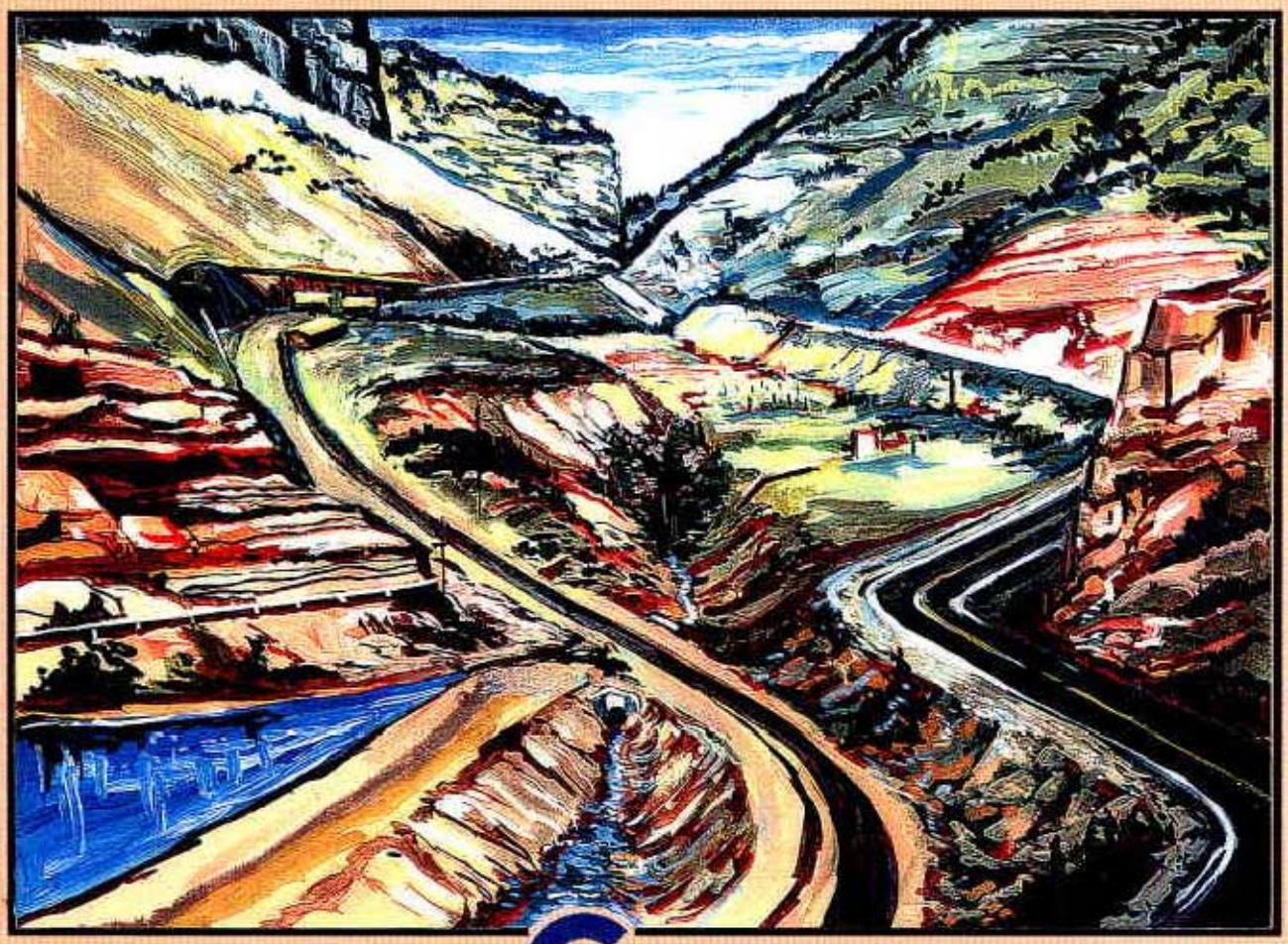
ENVIRONMENTAL ASSESSMENT APPLICATION FOR LEASE WILLOW CREEK NORTH AREA

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Price River Resource Area



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Prepared for:

United States Department of the Interior
Bureau of Land Management
Price River Resource Office

and

United States Department of the Interior
Office of Surface Mining
(Cooperating Agency)

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DIV. OF OIL, GAS & MINING

ENVIRONMENTAL ASSESSMENT

CYPRUS PLATEAU MINING COMPANY
APPLICATION FOR LEASE
WILLOW CREEK NORTH AREA

December 1995

Revised - June 1996

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3425
UTU-73753
UT-066

DECISION RECORD/FINDING OF NO SIGNIFICANT IMPACT

EA Log No.: UT-066-95-28 Project Name: Willow Creek North Coal Lease Tract

EA Preparation Date: March 20, 1996 Phone No.: (801) 636-3600

BLM Office: Price River Resource Area County: Carbon

BLM Office Location: Price, Utah Phone No.: (801) 636-3600

Applicant: Cyprus Plateau Mining Corp. Phone No.: (801) 637-2875

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Price, Utah 84501

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Address: P. O. Box 774018
Steamboat Springs, CO 80477

Proposed Action: To hold a Federal coal lease sale for the applied lease tract.

RECORD OF DECISION

Decision:

My decision is to recommend holding a lease sale of the Federal coal lease application with the existing standard lease stipulations. The authority for the lease sale is under the Mineral Leasing Act of 1920, as amended.

Rationale:

1. The action is not adverse to local, state or Federal land use plans for the area.

2. The proposed action is in conformance with the Price River Planning Area Management Framework Plan.

3. The proposed action would not cause any significant environmental impacts.

4. The proposed lease tract would provide access to significant coal reserves adjacent to existing Federal coal leases where mining applications are pending and would avoid potential coal bypass.

Finding of No Significant Impact: Based on the analysis of potential environmental impacts contained in the attached environmental assessment, I have determined that impacts are not expected to be significant and an environmental impact statement is not required.

_____ _____

Area Manager Date

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1.0 PURPOSE AND NEED

1.1 BACKGROUND INFORMATION

Cyprus Plateau Mining Corporation (CPMC), a wholly owned subsidiary of Cyprus Western Coal Company (CWCC), currently operates the Star Point No. 2 underground coal mine complex located near Wattis, Utah approximately fifteen miles southwest of Price, Utah as shown on Figure 1.0-1, General Location Map. Cyprus-Amax Coal Company, the parent company of CWCC, also owns the inactive Castle Gate mine, preparation plant, and loadout facilities located near the former town of Castle Gate, Utah approximately 10 miles north of Price, Utah and either owns or controls extensive underground coal reserves in the vicinity of the Castle Gate Mine.

