areas and those areas previously occupied by such facilities will be stabilized and rehabilitated, drainages re-established, and the areas returned to a premining land use.

Stipulation #16
The Lessee, at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed or displaced corner monuments (section corners, 1/4 corners, etc.), their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by a professional land surveyor registered in the State of Utah, and to the standards and guidelines found in the Manual of Surveying Instructions, United States Department of the Interior.

Stipulation #17
The Lessees, at their expense, will be responsible to replace any surface and/or developed groundwater sources identified for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain

existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251).

Stipulation #18

STIPULATION FOR LANDS OF THE NATIONAL FOREST SYSTEM
UNDER JURISDICTION OF
THE DEPARTMENT OF AGRICULTURE

The licensee/permittee/lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of Interior, (2) uses of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operating plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Telephone Number: 801-637-2817

who is the authorized representative of the Secretary of Agriculture

____
Signature
Licensee/Permittee/Lessee

Stipulation #19
ABANDONMENT OF EQUIPMENT:
The lessee/operator is responsible for compliance and reporting regarding toxic and hazardous material and substances under Federal Law and all associated amendments and regulations for the handling of such materials on the land surface and in underground mine workings.

The lessee/operator must remove mine equipment and materials not needed for continued operations, roof support and mine safety from underground workings prior to abandonment of mine sections. Exceptions can be approved by the Authorized Officer (BLM) in consultation with the surface management agency. Any on-site disposal of non-coal waste must comply with 30CFR § 817.89 and must be approved by the regulatory authority responsible for the enforcement of the Surface Mining Control and Reclamation Act (30 U.S.C. 1201, et seq.). Creation of a situation that would prevent removal of such material and equipment by retreat or abandonment of mine sections, without prior authorization would be considered noncompliance with lease terms and conditions and subject to appropriate penalties under the lease.

All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put into place, the lessee shall inspect the area and certify through documentation any equipment/machinery, hazardous substances, and used oil that is intended to be left underground. The Authroized Officer may participate in this inspection. The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120 (h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map showing location of equipment/machinery (model, type of fluid, amount remaining, batteries, etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification.

WASTE CERTIFICATION:
The lessee shall provide on a yearly basis and prior to lease relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no hazardous subanances defined as per (40 CFR 302.4) or used oil as per Utah State Management Rule R-315-15, deposited within the lease, either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The back-up documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Reauthorization Act of 1986 or equivalent.

Stipulation #20
Notwithstandin the approval of a resource recovery and protection plan by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (1) the operator/lessee fails to achieve maximum economic recovery [as defined at 43 CFR § 3480.0-5(21] of the recoverable coal reserves or (2) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unminable by the operation, the operator shall submit appropriate justification to obtain approval by the Authorized Officer to leave such reserves unmined. Upon approval by the Authroized Officer, such coal beds or portions thereof shall not be subject to damages as described above. Further, nothing in this section shall prevent the operator/lessee from exercising its right to relinquish all or portion of the lease as authorized by statute and regulation.

In the event the Authorized Officer determines that the R2P2 as approved will not attain MER as the result of changed conditions, the Authorized Officer will give proper notice to the operator/lessee as required under applicable regulations. The Authorized Officer will order a modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves whall become due and payable upon determination by the Authorized Officer that the coal reserves have been rendered unminable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the MMS demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

DESCRIPTION OF EXPECTED MINING AND SUBSIDENCE (AFTER NORWEST, 2000)

DESCRIPTION OF EXPECTED MINING AND SUBSIDENCE (AFTER NORWEST, 2000)

1.0 SUBSIDENCE PREDICTION

During longwall extraction, coal-supporting overburden is fully removed. The strata above caves into the void. Rock strata failure is a complicated process and dependent upon rock strength, discontinuities, in-situ stress, orientation, and area extracted. Failure of rock strata is transmitted to the surface, resulting in ground subsidence. Prediction of the extent and magnitude of surface subsidence is dependent on local geological variation and is more accurate where empirical data on mining parameters is combined with a surface subsidence monitoring program to derive the main subsidence parameters.

A number of previous studies have been carried out at Skyline relating to the effects of subsidence on perennial streams, springs, highways, ridges, and a gas pipeline. These studies provide a valuable data set defining the local conditions and the degree of impact subsidence is likely to have on the surface and on sub-surface strata. Aspects relating to surface water and groundwater are discussed in more detail in the technical report on surface water and groundwater.

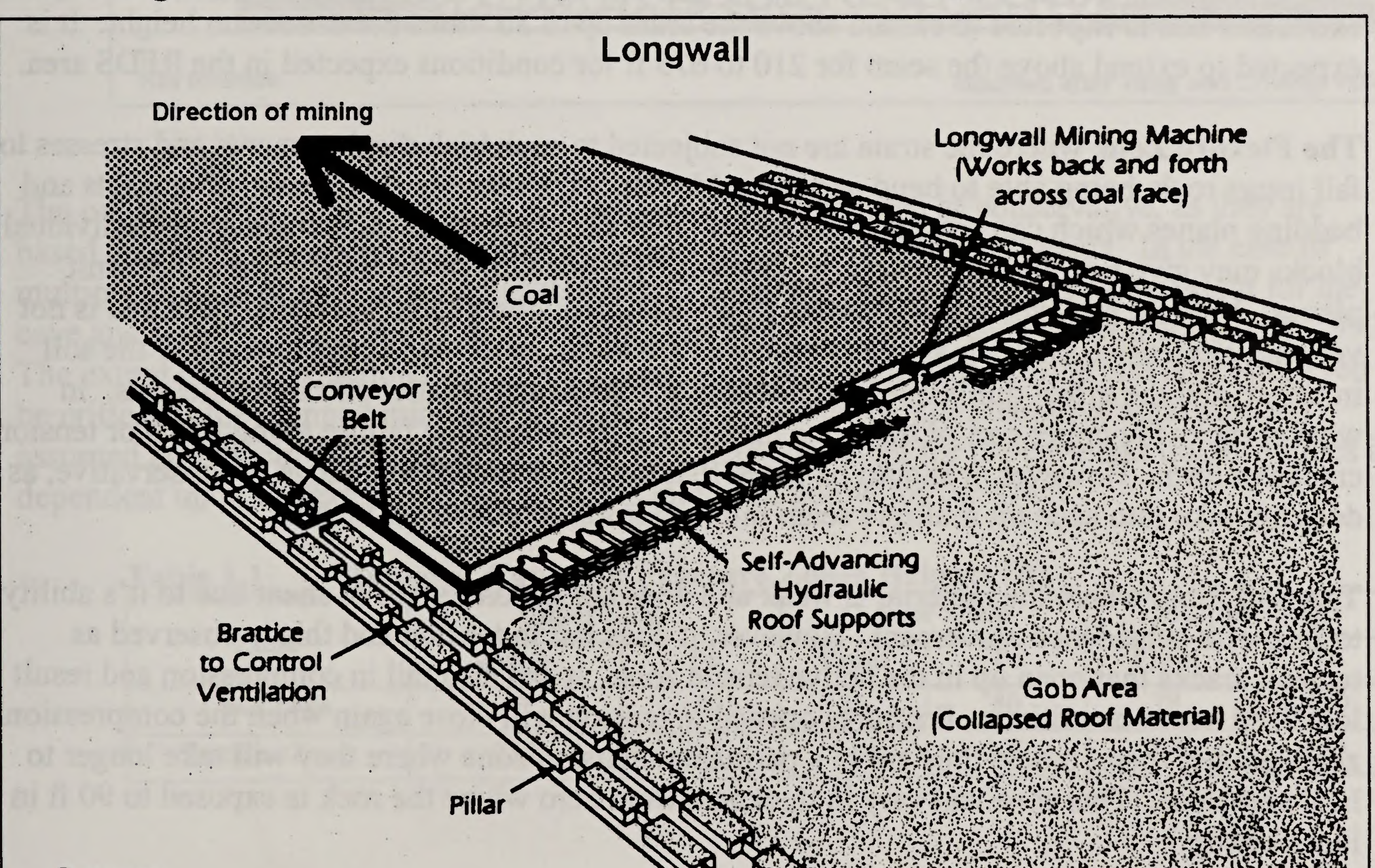
A numerical prediction method has been adopted for this study that enables the major parameters to be modified to simulate the behavior of a wide series of strata characteristics and mining conditions. The ability of this model to simulate more complex mining conditions and multiple seam mining enables the main parameters to be developed by back analyzing the response over previously mined panels. This process is referred to as calibration of the model to local mining and geologic conditions.