Due to the declining reserves of the existing Star Point Mine complex, the need to meet on-going coal contract commitments, and a desire to maintain stable on-going operations and related employment in the Price area, CPMC is proceeding with lease acquisition, planning, engineering, and environmental permitting for an underground coal mine, the Willow Creek Mine (Mine). The Mine is designed to replace the Star Point No. 2 complex as existing coal reserves are depleted. For CPMC, as the project proponent, the purpose and need for the proposed action are directly related to the objectives of optimizing economic recovery of available coal reserves in the immediate vicinity of the planned Mine and establishing effective access to potential future coal reserves on the west side of the Price River.

In March 1995, CPMC, on behalf of CWCC, submitted a coal lease application to the Utah State Office of the Bureau of Land Management (BLM) for approximately 2,300 acres of land owned by the United States of America and managed by the BLM. CPMC also submitted a Mining and Reclamation Permit Application (May 3, 1995) to the Utah Division of Oil, Gas and Mining (UDOGM) addressing planned development, operation, and reclamation of the Willow Creek Mine and related facilities on existing fee lands and Federal, State, and County coal leases.

The proposed lease area is located approximately 10 miles north of the town of Price, Utah in Carbon County. Proposed new surface facilities for the Mine will be located adjacent to and north of Willow Creek and State Highway 191 in Willow Creek Canyon, approximately 1 mile northeast of the junction of Highway 191 with U.S. Highways 6 and 50. The Mine will utilize the existing preparation plant and loadout facilities currently permitted as part of the adjacent Castle Gate Mine. The Mine permit area covers an area of approximately 23 sections, extending north and south approximately 2.5 miles from the junction of the two highways and 6 miles to the east, as shown by Figure 1.0-2, Proposed Activities. The proposed lease area covers all or portions of five sections along the northern boundary of the proposed Mine permit area. This general area is part of the Book Cliffs of Central Utah and is characterized by high plateaus to the north; steep, narrow ridgelines cut by deep erosional drainages in the permit area and adjacent areas to the east, west, and south; and the relatively flat, dry, semi-desert areas of the Colorado Plateau to the south of the town of Price. Within the permit area, topographic relief ranges from 6,200 feet near the confluence of Willow Creek with the Price River, to over 8,600 feet along the ridgelines to the southeast.

1.2 PURPOSE AND NEED FOR PROPOSED ACTION

1.2.1 Coal Leasing

The proposed action is approval and issuance of a coal lease for approximately 2,300 acres of Federal lands administered by the BLM pursuant to CPMC's March 1995 lease application. Subsequent development, operation, and reclamation of the Mine are considered in this Environmental Assessment (EA) as reasonably foreseeable related future actions. The purpose and need for the proposed action are to make the associated mineral resources available for development, extraction, and beneficial use consistent with applicable provisions of the Mineral Leasing Act of 1920 as amended by Sections 2 and 3 of the Coal Leasing Amendments Act of 1976; the Federal Land Policy and Management Act of 1976 (FLPMA); BLM regulations; and the land use

planning and management determinations presented in the Price River Resource Area Management Framework Plan (MFP). CPMC applied for the subject coal lease to provide for efficient development of both the associated Federal coal reserves and existing adjacent leased Federal and fee coal reserves; provide access for future development of coal reserves to the west; and avoid bypass and possible sterilization of some of the marginal coal reserves contained within the proposed coal lease tract.

1.2.2 Required Agency Action

Under both FLPMA and the National Environmental Policy Act (NEPA), the BLM is required to evaluate proposed management actions relative to compliance with existing land management decisions and to determine whether or not the action would result in unnecessary or undue degradation of the potentially affected Federal lands. This EA provides the necessary information on issues, benefits, and concerns to allow the BLM as the responsible Federal land management agency to make the required determinations on both potential environmental impacts and lease issuance. As a cooperating agency, the Federal Office of Surface Mining (OSM) will review and provide input on the environmental analysis.

1.3 AGENCY ROLES AND RESPONSIBILITIES

The proposed coal leasing and potential related future mining operations have been designed to effect full compliance with all applicable Federal, State, and local laws and regulations. Specifically, coal lease acquisition and management must comply with applicable land management regulations and guidelines of the BLM, and any mining plan application that may result from BLM's leasing decision must adhere to applicable regulations and guidelines set forth by OSM.

1.3.1 Bureau of Land Management

The BLM has the responsibility and authority to determine whether or not mineral leases, permits, and licenses are to be issued for Federal lands under the BLM's jurisdiction. Under applicable NEPA provisions, prior to granting leases, permits, or licenses, an evaluation of the potential effects of the proposed development on the environment of the affected area(s) must be completed. As the primary responsible Federal land management agency for those Federal lands which will be affected by the proposed Willow Creek Mine, the BLM will utilize this EA as a basis for the required determination on the lease application. The BLM will select a Preferred Alternative and determine whether or not the Preferred Alternative will result in unnecessary or undue degradation of potentially affected Federal lands consistent with applicable provisions of FLPMA. The BLM will also review the lease application and associated development plans in the context of the existing Management Framework Plan (MFP). Lease approvals may be conditioned on coordination with other resource values and land uses and appropriate rehabitation of disturbed lands.

1.3.2 Office of Surface Mining

The OSM has jurisdiction over any mining plan application that may result from BLM's leasing decision. As a result, OSM is participating in the preparation of this EA as a formal cooperating agency.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) gives OSM primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations. In January 1981, pursuant to Section 503 of SMCRA, the UDOGM developed, and the Secretary of the Interior approved, a permanent program authorizing UDOGM to regulate surface coal mining operations and surface effects of underground coal mining on non-Federal lands within the State of Utah. In March 1987, pursuant to Section 523 (c) of SMCRA, UDOGM entered into a cooperative agreement with the Secretary of the Interior authorizing UDOGM to regulate surface coal mining operations and 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 permit application packages to OSM and UDOGM for proposed mining and reclamation operations on Federal lands in the State. UDOGM reviews the packages to assure that the permit application complies with the permitting requirements and that the coal mining operation will meet the performance standards of the approved permanent program. If it does comply, UDOGM issues the applicant a permit to conduct coal mining operations. OSM, BLM and other Federal agencies review the permit application package to assure that it complies with the terms of the coal lease, the Mineral Leasing Act of 1920, NEPA, and other Federal laws and their attendant regulations. OSM recommends approval, approval with conditions, or disapproval of the mining plan to the Assistant Secretary, Land and Minerals Management. Before the mining plan can be approved, BLM and the surface management agency (if other than the BLM) must concur with this recommendation.

UDOGM enforces applicable performance standards and permit requirements during the mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility for this enforcement. BLM has authority in those emergency situations where UDOGM or OSM inspectors cannot act before significant environmental harm or damage occurs.