The areas that are outside of the longwall mineable zone, and recoverable by room and pillar mining with full extraction, are extremely limited (see Figures 4.1 and 4.2 for Alternative B and Figures 4.3 and 4.4 for Alternative C). The only significant zone is for the upper seam in the northeast corner of the Tract. This area is relatively small and is in an area that may be influenced by a sandstone channel above the upper seam that could greatly restrict the mineable area. It is also located under an area of the surface that has no important structures or resources requiring special consideration. Consequently, if this area is mined by room and pillar extraction with full extraction and subsidence predictions are based on the assumption that it is longwall mined, then this represents a conservative approach with an insignificant error.

1.2 SUBSIDENCE CHARACTERISTICS

In order to understand the subsidence characteristics from longwall mining a description of the mining method is appropriate. Initially a rectangular panel of coal is developed by room and pillar methods and then completely extracted by the longwall equipment using an automated cutting head (shearer) that moves along a track parallel to the working coal face. The shearer contains two rotating drums that cut a thin slice of coal on each successive pass. The cut coal falls onto a chain conveyor and is transported along the working face to the gate roads and eventually out of the mine. The coal within a longwall panel occupies a rectangular area that is about 800 ft in width and from 3,000 to 15,000 ft in length. Hydraulic roof supports are used to protect mine workers and equipment. As the shearing machine progresses through the panel, the roof supports are advanced. The unsupported mine roof and overlying rock then collapse into the void left behind the advancing roof supports. Once the panel is mined, the longwall machine is moved to an adjacent panel and the process is repeated resulting in near-complete extraction of the coal seam over large areas (See Figure 1.1).

Figure 1.1 Schematic Diagram of a Longwall Mining Panel



Source:
Energy Information Administration

The overburden caving and subsidence process can be divided into four main zones of strata movement above the mine where different subsidence behaviour is observed. These zones are not distinctly separate, but they transition into one another with some degree of variability dependent upon geologic conditions. These zones are presented in the schematic cross section in Figure 5.2 and described below, together with the approximate extent of the zone that might be expected.

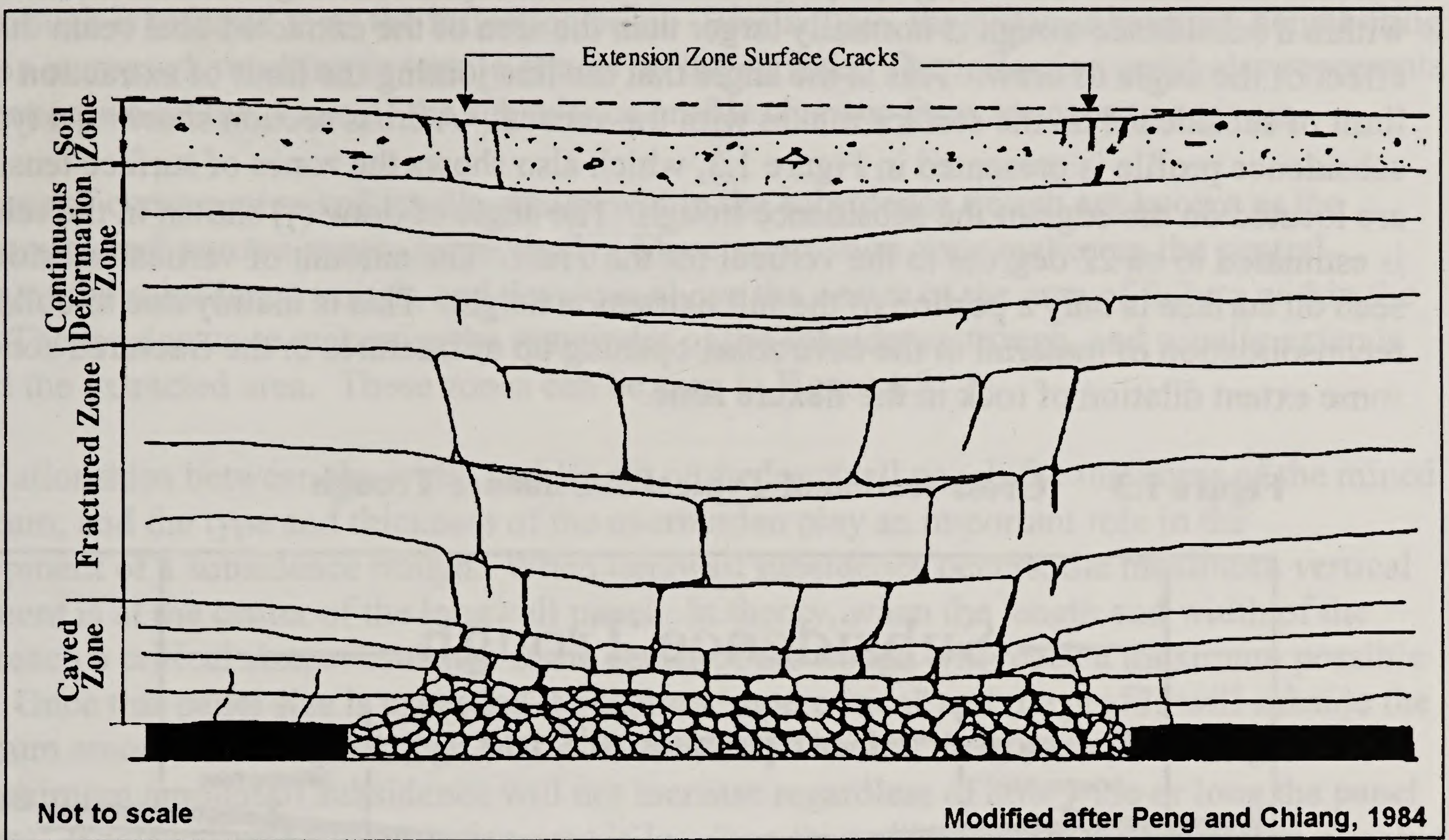
The Cave Zone where the roof rock fail in discrete blocks and fall into the void behind the longwall supports. This is immediate and continues upwards until the bulking of these rocks provides support to the strata above. This height of this zone is dependent upon the bulking ratio and height of extraction and is typically in the range of 5 to 8 times seam height. It is expected to be in the range of 35 to 180 ft for the variation in conditions expected in the Tract. As the overburden fails above the vertical load will be transferred onto the cave zone and it will re-consolidate to support this load.