1.3.3 Other Jurisdictional Agencies

For any related future mining operations, CPMC will also comply with applicable regulatory requirements relating to the following designated activities/structures under the authority of the noted jurisdictional agencies:

Federal Agencies

Environmental Protection Agency (EPA) - Compliance with applicable air, water, and hazardous materials requirements under programs administered by the Utah Division of Air Quality (UDAQ) and Utah Division of Water Quality (UDWQ)

U.S, Army Corps of Engineers (COE) - Compliance with Section 404 of the Clean Water Act as it relates to the planned construction and stream realignment activities in Willow Creek

U.S. Commerce Department, Bureau of Alcohol, Tobacco, and Firearms - Permits for procurement, transportation, storage, and use of explosives

Mine Safety and Health Administration (MSHA) - Compliance with applicable requirements relating to coal processing waste dams; impoundments and sedimentation ponds; plans for underground disposal of development waste, coal processing waste, or excess spoil; refuse piles; reclamation and closure of mine openings; any discharges into underground mines; mining within 500 feet of an active underground mine; and plans for extinguishing coal mine waste fires

U.S. Fish and Wildlife Service (USFWS) - Compliance under the Endangered Species Act, Bald Eagle Protection Act, and Migratory Bird Act

State Agencies

Utah Division of Oil, Gas, and Mining (UDOGM) - Compliance under the State of Utah Coal Mining Rules

Utah Division of Air Quality (UDAQ) - Compliance with applicable air quality permitting and operational requirements

Utah Division of Water Quality (UDWQ) - Compliance with applicable water discharge permitting, operational, monitoring, and reporting requirements

Utah State Engineer - Compliance with well and pond design and construction requirements and water rights requirements

Utah Department of Transportation (UDOT) - Highway modification and driveway permits

Utah Division of Wildlife Resources (UDWR) - Compliance with applicable wildlife protection measures

Utah State Historic Preservation Office (SHPO) - Compliance with applicable provisions of the National Historic Preservation Act

Local Agencies

Carbon County - Compliance with applicable requirements for special use, building, and water and sewer permits

CPMC has either applied for and received, or approvals are pending for all required permits and approvals.

1.4 CONFORMANCE WITH LAND USE DESIGNATIONS AND PLANS

In accordance with applicable provisions of 43 CFR 1600, the BLM has developed and implemented a Management Framework Plan (MFP) for the Price River Resource Area which addresses both multiple use objectives and resource specific objectives for protection and management of those Federal lands under the BLM's jurisdiction and authority. The following program description summarizes the Minerals Management Decisions presented in the MFP:

> "The minerals program provides for the exploration and disposal of minerals by lease, license, or permit; coordination of minerals development with other land uses; and the assurance of rehabilitation of mined land ..."

The proposed action of coal leasing is consistent with both the general minerals management objectives as stated and specific multiple use objectives and decisions as outlined in the MFP.

The multiple use objectives and decisions for specific management categories (range, recreation, watershed, wildlife, and cultural) include limitations relative to the nature and extent of allowable disturbance. Relative to coal leasing, actual physical disturbance would be limited to that disturbance which would result from mine development, operation, and reclamation, as reasonably foreseeable related future actions. Specific control, reclamation, and monitoring provisions included in the mining and reclamation plans reviewed and approved by UDOGM with input from the BLM effectively address compliance with all applicable limitations imposed by the BLM's multiple use objectives and decisions as outlined in the MFP.

1.5 ISSUES AND CONCERNS

Issuance of the requested supplemental coal lease and related development and operation of the planned Willow Creek Mine offer a number of important benefits specifically including the following:

- Combines adjacent minable coal reserves with existing leased coal reserves as a logical mining unit assuring effective utilization and recovery of the available resource
- Assures continued availability of a valuable energy resource used to generate electricity and as an industrial heating fuel
- Provides for efficient development and consequent conservation of known coal reserves

- Facilitates effective reclamation, through a comprehensive reclamation program, of both new disturbance and previously disturbed areas

- Provides stable, high-paying jobs for approximately 250 to 300 employees with an annual payroll and benefits of $15 million or more

- Supports Federal, State, and local governments through payments of property, sales, excise, fuel, and other taxes estimated at $50 million or more annually

- Supports the National, State, and local economies through direct purchases of equipment, materials, supplies, and services (estimated at $25 million or more annually); royalty payments on fee and leased lands (estimated at $5 million annually); and indirect turn-over of these expenditures in the economy (multiplier of approximately $3.00 in total economic benefits for every dollar spent in wages, benefits, and purchases of goods and services)

- Supports local communities through charitable contributions

Since the Mine is designed to replace CPMC's existing Star Point Mine as the Star Point reserves are depleted, many of these are existing benefits which will be lost when the Star Point Mine closes if the proposed Mine is not developed. The new Mine will offer employment levels similar to the Star Point Mine although increased efficiency will result in production levels approximately 1.6 times current Star Point Mine production. The increase in production level is expected to result in corresponding increases in economic benefits. In addition, the adjacent unleased Federal coal is under significant cover depths and would probably be unminable using current mining technology if not recovered in conjunction with the planned Mine operations.

As well as the noted benefits, the planned mining and reclamation operations and related activities have the potential to result in possible environmental and socio-economic impacts. Based on available information on existing environmental resources and the planned mining and reclamation plans, potential impacts could occur in the following areas:

- Disturbance of existing soils, vegetation, and wildlife resources
- Impacts on existing land uses
- Air quality impacts
- Surface and ground water impacts
- Subsidence effects
- Socio-economic impacts

More detailed information on existing environmental resources and analysis of the planned mining and reclamation plans, potential mining-related impacts, and planned control and mitigation measures is presented in the following sections of this EA.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO ACTION ALTERNATIVE

Under the No-Action Alternative the requested coal lease would not be issued. The proposed lease area and associated resources would remain in their current condition and configuration, subject however to any disturbance related to existing approved exploration and other activities. Since the No-Action Alternative would generally result in maintenance of existing conditions, it can be considered a reference for evaluation of all other potential alternatives.

It is important to note that development of the Mine, which is considered to be a reasonably foreseeable result of the Proposed Action, would likely still occur under the No Action Alternative, but would be limited to existing fee and leased Federal, State and County lands.

2.2 PROPOSED ACTION

2.2.1 Coal Leasing

The Proposed Action is approval and issuance of a coal lease for Federal lands administered by the BLM. The coal lease application (Lease Serial No. UTU-73753) covers approximately 2,300 acres of Federal lands located in the following areas as shown on Figure 1.0-2, Proposed Activities:

T12S, R9E, Section 25; Section 26-E½E½

T12S, R10E, Section 28 - S½, NE¼, S½NW¼, and NE¼NW¼; Section 29 - E½SE¼, NW¼, N½NE¼, and NW¼SW¼; Section 30 - N½, SW¼, W½E¼, and NE¼SE¼

Leasing would provide both surface access for necessary mining and related activities and the rights to extract economically recoverable coal reserves consistent with the terms of the lease agreement and under the provisions and requirements of an approved Mining and Reclamation Permit from the UDOGM. The subject Federal coal reserves would be accessed from mine workings developed in fee and existing leased Federal coal reserves to the south and east. No direct mining-related surface disturbance is planned within the proposed lease area and surface effects would be limited to potential mining-related surface subsidence.