The Fractured Zone where the rocks are subjected to high stresses and fail along weakness planes and in some cases intact rock. It is a zone where the rock is fractured vertically and typically horizontally along bedding forming blocks. However, the discrete blocks remain in their relative position and no significant bulking occurs. This zone is dependent on the height of extraction and is expected to extend above the seam up to 30 times the extraction height. It is expected to extend above the seam for 210 to 675 ft for conditions expected in the RFDS area.

The Flexure Zone where the strata are not subjected to such high displacements and stresses to fail intact rock, being able to bend and flex. Movement is still expected on existing joints and bedding planes which can open up in zones of tension. Some shear movement along individual blocks may give rise to stepped vertical displacement of joints in strong beds or along fault planes. Vertical movement along fractures typically remains within individual beds and is not vertically extensive unless massive strong beds are in the zone. This zone extends to the soil interface and the effect diminishes with deeper workings and smaller extraction heights. In weaker rocks the upper part of this zone may flex without causing failure along joints or tension cracks to form. However, it should be noted that the upper end of this range is conservative, as it does not take into account multiple seam interactions that reduce the height.

The Soil Zone where the material is weak and does not generally fail in shear due to it's ability to flex with subsidence movement. However, it does fail in tension and this is observed as tension cracks that open up in the active tensile zone. It can also fail in compression and result in localized heave conditions. Fractures opened in tension will close again when the compression zone reaches them, unless they are in a permanent tension zone where they will take longer to heal and close. This zone can vary in thickness from zero where the rock is exposed to 90 ft in Flat Canyon.

Figure 1.2 Overburden Subsidence Zones above a Longwall Panel



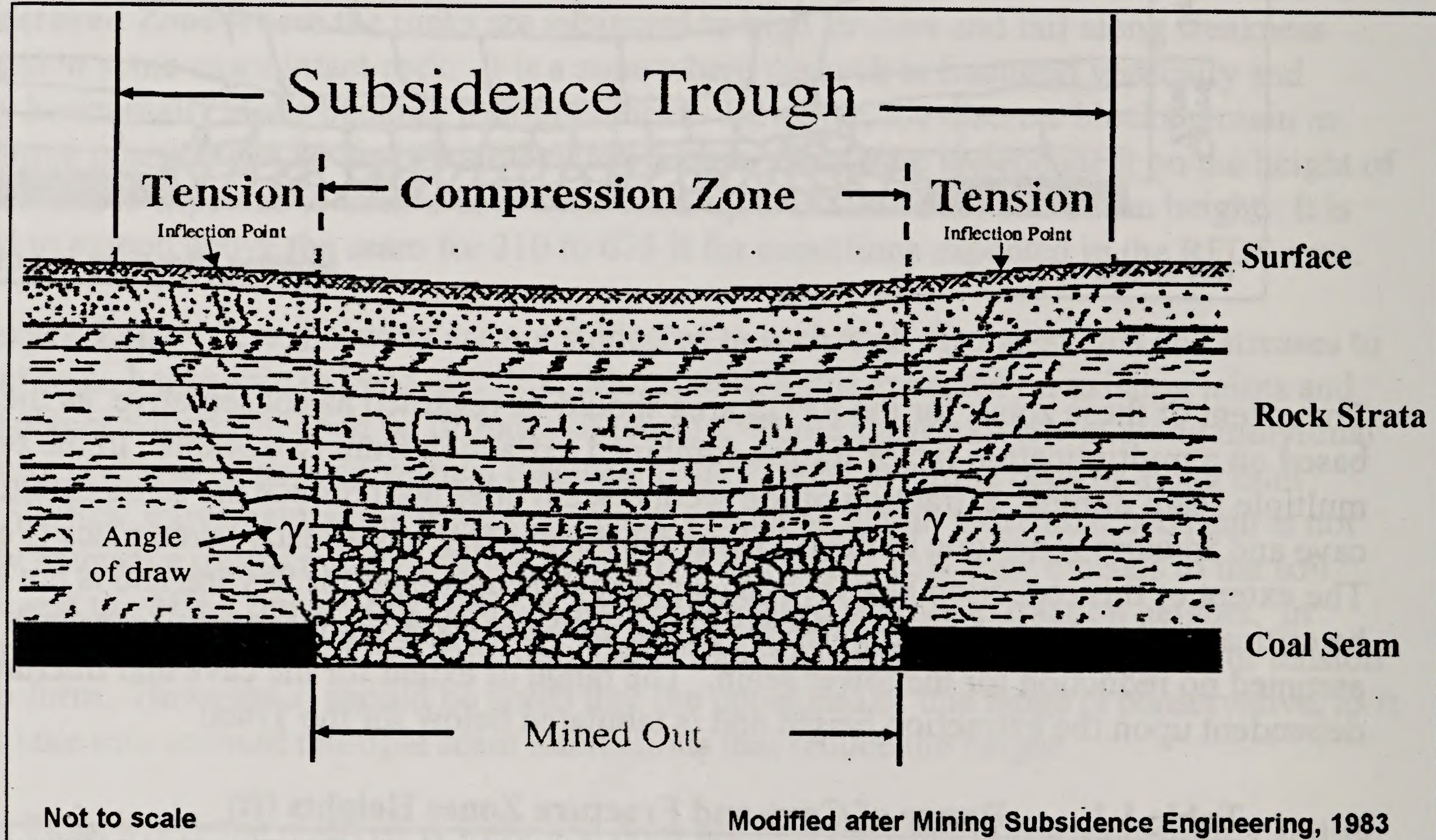
The extent of these zones for the RFDS area should be regarded as conservative, as they are based on a multiplication factor for the combined extraction from two seams. In the case of multiple seam mining, extraction of the second seam does not produce the same extent for the cave and fracture zones due to the previous subsidence that has already taken place (Peng, 1992). The extent of this reduction has not been empirically confirmed for Skyline and is not believed to be critical at the planned mining depths; hence we have taken a conservative approach and assumed no reduction for the lower seam. The range of extent for the cave and fracture zones is dependent upon the extraction height and is tabulated below for the Tract:

Table 1.1 Range of Cave and Fracture Zones Heights (ft)

Zone	Upper Seam		Lower Seam		Multiple Seam	
	From	To	From	To	From	To
Cave Zone	43	100	35	80	78	180
Fracture Zone	255	375	210	300	465	675

Surface subsidence above longwall panels forms in the shape of a trough. The surface area within a subsidence trough is normally larger than the area of the extracted coal seam due to the effect of the angle of draw. This is the angle that the line joining the limit of extraction to the limit of subsidence on the surface makes with the vertical. A cross section showing a typical subsidence profile is presented in Figure 1.3, which also shows the zones of surface tension that are located on the edge of the subsidence trough. The angle of draw (γ) shown in the schematic is estimated to be 22 degrees to the vertical for the Tract. The amount of vertical subsidence seen on surface is only a portion of the full extraction height. This is mainly due to bulking and reconsolidation of material in the cave zone, opening up of fractures in the fractured zone and to some extent dilation of rock in the flexure zone.