The Proposed Action of coal leasing involves the following sequence and general timing of events:

- Submittal of Coal Leasing Application (CPMC, March 1995)
- Submittal of Resource Recovery and Protection Plan (CPMC, February 1996)
- Completion of Coal Leasing EA (BLM, May 1996)
- Preparation and Issuance of BLM Decision Document (BLM, 2nd Quarter 1996)
- Public and Agency Review and Comment (BLM, 2nd and 3rd Quarter 1996)
- Issuance of BLM Final Decision (BLM, 3rd Quarter 1996)
- Coal Lease Sale (BLM, 3rd Quarter 1996)
- Issuance of Coal Lease (BLM, 4th Quarter 1996)

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The following alternatives to the Proposed Action of coal leasing have been identified, briefly evaluated, and eliminated from detailed analysis. Preliminary evaluation of these alternatives focused on consideration of the following general objectives:

- Effective conservation and/or utilization of available resources
- Protection, mitigation, and restoration of environmental resource values
- Protection of human health and safety

Reasons for elimination from detailed analysis are noted for each alternative.

Reduced Leasing Alternative - A reduction in the area and total reserves under the requested lease was considered as a possible alternative to the Proposed Action. This alternative was eliminated from detailed consideration and analysis because the requested lease block is based on a logical sequence of mine development and recovery of available coal reserves to the practical economic and operational mining limit. Reduction of the lease area would offer no advantage relative to reduction of potential mining-related impacts and would result in potential loss and sterilization of reserves since mining would then bypass these reserves and potential future access could be lost.

Expanded Leasing Alternative - Additional coal reserves are known to exist to the north which could be included within the proposed lease area by expanding the lease boundary to the north. This alternative was eliminated from detailed analysis because overburden cover depths increase rapidly beyond the northern boundary of the proposed coal lease block and potential mining feasibility becomes a concern at cover depths above approximately 2,200 feet due to ground control considerations. CPMC will evaluate mining feasibility for greater cover depths through progressive extension and monitoring of mine workings at the proposed mining limit. Additional coal reserves to the north of the proposed lease area, however, are under greater than 2,200 feet of cover and are not presently considered minable reserves with current mining methods and technology.

Deferred Leasing Alternative - The alternative exists to break the proposed lease area into segments and lease each segment separately as needed. This alternative has been eliminated from detailed consideration and analysis because it is inconsistent with integrated planning objectives and development of logical mine development plans and the associated regulatory and economic commitments, and would result in considerable duplication of effort for both the BLM and CPMC.

2.4 REASONABLY FORESEEABLE RELATED FUTURE ACTIONS

Issuance of the proposed coal lease could result in the following reasonably foreseeable related future action. It should be noted, however, that these actions may occur regardless of whether or not the Proposed Action is implemented.

- Coal Mine Development, Production, and Reclamation
- Powerline Relocation

Because of their complexity and scope, these reasonably foreseeable related actions are described in the following sections and related potential environmental impacts are summarized, as appropriate, in Section 4.0.

2.4.1 Coal Mine Development, Production, and Reclamation

2.4.1.1 General Project Scope and Schedule

Underground mining operations, which would be a reasonably foreseeable future action which would result from the proposed coal leasing, will target recovery of remaining recoverable coal reserves contained in the "A", "C", "D", and "K" coal seams. The proposed mining plans include mining of recoverable reserves in areas with less than approximately 2,200 feet of overburden cover as shown by Figure 1.0-2, Proposed Activities. There are extensive reserves under areas with greater than 2,200 feet of overburden, however, recovery of these reserves is not considered feasible at this time using current mining technology. Most of the mine development work will involve underground methods using continuous miners and electric shuttle cars.

CPMC plans to utilize high-productivity, longwall mining systems for actual coal production, with coal haulage from the mine using a high-speed main conveyor fed by several face conveyors from each of the active development areas, continuous miner sections, or longwall panels. The mine has been designed for a nominal annual production rate of 5.0 million tons of coal, based on an operating schedule of 250 days per year, 2 shifts per day, 8-hour shifts, with a base production rate of 1,000 tons per hour. The potential exists that, based on coal market conditions, the production rate could be increased by adding a third shift, resulting in a peak design production rate of 6.0 million tons of coal per year. The projected life of the Mine is approximately 15 to 20 years with the potential to extend the mine life significantly with development of additional coal reserves to the west.

2.4.1.2 Mine Construction and Development

Mine construction and development will involve those activities necessary to complete the surface facilities and systems as shown on Figure 2.0-1, Mine Surface Facilities, and to develop mine portals, main entries, longwall panels, and the entire underground infra-structure which will be required to support the planned underground mining operations. From an environmental standpoint, the mine construction and development phase will be important due to the fact that essentially all direct mining-related surface disturbance will occur during this phase. Mine construction and development activities have been designed and will be conducted in a manner that prevents or controls erosion and siltation, water pollution, and damage to public or private property. In addition, to the extent possible using the best technology currently available, the proposed activities will be conducted so as to minimize damage to fish, wildlife, and related environmental values, and minimize additional contributions of suspended solids to streamflow or runoff outside the permit area.

In order to provide for a smooth transition of coal production from the existing Star Point Mine complex to the new Mine facility and continue to meet existing coal contract obligations, CPMC initiated certain pre-development activities during the 1995 construction season. These activities included re-excavation of the existing mine face-up area, placement of the coal refuse material previously placed in this area under the Utah AMR program in the existing permitted Schoolhouse Canyon coal refuse disposal area, and widening of a portion of State Highway 191 to accommodate required turn lanes. Re-excavation of the face-up area and relocation of the resulting coal refuse proceeded under a technical revision to the existing approved Castle Gate Mine Permit. Required highway modifications occurred entirely within the existing Highway 191 right-of-way and were conducted under approved plans developed in consultation with and under the jurisdiction of the UDOT.

All other planned construction and development activities will proceed, as soon as operationally feasible, following receipt of required permit approvals. It is anticipated that the necessary permits will be approved early in the second quarter of 1996, with construction and development activities proceeding immediately upon receipt of permit approvals and continuing over the next 18 to 24 months.