Figure 1.3 Cross-section of Typical Subsidence Trough



Ground movements within a subsidence trough have both vertical and horizontal components. Downward vertical movement usually occurs at all areas within the trough. The vertical movement is usually greatest at the center, and it progressively decreases at points along the trough profile until the limit of the affected surface area is reached.

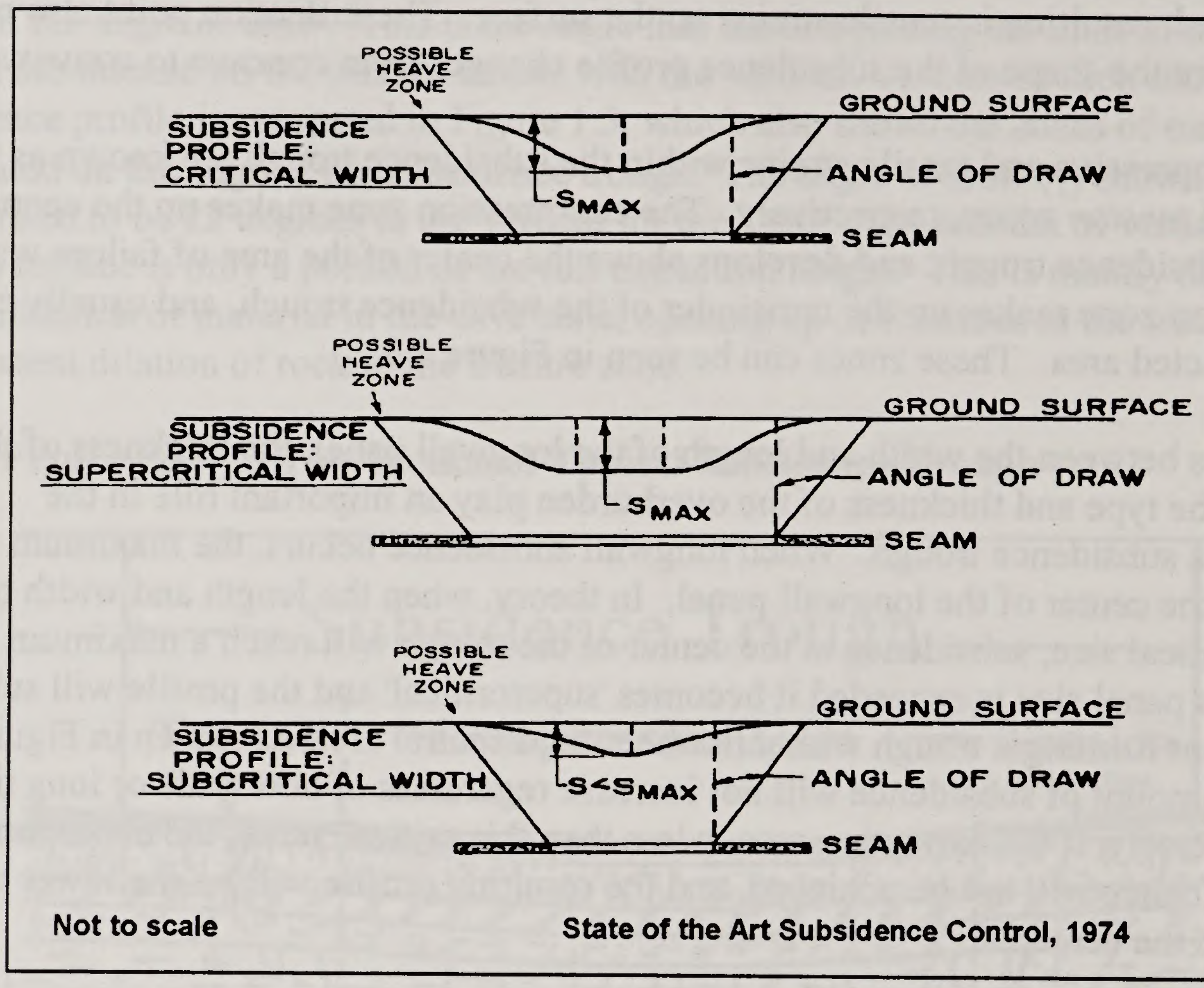
Horizontal movement or displacement also occurs within the subsidence trough, as points on the surface tend to move horizontally toward the center. For adjacent points near the center, the horizontal distance between points is reduced resulting in compressive strains at the surface. The amount of compression decreases at points further from the center as the distance between neighboring points is reduced by lesser amounts, until a position is reached where the compression is zero. No horizontal movement will be experienced at this location. This position in the trough is referred to as the inflection point. Beyond this, the distance between neighboring points is increased, resulting in tensile strains on the surface. The inflection point also represents the location where the shape of the subsidence profile changes from concave to convex.

The areas of compressive and tensile strains within the subsidence trough are known as the *compression* and *tension* zones, respectively. The compression zone makes up the central portion of the subsidence trough, and develops above the center of the area of failure within the mine. The tension zone makes up the remainder of the subsidence trough, and usually extends beyond the extracted area. These zones can be seen in Figure 1.3.

The relationships between the width and length of the longwall panel, the thickness of the mined coal seam, and the type and thickness of the overburden play an important role in the development of a subsidence trough. When longwall subsidence occurs, the maximum vertical movement is at the center of the longwall panel. In theory, when the length and width of the panel reach a critical size, subsidence at the center of the trough will reach a maximum possible value. Once this panel size is exceeded it becomes 'supercritical' and the profile will subside the maximum amount forming a trough with a flat-bottomed central area, as shown in Figure 1.4. The maximum amount of subsidence will not increase regardless of how wide or long the panel becomes. Conversely, if the extraction area is less than this critical value, the maximum possible theoretical subsidence will not be achieved, and the resulting profile will be shallower and will not flatten out in the center.

Since the width of the panel is the shorter dimension, it plays the primary role in the determination of the maximum amount of subsidence. Critical width occurs when the width of the extracted area is typically in the range of 1 to 1.5 times the overburden thickness.

Figure 1.4 Critical, Supercritical, and Subcritical Widths

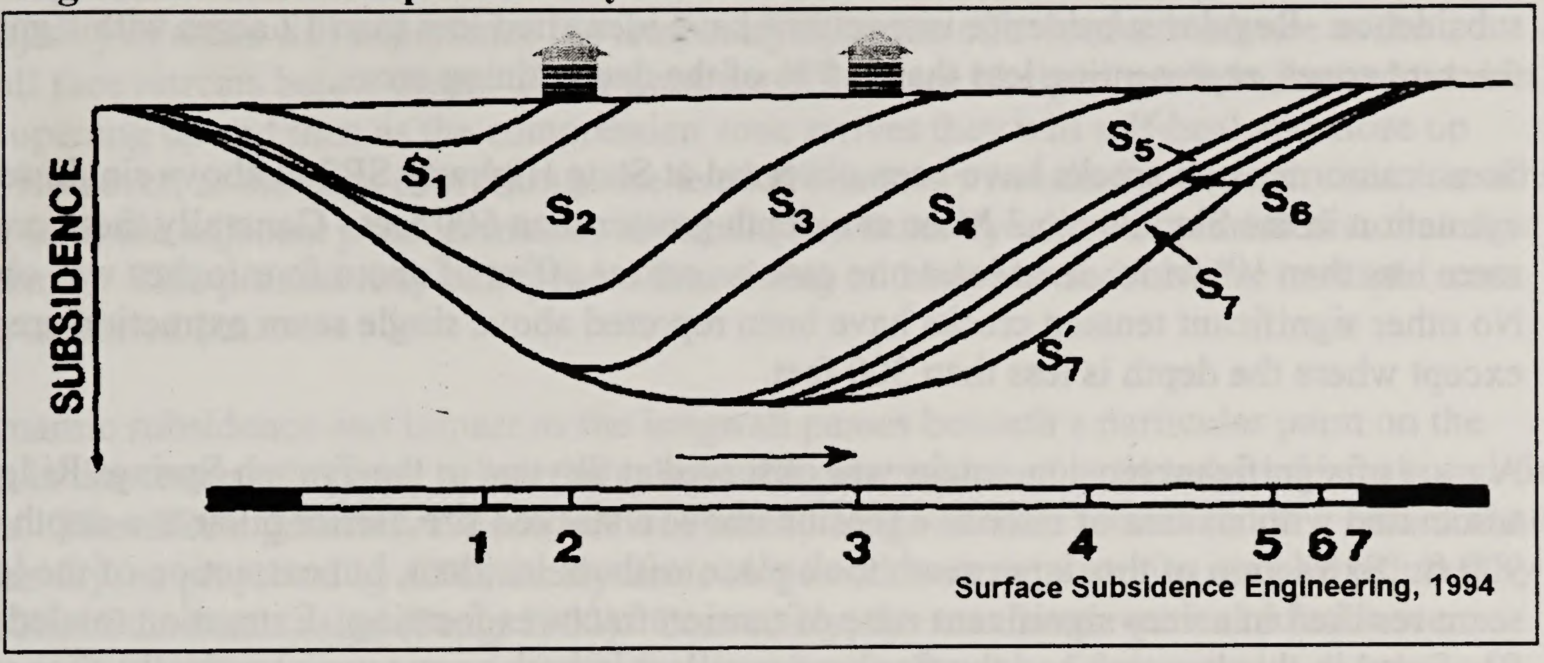


The development of a subsidence trough is a progressive event. When a longwall panel begins operation, initial surface subsidence will result in a subcritical trough. As the panel advances, the trough reaches critical dimensions, and ultimately flattens out as supercritical conditions are reached. A structure may initially be located in the tension zone of the basin as the panel approaches, causing a pulling of the structure towards the longwall face. Cracks and separations at structural interfaces may occur as a result of the dropping and extension of the ground surface. In addition, structures may tilt towards the approaching longwall face.

As the face advances below the ground surface the zone of tension now becomes a zone of compression, since it is now located near the center of the subsidence trough. Cracks that may have opened up in the tensile zone may now close. The induced slope of the ground surface may now return to the original slope unless it is located on the margins of the panel.

The time dependent changes of the ground surface as the longwall passes below a given area is referred to as dynamic subsidence and is illustrated in Figure 1.5. Cracks in the surface land and structures may open and close as the subsidence 'wave' passes through.

Figure 1.5 Development of Dynamic Subsidence Profiles with Face Advance



A short discussion of the variation in subsidence factors related to the existing Skyline Mine experience and those expected in the Tract is given below. Reference is made to subsidence impact studies carried out by CFC at Burnout Creek, Trough Springs Ridge and State Highway SR 264. Discussion of relevant aspects of these impacts will be included with the technical reports relating to each area of impact.

1.1.1 Tension Fractures & Hydraulic Communication

Tension fractures can form at surface due to flexure of the strata as a result of differential subsidence. Where these cracks are observed they are often within 10 degrees from the vertical alignment of permanent coal pillars and their severity is dependent upon the degree of subsidence. The potential for surface cracking increases with the following factors:

- thicker or multi-seam extraction;
- shallower overburden depths;
- vertical alignment (stacking) of pillars in multi-seam mining;
- stacking of fire barrier pillars;
- reduced lateral constraint at escarpments and ridge crests;
- steeper slopes where gravitational components are greater;
- thicker and stronger beds that are shallow and jointed;
- thinner and more brittle soil cover; and
- surface features sensitive to cracking, such as roads;

Experience at the Skyline Mines where comparable overburden depths are greater than 600 ft. indicates that the formation of significant zones of surface tension fracture are relatively rare. They are seldom observed during mining of the upper seam and are generally associated with mining of the lower seam where abutment or fire barrier pillars are vertically aligned in the vicinity of exposed ridges with low lateral constraint. Over the whole of the Skyline Mine area where depths are greater than 600 feet there are about 2,640 acres that have been influenced by subsidence. Regular subsidence inspections have identified less than 12 acres with significant fracture zones, representing less than 0.5 % of the deep mining areas.

Some minor tension cracks have been observed at State Highway SR264 above single seam extraction in the Skyline No.3 Mine at a depth greater than 600 feet. Generally these cracks were less than ¼" wide. In at least one case a vertical offset of about four inches was observed. No other significant tension cracks have been reported above single seam extraction areas, except where the depth is less than 300 feet.

A zone of significant tension cracks was observed at Skyline in the Trough Springs Ridge area, associated with an area of intensive tension above a stacked fire barrier pillar at a depth of about 900 ft. Extraction of the upper seam took place without incident, but extraction of the lower seam resulted in a very significant zone of tension fractures forming. Extraction totaled about 22 ft. of coal in this location and the fire barrier pillars in both seams were vertically aligned. Although the fire barrier extended for about 6,000 feet, less than 1,500 feet experienced cracking and this was at a ridge where a sandstone bed was located near the surface. A section of Burnout Creek passed through the same tension zone without any evidence of tension cracks or any significant hydraulic communication observed between surface water and groundwater systems.

A detailed study was not carried out by Skyline staff at the time, but the available data indicates that tension cracks at Trough Springs Ridge were over 5 ft wide in some places. It can be concluded that over 5 ft of total extension was experienced in this tensile zone, although the effect of possible slope movement on the ridge cannot be discounted. This is consistent with subsidence predictions that indicate the cumulative extension over the tensile zone would be expected to be in the region of 8 ft if the ground surface was flat.

Similar conditions to those observed at Trough Springs Ridge are unlikely to occur with the same degree of severity in the valley floors found within the Tract.

It should also be noted that the severity of tension crack formation that occurred above the Plateau Mine in the North Fork of the Right Fork of Miller Creek located on the steep eastern margin of the Wasatch Plateau (Slaughter et al., 1995) should not occur in the RFDS area. At the Plateau Mine, tension crack formation over multiple seam extraction under shallow cover (300 to 500 feet) caused the diversion of a perennial stream into mine workings. The greater depth of cover and the location of the RFDS area away from the plateau escarpment should preclude such catastrophic events as those observed at Miller Creek.