Required mine construction and development activities will proceed in a logical sequence to assure effective environmental protection and engineering control of these activities. The following general sequence of activities will be applicable for all planned mine construction and development activities:

- Establish preliminary access
- Construct required drainage and sediment control structures
- Recover and stockpile available soil or substitute materials
- Construct required roads
- Proceed with required site grading, excavation, and cut/fill operations
- Complete required foundation preparation work
- Construct required structures and facilities
- Complete required utility installations
- Develop mine portals, main entries, and longwall panels
- Complete infrastructure for underground operations (includes electrical systems, water distribution, communications, ventilation, mine drainage systems, and conveyors)
- Systems testing and commissioning

2.4.1.3 Mining and Related Operations

The mine plans and planned mining methods described in this section reflect CPMC's detailed review and evaluation of all existing available geologic and coal quality data, consideration of related environmental factors such as hydrologic and subsidence considerations, and the extensive operating experience of CPMC and other mine operators in this area. Overall project objectives include the following:

- Maximize recovery and utilization of the available coal resource
- Optimize coal production efficiency and economics
- Facilitate potential future development of nearby coal reserves
- Provide a safe, healthy, secure working environment
- Minimize potential adverse environmental impacts
- On completion of mining, provide for restoration of a productive, self-sustaining postmining land use

Based on CPMC's detailed review and evaluation of possible alternative mining scenarios, the plans presented in this section were selected as the best combination of mine layout, mining method, and mine sequencing in order to achieve the noted objectives and provide for organized sequential mining operations.

Based on previous mining experience in the general area and given the constraints imposed by existing mining technology, it is assumed that a maximum effective cover of approximately 2,200 feet represents a practical mining limit due to ground control considerations. This assumption will be tested by extending the D Seam main entries to the north beyond the 2,200 foot cover limit. If no significant ground control problems are encountered in the D north extension, CPMC will proceed progressively with longwall panel development and longwall extraction, monitoring ground conditions and response at each stage of the development process. Mining would remove coal reserves down to a minimum practical mining thickness of 5 feet which is the lower limit for the selected continuous mining equipment. The longwall equipment planned for use in the Mine can effectively recover coal seams down to a minimum seam thickness of 6.5 feet. Longwall mining methods, which inherently provide the highest potential recovery of any available underground mining method, will be used wherever operationally feasible to recover available coal resources. In any area where longwall operations are not feasible, room and pillar mining methods will be utilized, and CPMC will generally practice full retreat mining in room and pillar mining sections to recover as much of the remaining coal as reasonably possible.

Planned coal development and production is expected to begin with the D Seam (1996 through 2001), progress to the K Seam (1998 through 2012), continue with the A Seam (2001 through 2013), and then go back and pick up the C Seam (2006 through 2011). All mining prior to 1998 would occur in fee and existing Federal coal lease areas. Mining of the additional coal reserves contained in the supplemental lease tract would occur beginning in 1998 and continuing through 2006. It is estimated that the proposed coal lease tract contains approximately 18 to 20 million tons of high quality coal, although recovery of the in-place reserves in this area may be constrained by practical mining considerations related to the depth of the overburden cover. The supplemental lease area is important to the overall Willow Creek mine plan because it would provide direct access along the northern mining limit to extensive potential future coal reserves to the west of the Price River and serve as an effective access corridor for development of the eastern reserves included in the present mine plan.

Underground mining is a relatively complex process involving a number of inter-related activities designed to optimize coal production and handling, minimize environmental damage, and assure safe and healthy working conditions for the miners. The planned mining operations will involve the following activities:

Mining Activities

- Mine development
- Coal extraction
- Coal haulage
- Waste handling

Support Activities

- Ground control
- Mine ventilation
- Mine drainage
- Maintenance and miscellaneous support activities

The mining activities are discussed in the following sections. Ground control is an integral part of mining and is addressed both in the discussion of mining activities and under Subsidence Control and Monitoring. Other associated support activities are discussed separately.

Mine Development. Mine development involves excavation and construction of the underground openings, or entries, required to access the minable coal reserves, provide for efficient production of those reserves, facilitate haulage of both coal and mine waste, and provide for effective ventilation of the mine workings. Development activities would include development of mine portals, main entries, sub-mains, slopes and raises, and longwall panels.

The mine entries will be the primary mine access and supply routes for each minable coal seam, providing access and ventilation for all underground mine workings. Bleeder entries, which will be used to bleed off naturally occurring methane gas prior to mining and to route any continuing methane drainage to exhaust entries during and following mining, will be developed as mining progresses. Longwall panel development will involve development of headgate and tailgate entries parallelling each longwall panel.

Development of slopes and raises may take advantage of modern raise-boring technology which involves drilling a pilot-hole using conventional surface or underground long-hole drilling equipment, connecting a rotary cutterhead on the lower level to a drive unit on the upper level, and progressively boring the required mine opening by advancing the rotating cutterhead toward the drive unit. All other mine development will involve the use of continuous miners to advance the development entries, electric shuttle cars to remove the excavated coal or waste rock, and electric roof-bolters to provide required roof support.

Coal Extraction. CPMC plans to utilize the longwall mining method as the primary coal extraction and production technique. There are, however, certain areas where longwall mining will not be feasible due to limited seam thickness, the configuration of the remaining coal reserves (inadequate width or length to justify the costs associated with longwall development and set-up), geologic conditions, or potential subsidence concerns. In these areas, room and pillar mining methods will be utilized with continuous miners, shuttle cars, and roof bolters as the primary production equipment. Typical longwall recovery rates are 75 percent or greater since this mining method eliminates the need for temporary or permanent support pillars within the mining area. Longwall mining involves continuous recovery of coal from large blocks, or longwall panels, using semi-automated equipment systems. CPMC has used the longwall method successfully for the past 11 years at the Star Point Mine and feels that, based on site conditions, it represents the best method to assure maximum resource recovery and controlled subsidence. The longwall panels are expected to be approximately 500 to 800 feet wide and vary from 2,000 to 9,500 feet in length.

The following primary equipment is required to support longwall mining operations:

- Longwall shearer
- Armored face conveyor

- Stage loader
- Hydraulic support shields
- Panel conveyor
- Hydraulic and electrical support equipment and controls
- Shield transporters

Room and pillar mining, using continuous miners, is one of the primary underground coal mining methods utilized in many mines and offers the benefits of low capital cost for the required mining equipment and considerable flexibility. Continuous miners can negotiate tectonically disturbed areas of the mine and adapt to seam variations and uneven reserve blocks. Continuous mining equipment is also relatively mobile and can easily be moved to different locations within the mine allowing relatively quick adjustments and continued production if ground control, water, or other problems prevent further mining in an active mining area. Room and pillar mining involves development of underground mine openings (entries and cross-cuts) with intermediate pillars to support the mine roof during active mine advance. Each mining area developed using this method then becomes a "room" with a grid of supporting pillars. Once the mining advance reaches the mining limit for each area, retreat mining begins with partial extraction of the coal remaining in the support pillars. Because at least partial pillars must be retained during retreat mining to prevent total collapse of the mine roof, coal recovery using room and pillar methods rarely exceeds 55 to 60 percent. Essentially all mine development work would be conducted using room and pillar mining methods except for completing slopes and raises, and would also be used to recover coal which is not recoverable using longwall methods.