The potential for hydraulic communication between surface water, groundwater and the mine workings is generally restricted to the cave and fractured zones. Due to the expected overburden depths and strata, no significant vertical connection between surface water and groundwater is expected in the Tract. This topic is discussed in more detail in the technical report on surface water and ground water.

1.1.2 Dynamic Subsidence

The majority of areas will experience the temporary dynamic effects of subsidence as the longwall face retreats below them. These transient effects are likely to result in limited tension cracks opening up and then as the compression zone arrives they will self-heal and close up again. However, at the edge of workings the tension zone may remain for a longer time (months / years) until the adjacent panel is mined, or remain permanently where it is located at the edge of workings. This process may be repeated for mining of the lower seam where multiple seam mining is carried out.

The dynamic subsidence and impact as the longwall passes beneath a particular point on the surface in the center of a panel is less than above the gate roads and at the edge of panels and fire barriers. The effects generally reduce with the rate of longwall face retreat and at a rate of about 50 ft per day, as projected by CFC, the dynamic slope and horizontal strains may be reduced by up to 50% of the static value (Peng, 1992). Conversely, the maximum vertical subsidence velocity will increase in an approximately linear rate with the rate of face retreat. A value of about 0.2 vertical ft per day is projected for the overburden depths in the Tract (Peng, 1992).

5.1.3 Sinkhole Development

Where the thickness of bedrock above the coal seam is less than the potential cave zone there is the potential for sinkholes to develop due to void migration. The maximum height of the cave zone is conservatively estimated to be about 180 ft and the minimum depth of workings about 800 ft with no possibility that sinkholes could develop in the Tract. However, there is the potential for small holes to develop in tensile zones where shallow bedrock is fractured and soil migrates into the fractures at localized failure zones.

1.2 GEOTECHNICAL INFLUENCES

The main geotechnical influence on subsidence is the behavior observed with strong strata reducing the subsidence percentage and reducing the horizontal influence beyond the excavated area (angle of draw). The influence of strong beds has been estimated from the amount of sandstone in the overburden, as determined by exploration drilling and both cuttings and geophysical borehole logs. Each subsidence prediction point has been allocated a percentage of sandstone which is used in the numerical model as a key input parameter.

1.3 IMPACT OF TOPOGRAPHY AND SURFICIAL MATERIALS

Subsidence is often evaluated on the assumption that the coal seam and ground surface are both horizontal. In the proposed Tract the dip of the seam is expected to be in the range from 2 to 6 degrees. For the evaluation of subsidence this is considered to be flat and hence no corrections have been applied for inclined workings.

The surface topography is generally undulating and cannot be considered to be flat, except in some of the valleys. Where steeper terrain is encountered; having ridges, cliffs and canyons, there are likely to be more significant topographic effects on subsidence. This can partly be explained by the lack of lateral confinement at steep slopes and cliffs. There is also the effect of the gravitational component of the slope weight that has the tendency of allowing material to move slightly down the slope or in extreme cases lead to slope failure.

Over the Tract there are only a few minor cliffs; and these are generally associated with the Castlegate Sandstone Formation that is typically thin and only found on some of the higher ridges. No prominent cliff escarpments were observed during the field visit. The canyon slopes are not generally steep, but in some cases may increase the effect of subsidence.

Previous experience at the Skyline Mine has encountered no major slope failures. Small localized movements have been observed. A detailed evaluation of slope impacts would require a specific detailed mine plan and sequence of extraction in order to estimate the location and extent of subsidence in relation to particular slopes. Without a specific mine plan this topic is discussed in general terms and the likely range of impact estimated. Slope stability aspects will be discussed further in Section 8.

The opening of tension fractures is possible where high tensile strains are imposed on brittle strata for significant periods of time. A series of tension fractures resulted on Trough Springs Ridge from prior mining. In this case, an extensive zone of tension was created when fire barrier coal pillars were vertically aligned in two thick coal seams. The existence of a strong sandstone bed near to surface, on a ridge without lateral confinement on both sides, resulted in the very high tensile strains being focused on particular joint sets within the sandstone bed. The combination of these factors resulted in significant short-term impact due to the formation of fractures that opened in the bedrock. Some of the fractures were over 5 ft wide and 25 ft deep, with longitudinal extent over 200 ft in places. They were mitigated by filling with soil and no long-term adverse impact is expected for the area.

It is possible that similar conditions might exist in the vicinity of some ridges at higher elevations in the Tract, especially if stacked fire barriers are developed. However, it is likely that the magnitude would be less, as mining in the Tract is generally deeper over most of the area and extraction heights generally less than the Trough Springs Ridge area. If similar conditions of mining, topography and near surface sandstone exist, then similar fractures might occur, although the likelihood is believed to be low.

1.4 NUMERICAL PREDICTION METHOD

The Surface Deformation Prediction System (SDPS) numerical model was used to predict surface subsidence. This is discussed in more detail in Appendix F of the NorWest Technical Report for Geology, Mining, Subsidence, and Seismicity (Project File), together with a presentation of the results for the main subsidence parameters. The model was calibrated against actual subsidence monitoring data from the Skyline Mine.

Without a specific mine plan for the RFDS, a characterization process was used to estimate the likely range of subsidence for different mining scenarios based upon a generic longwall mining layout at each location. Single and multiple seam layouts, based on typical Skyline mine layouts, were developed for this purpose. These layouts are presented in Appendix F and are identical for each type of subsidence prediction point. They have not been placed at a particular location or assumed orientation. In order to evaluate the effect of mining at different orientations the layout can be rotated in order to simulate the orientation effects. The validity of rotating the generic layout to evaluate orientation effects is sufficient for the level of detail required to assess the general range of values likely to be encountered. It also enables a conservative approach to be adopted when evaluating location and orientation impacts.

1.5 NUMERICAL MODEL CALIBRATION

Calibration was based on subsidence data supplied by CFC from undermining of State Highway SR264 by longwall extraction of the Upper O'Connor Seam in the Skyline Mine. The model calibration is discussed in Appendix F. The percentage of hard rocks (sandstone) in the overburden for this area is estimated to be about 55 %. The calibration results indicate that an angle of draw of 18.4 degrees and a maximum vertical subsidence factor of 50 % of extraction height provide the best fit to the measured subsidence data. However, a conservative approach has been adopted for this study by assuming for the numerical model analysis that the angle of draw is 22 degrees, with a vertical subsidence factor of 55% for single seam extraction cases.

Further evidence at Skyline from Mining of the Upper O'Connor and Lower O'Connor B Seams indicates that there is a higher vertical subsidence factor for mining of the lower seam after the upper seam has already been extracted. This effect has been observed elsewhere (NCB, 1975 and USBM IC-9194). There is some limited evidence from subsidence monitoring data for the Questar Gas Transmission Pipeline, using photogrammetric survey techniques with a reported accuracy of ±1 ft., that suggests a vertical subsidence factor of 75% for mining of the second seam. However, this factor should be treated with caution, as it has not been confirmed by more reliable surveying techniques. In the absence of reliable subsidence monitoring data for multiple seam conditions, we believe that it is a reasonable basis for the evaluation at this point in time. The numerical model cannot accept different subsidence factors for each seam when multiple seam conditions are being modeled. In these cases we have assumed that a weighted average of the combined subsidence factors is applied to both seams at these locations.

The angle of draw used in the numerical model has been assumed to be constant at a value of 22 degrees. However, a slightly different angle of draw is recommended when defining mining restrictions to allow for the possibility that local variability may be observed due to operational and geologic variations. No rigorous evaluation has been carried out regarding the degree of local variability that might be expected. Previous work by Harding Lawson Associates (See Section 8 of this Report) indicated that the observed angle of draw was in the range of 18 to 23 degrees. We propose that the upper value of 23 degrees should be used as the basis for defining subsidence protection zones. In addition a buffer zone should be included to allow for the possibility of anomalous conditions due to variable geology and the possibility of pillar failure in the abutment area over time. The buffer against sensitive features can be incorporated into the Angle of Draw estimates by defining a conservative angle of draw. For sensitive resources and structures a protection zones is recommended based on an Angle of Draw of 30 degrees from longwall extraction areas and is discussed later in the report.

1.6 PREDICTION RESULTS

The detailed results from the numerical model runs are presented in Appendix F. The three main subsidence factors likely to influence surface stability [vertical subsidence (ft), horizontal strain (millistrain), and induced slope change (%)] are presented for each subsidence prediction location as a series of contours overlain on the generic panel layout.

Vertical subsidence is the parameter most commonly quoted for impact evaluation, as the other main parameters are typically related to it. Subsidence predictions normally assume uniform flexure of the surface with subsidence occurring in small discrete steps. Flexure of the ground surface, due to differential subsidence, results in horizontal ground strains and induced slope changes that often occur soon after the longwall face passes underneath.

Horizontal strains are expressed in millistrain in this Report, with 1 millistrain being equivalent to a net change of 1 unit for each 1000 units of length. Tensile strains are positive and are equivalent to extension of the ground surface and compressive strains are negative. A measure of the degree of strain intensity is given by the maximum strain value and width of the zone of tension. The total extension possible over the tensile zone gives an indication of the degree to which tensile strains have the potential to result in tension cracks opening up at surface.

The seams depths and sandstone percentages for each subsidence prediction point are summarized in Table 1.2, together with the maximum values estimated for each of the main subsidence parameters at the worst case position in relation to the mine layout. For the model results the worst case is generally represented by a fire barrier pillar in single seam extraction and a stacked abutment pillar in multi-seam extraction cases. Further details of the model runs and the generic mine layout used for the model are presented in Appendix F, together with the contour plots of subsidence parameters that were used to estimate the maximum parameter values presented in the table.

Table 1.2 Subsidence Point Characteristics and Maximum Predicted Values

Parameter	Subsidence Prediction Point								
	1 Boulger South	2 Little Swens	3 Swens West	4 Swens East	5 Flat West	6 Boulger Dam	7 Boulger West	8 Boulger Central	9 Cunn-ingham
Overburden Thickness above Lower Seam (ft)	1850	1600	1700	1100	1500	1200	1750	1500	1600
Number of Seams Mined	2	1	2	2	1	2	1	2	2
Amount of Hard Rocks in Overburden (% sst)	50	65	65	65	60	65	50	50	50
Estimated Thickness of Surficial Material (ft)	20	30	20	30	120	120	80	80	20
First Seam Maximum Vertical Subsidence (ft.)	5.5	5.5	4.7	5.5	4.7	6.9	5.0	6.6	6.9
Maximum Total Vertical Subsidence (ft)	11.5	5.5	10.7	13.0	4.7	14.4	5.0	14.1	12.9
Maximum Horizontal Tensile Strain (millistrain)	7	9	8	16	8	16	7	11	10
Average Tensile Strain in Tensile Zone (millistrain)	5	5.5	4.5	8.5	4.5	9	4	7	5.5
Width of Tensile Zone (ft)	500	500	600	450	500	500	600	600	600
Approximate Maximum Extension Possible in Tensile Zone (ft)	2.5	2.8	2.7	3.8	2.3	4.5	2.4	4.2	3.3
Maximum Horizontal Compressive Strain (millistrain)	-8	-5	-8	-16	-5	-16	-5	-12	-10
Maximum Slope Change (%)	1.5	0.9	1.5	2.8	0.7	3.0	0.7	2.2	1.9

The parameter values presented in Table 1.2 have been estimated for permanent locations with maximum impact such as the edge of abutment pillars or above fire barriers, depending upon the parameter and single or multiple seam cases. These areas represent a relatively small proportion of the overall mining area and should not be regarded as representative. In reality, the subsidence parameters will vary over the mining area and with time. They can be sub-divided into permanent (at the edge of pillars), short term (between adjacent panels with durations measured in months) or dynamic (above the moving longwall face with durations measured in days). The range of subsidence parameter variation is dependent on the mining layout and geologic conditions. The numerical modeling results presented in Appendix F have been evaluated further in relation to the mining layout features listed below:

- panels (in the center of panels);
- single abutment (at the edge of solid coal pillars);
- stacked abutment (where both seams are next to solid coal pillars);
- single fire barriers (where a fire barrier is in one seam only);
- stacked fire barriers (where fire barriers in two seams are aligned);
- gate roads (where gate road pillars are left between panels); and
- longwall face (dynamic effects as the face retreats).

The significant parameter values for each of these areas are presented in Table 1.3 for each subsidence prediction point. It should be noted that these values are approximations that have been taken in most cases from the contour plots presented in Appendix F. In some multi-seam cases the parameter is not taken directly from the subsidence model output, but is estimated by applying a typical ratio derived from the single seam case. The figures relate to the cessation of mining, except for dynamic subsidence that applies to longwall-face retreat or single-abutments that exist for a short time between panels.

Table 1.3 Range of Predicted Subsidence Parameter Values at Different Mine Features

Parameter	Subsidence Prediction Point								
	1 Boulger South	**2** Little Swens	**3** Swens West	**4** Swens East	**5** Flat West	**6** Boulger Dam	**7** Boulger West	**8** Boulger Central	**9** Cunn-ingham
Overburden Thickness above Lower Seam (ft)	1850	1600	1700	1100	1500	1200	1750	1500	1600
Number of Seams Mined	2	1	2	2	1	2	1	2	2
Maximum Subsidence (ft)									
Panels	10	5	10	12	4	13	4	13	12
Single Fire Barrier	7	2	6.5	7	2	9	2	8	7
Stacked Fire Barriers	4.5	-	4.5	5.4	2	6	3.5	5.9	5.4
Gate Roads	9.5	4.5	9.5	11.5	3.5	12.5	3.5	12.5	11.5
Maximum Horizontal Tensile Strain (millistrain)									
Single Abutment	2	4	2	6	4	6	2	4	4
Stacked Abutment	6	-	8	16	-	14	-	10	10
Single Fire Barrier	4	8	4	12	8	12	6	8	8
Stacked Fire Barrier	12	-	16	32	-	28	-	20	20
Gate Roads	2	2	2	4	2	4	1	2	2
Longwall Face (Dynamic)	1	2	1	3	2	3	1	2	2
Maximum Slope Change (%)									
Single Abutment	0.6	0.8	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Abutment	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Single Fire Barrier	0.6	0.7	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Fire Barrier	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Gate Roads	0.2	0.1	0.2	0.4	0.2	0.4	0.1	0.2	0.2
Longwall Face (Dynamic)	0.3	0.4	0.3	0.7	0.3	0.6	0.3	0.5	0.4

From the table it can be seen that the different underground mine structures produce significantly different results for some parameters. It should also be noted that some of the values are slightly different from the figures presented in Table 1.2 due to the approximations used in reading contour intervals from the plots in Appendix F of the NorWest Technical Report for Geology, Mining, Subsidence, and Seismicity (Project File). Some of the most important observations are discussed below with the relative variation of parameter values.