The following primary equipment is required to support room and pillar mining operations:

- Continuous miner
- Shuttle cars
- Roof Bolter
- Feeder Breaker
- Section power center
- Mantrip vehicle
- LHD scoop
- Portable rock duster
- Section conveyor
- Miscellaneous support equipment

Coal Haulage. The coal haulage system will consist of several interconnected components to transport the coal to the surface. Coal haulage between the various mining levels will involve the use of main haulage belts on the intermediate access slopes which will transfer the coal from the lower level to the main haulage belt on the next level above. All coal transfer points are designed to minimize dust generation and dispersion using enclosures or water sprays, drop height will be limited to the extent operationally feasible, and impact beds and conveyor skirting will be utilized as appropriate to minimize coal breakage and dust generation and contain both the coal stream and any associated coal dust. Consistent with safety considerations and applicable MSHA regulations, all underground coal haulage belts will be located in separate entries where they are isolated from both intake and return airways.

Waste Handling. Mining and related activities can result in production of mine waste materials including waste rock, carbonaceous shale, weathered coal, floor clay, and parting material. Where it is operationally feasible to separate these materials, they will be removed and handled separately using the same equipment and haulage systems that will be utilized for room and pillar operations. Mine waste generated in conjunction with ongoing mining and related operations would be temporarily stockpiled until it can be recovered and transported to the surface during a scheduled waste handling shift.

Mine Ventilation. Effective ventilation of mine workings will involve the use of ventilation fans and control of airflow within the mine workings to provide adequate airflow volumes and flow rates in all active working areas. Airflow will be controlled, under mine ventilation plans submitted to and approved by MSHA, by maintaining

a pressure differential which will force the air to follow a pre-determined path through the mine workings. The pressure differential and desired airflow will be maintained by isolating intake and return airways with air-tight stoppings and utilizing the network of mine entryways to effectively route both clean (intake) and used (return) air through the mine.

Dewatering and Mine Drainage Control. Ground water inflow to the active mine workings is expected to be limited given the relatively low overall permeability of the geologic sequence, limited recharge, and consequent lack of a significant ground water aquifer in the area to be mined. Water accumulations in abandoned underground workings in the area may result in localized increases in the amount and availability of ground water, particularly in down-dip areas to the north and east. Any ground water inflows to the active mine workings will be controlled by intercepting the water near the point of inflow with either shallow ditches or sumps and transferring the water to either abandoned mine areas or temporary holding areas. Minor ground water inflows will not be addressed unless they interfere with mine operations or pose a potential safety hazard.

Given the limited ground water inflow which is expected, mine water discharge to the surface is not anticipated. In the unlikely event that discharge does become necessary, however, mine drainage will be transferred within the mine and then to the surface utilizing a series of ditches in combination with intermediate sumps and submersible pumps and pipelines. On the surface, any mine drainage would either be routed to the mine water storage tank through the mine water system piping, or discharged to Sedimentation Pond 001, which has been designed to provide temporary storage for approximately 1.0 acre-feet of mine water discharge. Any mine water discharge routed through the sedimentation pond would be subject to sampling and applicable effluent discharge limitations. Operational water supply requirements will be addressed through a combination of mine water use and recycling and supplemental water supply withdrawals from the Price River under existing permitted water rights held by CPMC.

Maintenance and Miscellaneous Support Activities. A number of support activities including rock dusting; extension of mine electrical, communications, and water systems; equipment maintenance and repair; and material and equipment supply and storage are necessary to maintain safe, efficient underground operations. Many of the necessary mining support functions including electrical distribution, mine ventilation, underground communications, and health and safety considerations are governed and monitored by MSHA under applicable provisions of the Coal Mine Health and Safety Act of 1969, and will be conducted under specific MSHA plan approvals.

2.4.1.4 Subsidence Control and Monitoring

Underground mining typically leaves a void where the coal has been removed, resulting in full or partial collapse of the immediate overlying units and potential deformation or settlement of the overlying ground surface, termed subsidence. The amount and nature of surface subsidence can be highly variable depending on coal extraction thickness, depth, mining method, mining sequence, geology, stratigraphy, and other factors. An evaluation of proposed mining plans and available geologic information determined the critical mining width above which maximum potential subsidence would occur is approximately 1.6 times the minimum overburden depth. At mining widths greater than or equal to this critical width, the maximum potential surface subsidence is projected at 0.7 times the coal extraction thickness. The angle of draw, which defines the horizontal limit of potential subsidence effects and is measured from a vertical projection of the actual mine disturbance limit, is predicted to be 22.5 degrees (Agapito, 1994).

All of the planned mining and related operations, including those activities within the proposed lease tract, have been designed to provide for safe operating conditions and to control or minimize subsidence to the extent reasonably practicable within the constraints of effective resource conservation and recovery. Design ground control measures include CPMC's layout and orientation of planned mining areas; mine development sequencing; sizing of development entries, pillars, and longwall panels; and selection of appropriate mining method(s) for specific mining areas. Operational ground control measures will include the following:

- Control and sequencing of development and mining operations consistent with design plans
- Use of roof bolts, trusses, cribs, timber props, and other artificial roof support measures consistent with an approved MSHA Roof Control Plan
- The temporary roof control provided by shield supports on longwall panels as well as the controlled stress relief inherent in the longwall mining method
- Use of yielding chain pillars in longwall areas to provide for gradual controlled caving and stress relief
- Controlled pillar recovery during retreat in room and pillar mining sections and the accompanying controlled caving and stress relief
- Retention of barrier pillars or avoidance of full extraction mining adjacent to main and sub-main haulageways and in other areas where necessary to prevent or minimize surface subsidence and protect surface features or structures
- Implementation of a comprehensive subsidence monitoring program with evaluation of the resulting data and modification of mining plans and methods if appropriate

2.4.1.5 Mine Structures and Facilities

The planned underground mining and related activities will require limited surface support facilities. The facilities to be utilized in conjunction with the planned operations will include both existing facilities located in the Castle Gate, Gravel Canyon, and Crandall Canyon areas and new facilities to be constructed in the planned Mine surface facilities area. None of the planned surface facilities will be located within the proposed coal lease area. The planned facilities will provide the necessary infrastructure for effective management and handling of personnel, equipment, materials and supplies, and both coal and mine waste materials, and will include a number of structures specifically designed to control or mitigate potential mining-related impacts.

The surface structures and facilities will be operated, maintained, and ultimately reclaimed in a manner that prevents or controls erosion and siltation, water pollution, and damage to public or private property. In addition, to the extent possible using the best technology currently available, proposed structures, facilities, and operations will minimize damage to fish, wildlife, and related environmental values, and additional contributions of suspended solids to streamflow or runoff outside the permit area.

2.4.1.6 Reclamation of Mining Disturbance

Reclamation of surface disturbance areas will generally occur following the cessation of mining operations, although CPMC may implement temporary stabilization measures in certain areas following initial construction or during ongoing operations, including progressive reclamation of the Schoolhouse Canyon refuse stockpile.

Objectives of the planned reclamation activities will be twofold; 1) For construction disturbance and ongoing surface disturbance such as that associated with expansion of the coal refuse stockpile, temporary stabilization and contemporaneous reclamation will serve to stabilize disturbance areas, minimize erosion, and limit potential surface water impacts; 2) For long-term use areas, final reclamation is designed to restore disturbed areas to a safe, stable condition and to reestablish the productivity of the land consistent with the postmining land use(s). The Mine reclamation plan has been designed to successfully meet these objectives and will result in effective temporary stabilization, and a postmining configuration which blends with the surrounding terrain and provides environmental values consistent with or superior to those which existed prior to mining.

Reclamation will involve a logical sequence of activities designed to achieve the overall reclamation objectives in an organized progressive manner. The following represent the general steps for reclamation of any mine or mine-related surface disturbance areas:

- Facility demolition and removal
- Stabilization and sealing of mine openings
- Disposal of coal refuse, non-coal wastes, and mine waste materials
- Backfilling and grading to establish the final design configuration
- Drainage reestablishment
- Road removal
- Soil/substitute replacement
- Revegetation
- Post-reclamation management, maintenance, and monitoring
- Removal and reclamation of sedimentation ponds and associated structures

Since there will be no surface disturbance other than potential mining-related subsidence within the proposed coal lease area, the noted reclamation considerations are not directly applicable.

2.4.2 Powerline Relocation

The only existing structure which will potentially be impacted by subsidence resulting from the proposed mining operations is a power transmission line extending up Barn Canyon. Relocation of the powerline to an area which would not be impacted by the proposed mining activities or related subsidence is currently under consideration and would represent a reasonably foreseeable related action. Two potential line relocation options were identified and are briefly outlined below:

- **Power Line Relocation Option A** - This routing option follows an existing electric distribution line along the railroad and the Price River to the entrance to Sulphur Canyon. It then follows Sulphur Canyon to Emma Park where it meets the existing line from Barn Canyon. This routing option would require the construction of approximately 5 miles of transmission line at an estimated cost of $2,529,000 and would result in maximum surface disturbance of approximately 12.1 acres (assumes a 20 foot disturbance corridor). Actual surface disturbance would probably be significantly less since poles could be set in many locations with only localized disturbance and both the section along the Price River and the upper half of Sulfur Canyon would be accessible from existing roads. Construction along this alignment could follow an abandoned communications line and utilize the existing associated access. Any associated requirements for new right-of-way or modification of existing rights-of-way would be the responsibility of PacifiCorp as the owner and project proponent. Option A is the preferred option since construction and maintenance access requirements would be minimized; this alignment would generally avoid conflicts with mining activities and existing powerlines, the risk of land subsidence and associated rock slides would be precluded, and total length and construction cost would be reduced.

- **Powerline Relocation Option B** - This powerline routing option follows the existing Carbon-Spanish Fork #1 138 kV line. It then proceeds up Willow Creek Canyon approximately 3 miles from the Carbon Power Plant to Hells Canyon, up Hells Canyon about 1 1/4 miles to Emma Park and then about 2 1/2 miles to a point where it meets the existing Carbon-Spanish Fork #2 line. This routing option is approximately 7 miles in length. Construction costs are estimated at $3,643,000 and maximum surface disturbance would be approximately 17.0 acres (assumes a 20 foot disturbance corridor). Actual surface disturbance would probably be reduced due to pole placement considerations, but this option would require construction of a new access. Any associated requirements for new right-of-way or modification of existing rights-of-way would be the responsibility of PacifiCorp as the owner and project manager. Concerns associated with this option include the potential for three major transmission lines along the sides of Willow Creek Canyon; conflicts between mine facilities and transmission lines; the need for extensive side hill construction and access roads in Hells Canyon; and difficult construction and maintenance within Hells Canyon.

3.0 AFFECTED ENVIRONMENT

Commercial and industrial development in the general area of both the proposed coal lease area and the associated Mine includes extensive historical underground mining activities, the nearby PacifiCorp Carbon Generating Station, and transportation facilities, as represented by U.S. Highways 6 and 50, State Highway 191, and the Denver and Rio Grande Western (D&RGW) Railroad line running up the Price River Canyon. Most of the proposed lease area and the remainder of the planned Mine permit area generally consists of undeveloped lands utilized for low-intensity grazing, wildlife habitat, limited dispersed recreation, and very limited timber production.

Active underground mines operated continuously from the 1870's through the 1940's, when coal demand and production began to decline due to reduced post-war industrial production and the shift to diesel railroad engines. The Castle Gate Mines No's. 1, 2, and 4, which were within the area encompassed by the mine permit boundary, were developed and operated from 1888 through 1972, when the last of the mines closed. Although extensive underground mine development and production occurred throughout the proposed permit area, associated surface disturbance was generally limited to mine portal and surface facility areas in the valley bottoms and on natural bench areas adjacent to existing drainages.

This section presents a discussion of the affected environment and the major resource areas of concern including:

- Geology
- Hydrology
- Soil Resources
- Vegetation
- Fish and Wildlife
- Land Use
- Cultural Resources/Native American Religious Values
- Air Quality
- Socioeconomics
- Transportation
- Recreation and Aesthetic Resources

The following resource categories or sensitive areas are not addressed within this EA for the specific reasons noted:

- Areas of Critical Environmental Concern (Includes Wildlife Refuges) - No areas of critical environmental concern have been identified within the project impact area

- Hazardous Waste - Hazardous wastes are not currently present within the project impact area and would not be used, generated or stored in conjunction with the reasonably foreseeable related mining activities

- Prime and Unique Farmlands - Prime and unique farmlands would not be affected because there are no designated prime and unique farmlands within the project impact area

- Wild and Scenic Rivers - Wild and Scenic Rivers would not be affected since there are no designated wild and scenic rivers within the project impact area

- Public Parks and Components of the National Parks System - There would not be impacts on public parks on National Park Service lands since no park lands fall within the project impact area

- Wilderness - Wilderness would not be affected because there are no designated Wilderness Areas or Wilderness Study Areas within or in proximity to the project impact area

- Designated Trail Systems - Designated trail systems would not be affected because no components of any designated trail system fall within the project impact area

- Wetlands - Wetlands would not be affected since no jurisdictional wetlands have been identified within the project impact area (riparian and stream community values are discussed under the vegetation (3.4) and fish and wildlife (3.5) sections)

- Floodplains - There are no perennial streams within the proposed lease area and the ephemeral drainages within the project impact area including Dry Canyon, Hell Canyon, Skinny Canyon, Dinosaur Canyon, and Barn Canyon, do not have defined floodplains. Floodplains, therefore, will not be affected

3.1 GEOLOGY

The proposed lease and associated Mine permit area are characterized as deeply incised "plateau topography". This topography consists of flat-topped ridges rising above and bordering adjacent Colorado Plateau high desert lands. Major canyons include the Willow Creek Canyon draining from the northeast. Elevations in the general permit area range from over 8,000 feet above sea level on the tops of the flat-topped ridges to about 6,000 feet above sea-level along the Price River south of the permit area. Strata in the area is composed of moderately weak fine-grained units interfingered with thick, resistant sandstone units. Erosionally, these units create moderate to steep weathered slopes interspersed with vertically exposed resistant ledges and cliffs. The characteristic high relief is the result of extensive erosion along zones of weakness, creating steep-walled canyons which intersect the proposed permit area.