Vertical Subsidence
For vertical subsidence the highest value is in the center of the panel and is only slightly reduced above gate roads. There is a significant reduction over fire barriers in a single seam which is further reduced to about half of the maximum value for stacked fire barriers in multiple seam cases. The highest value ranges from 10 to 13 feet for multi-seam cases and the lowest is 2 feet above single seam fire barriers.

Maximum Horizontal Tensile Strain (millistrain)
Low horizontal tensile strain (1 to 4 millistrain) is expected over gate roads and during dynamic subsidence. Low to Moderate values are expected over a single seam abutment or offset abutments in two seams (2 to 6 millistrain). Moderate to high values (4 to 16 millistrain) are expected over a stacked abutment in two seams and fire barrier in a single seam. A stacked fire barrier in two seams is expected to produce High to Very High values (12 to 32 millistrain).

Based on empirical observations at Skyline, the potential for significant tension fractures to develop is negligible at tensile strain values below about 6 millistrain, low for values between 6 and 16 millistrain and moderate for values over 16 millistrain. The potential increases significantly at ridges without lateral constraint and strong beds near surface, and decreases significantly at valley floors with increased lateral constraint and thicker soil layers. There is insufficient data to reliably estimate the dimensions of individual tension cracks characteristic of particular tensile strain values.

Maximum Slope Change (%)
The slope change is estimated to be very low (0.1 to 0.4 %) for gate roads and very low to low (0.3 to 0.7 %) for dynamic subsidence. It is estimated to be low to moderate (0.6 to 1.4 %) for a single abutment and single fire barrier, and moderate to high (1.4 to 3.0 %) for stacked abutments and stacked fire barriers in multi-seam mining.

These figures give an indication of the likely range of values in the vicinity of mine layout features. They do not represent exact figures, but should be treated as a reasonable approach to predicting the likely range of values for particular features and are useful in assessing the possible effect that these mine layout features would have at particular locations. Over the longwall mineable zone in Alternative 3 it would be expected that about 10% of the area would be subjected to abutment effects (single and stacked), about 5% to fire barrier effects (single and stacked), about 20% to gate roads and the remaining 65% to dynamic subsidence.

Based upon qualitative definitions of relative degrees of subsidence from the Skyline Mine experience evaluated over the tract it is estimated that about 85 % of the mining area will be subjected to a low degree of subsidence, 10 % to a moderate degree of subsidence and 5% to a high degree of subsidence. It should be noted that these are approximations and do not represent the impact, but are intended to provide an indication of the relative value of subsidence parameters.

When a specific mine plan is available a more accurate estimation for subsidence parameters can be made, but in the meantime this approach is sufficient for characterization of the range of impact and evaluation of particularly sensitive areas. The numerical model has been calibrated on single seam mining only, as the available data was only suitable for this case. Further subsidence monitoring and evaluation for the Tract is recommended to confirm the parameters used in the model predictions.

It should be noted that without a specific detailed mine plan the values for some of the mining features listed in Table 1.3 may not in some cases be consistent with the layout presented in the applicable mining scenarios for either of the two main alternatives. The results are discussed in more detail in relation to each of the alternatives separately.

SKYLINE MINE WATER DISCHARGE WATER QUALITY PARAMETERS

Comparison of Skyline Mine Discharge Water Quality to State of Utah Beneficial Use Standards (UAC R317-2)

		Beneficial Use Standards				CS-12				CS-14				UPDES Outfall			
Parameter	Unit	1C Domestic	2A, 2B Recreation	3A 4-Day Aquatic Wildlife	4 Agriculture	n	Max	Min	Average	n	Max	Min	Average	n	Max	Min	Average
226 Radium	pc/l	5				0	---	---		0	---	---		1	0	0	
Alpha gros	pc/l	15			15	0	---	---		0	---	---		1	0	0	
Ammonia N	mg/l			About 2		42	1.8	0	0.34	30	1.5	0	0.33	1	0.17	0.17	0.17
Arsenic-T*	mg/l	0.05		0.19	0.1	0	---	---		0	---	---		1	0	0	
B.O.D. 5	mg/l		5	5	5	1	7	7		0	---	---		1	9.3	9.3	9.30
Barium-D	mg/l	1				7	0.061	0	0.03	9	0.089	0	0.03	0	---	---	
Beta gross	pc/l	50		50	50	0	---	---		0	---	---		1	0	0	
Boron-T	mg/l				0.75	13	0.8	0.109	0.38	10	0.7	0.16	0.42	1	0.04	0.04	0.04
Cadmium-T*	mg/l	0.01		0.0011	0.01	0	---	---		0	---	---		1	0	0	
Chromium-T*	ug/l	0.05		0.011	0.1	0	---	---		0	---	---		1	0	0	
Copper-D	mg/l			0.012	0.2	7	0.01	0	0.00	9	0.01	0	0.00	0	---	---	
Cyanide	mg/l			0.0052		13	0.01	0	0.00077	10	0	0	0.00	1	0.014	0.014	0.0140
Fluoride	mg/l	2.4				17	2.07	0.1	0.65	10	1.52	0	0.45	1	0.33	0.33	0.33
Iron-D	mg/l			1 (Max)		7	0.23	0	0.07	8	0.23	0	0.03	0	---	---	
Lead-D	mg/l	0.05		0.0032	0.1	7	0.008	0	0.00114	9	0.008	0	0.00133	0	---	---	
Mercury-T*	ug/l	0.002		0.012		0	---	---		0	---	---		1	0.2	0.2	0.20
Nickel-T*	ug/l			0.16		0	---	---		0	---	---		1	0	0	0.00
Nitrate N	mg/l			4		29	2.7	0	0.80	20	12.32	0	2.47	1	0.84	0.84	0.84
NO2+NO3 N	mg/l	10				5	0.8	0.4	0.56	11	2.4	0	1.20	0	---	---	
Phenol	ug/l			0.01		18	1330	0	87.22	18	230	0	33.06	0	---	---	
Phos.-T	mg/l		0.05	0.05		38	0.21	0	0.04	19	0.99	0	0.13	1	0.62	0.62	0.62
TDS @ 180C	mg/l				1200	140	2084	288	797.08	67	2570	405	1104.12	28	718	120	311.21

Missing	1C Domestic	2A, 2B Recreation	3A 4-Day Aquatic Wildlife	4 Agriculture
Selenium	X		X	X
Silver	X		X	
Zinc			X	
Residual Chlorine			X	
H2S			X	
TSS		X	X	
Strontium-90	X			
Tritium	X			

*Total used in lieu of dissolved because dissolved data not availble

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