The geology of the general area is dominated by relatively flat-lying, interbedded sedimentary units. Typical surface topographic features of the area, including elevated plateaus, near-vertical rocky cliffs, and steep weathered slopes, are reflections of the main lithologic units consisting primarily of resistant sandstones, and interbedded shales, siltstones, and mudstones. With the exception of minor localized jointing and cleating, there are no known major structural features in the permit and immediately adjacent areas.

The Cretaceous Blackhawk Formation is the principal coal-bearing formation. Mineable coal seams include, in ascending order, the Sub -1, 2, and 3 Seams, the A/B Seam, C Seam, Kenilworth (K) Seam, and the D Seam as shown by Figure 3.0-1, General Stratigraphic Column. Mineable coal seams range from 3.5 to 25 feet in thickness and are bituminous in character. The Aberdeen Sandstone is the first stratigraphic unit below the lowermost coal seam to be mined. Ground water occurrences have been documented in the Aberdeen Sandstone as well as in several other sandstone members in the stratigraphic sequence. These units appear to have sufficient permeability to store and transmit ground water and, dependent on lateral extent and recharge conditions, may function as localized perched or regional aquifers.

Based on chemical analysis of coal, roof, and floor samples, overall sulfur content is low with organic sulfur as the dominant sulfur form in the coal and pyritic sulfur as the dominant form in the overburden materials. Acid-producing potential is consequently low and buffering capacity is relatively high due to the presence of significant quantities of calcium resulting in very low acid-forming potential. Similarly, chemical analysis generally indicate low concentrations for most potentially toxic components and low alkalinity-producing potential. The chemical analysis results and subsequent conclusions are generally consistent with chemical analysis of coal refuse materials from previous mining operations involving production from the same coal seams. Analysis results indicate some potential for elevated sodium as measured by the sodium adsorption ratio (SAR) and localized increases in boron and selenium concentrations. Elevated SAR values for drillhole samples are, however, inconsistent with analysis results for mine waste and coal refuse samples from the same geologic units. Where mine waste rock or coal refuse materials are placed in surface stockpiles, suitability testing for these specific components may be appropriate as part of the overall reclamation program.

3.2 HYDROLOGY

Within the proposed lease and associated permit and adjacent areas both surface and ground water hydrologic features and regimes are reflective of and strongly influenced by geologic structure, stratigraphy, lithology, and localized topography and climatic conditions.

Generally, the topography in the area is very rugged. High plateaus are present to the north, west, and northeast of the proposed lease and surrounding areas, with narrow ridgelines cut by deep drainages to the east, west, and south. The rugged, very steep terrain and deep drainages effectively limit the recharge and lateral continuity of any potential aquifers as evidenced by the limited number and low discharge rates of seeps and springs in the area. Semi-arid climatic conditions and precipitation patterns result in a high loss of moisture to runoff, evaporation, and sublimation reducing the amount of water available for recharge or streamflow. Recharge to underlying units is also limited by the small outcrop areas of the flat-lying units. Downward movement of recharge through the stratigraphic sequence to underlying units is limited by low vertical permeabilities of the units (which are often fine-grained, well cemented, or massive), the presence of relatively impermeable shale units acting as confining layers, and the general lack of faulting or fracturing.

As a result of these controls, ground water occurrence is limited to shallow ground water contained in the alluvial/colluvial deposits associated with local drainages; isolated zones containing perched ground water; limited ground water storage in abandoned mine workings which extend throughout the area; and a regional aquifer occurring in the deeper portions of the Blackhawk Formation and extending into the underlying Star Point and Mancos Formations.

3.2.1 Ground Water

3.2.1.1 Ground Water Resources

Ground water resources in the proposed lease, permit, and adjacent areas are limited in both extent and quantity. Ground water occurrence has been quantified by drilling, aquifer testing, hydrogeologic analysis of water-bearing strata, mapping of ground water storage in underground mines, a spring and seep survey, and analysis of water quality and quantity characteristics.

Ground water occurrences are limited to shallow alluvial/colluvial valley-fill deposits in local drainages; perched ground water in thin, laterally discontinuous units associated with the Price River, North Horn, and Flagstaff Formations; ground water accumulated over time in extensive underground workings; and a regional water-table aquifer consisting of deeper units in the Blackhawk Formation extending into the underlying Star Point and Mancos Formations.

Ground water recharge occurs through direct precipitation and infiltration at the outcrop of the various stratigraphic units and to a limited extent where drainages cross outcrop areas. The thick sequence of relatively low permeability units which overlie the coal seams effectively limit direct recharge. Ground water movement is limited by low transmissivities, the lack of significant secondary permeabilities, and limited recharge in outcrop zones. Ground water has gradually accumulated over time in the down-dip workings of mines, resulting in potentially significant volumes of water. Mine inflows are minimal.

Ground water use in the area is limited by the low number of seeps and springs, absence of effective aquifer units, depth to groundwater, variable ground water quality, and availability of surface water. A spring and seep survey identified only 12 minor springs and 3 seeps in the 14,670 acre permit area, none of which are in the proposed lease area. Other than limited use of the springs by wildlife and for livestock watering, ground water use is limited to several shallow alluvial wells along the Price River.

3.2.1.2 Ground Water Quality

Water quality is variable due to the differing lithological compositions of the area bedrock and the variable residence time of ground water, which affects the amount and types of dissolved constituents. Ground water quality variances depend on the recharge source, flow path, strata with which the water comes in contact, and discharge mechanism. Generally, water quality for alluvial/colluvial ground water sources is very similar to surface water quality for the associated drainages, reflecting close interaction between the two systems. Water quality for perched ground water sources, stored mine water, and the regional ground water aquifer system reflect some degradation relative to surface water sources due to contact with and dissolution of soluble minerals and salts in the geologic sequence.

A relatively short flow path between the recharge area and discharge point for most perched ground water results in limited water quality degradation. The total dissolved solids (TDS, typically soluble salts) concentrations of springs issuing from the Flagstaff or North Horn Formations are generally less than 500 mg/L. Springs issuing from the Price River Formation generally contain TDS concentrations of 800 to 100 mg/L. Generally, for both stored mine water and the regional ground water aquifer, water quality degradation (relative to TDS levels) is greater the deeper in the geologic sequence the water is found. There is some potential that interception of ground water by the abandoned mine workings may reduce further downward percolation and resulting degradation of water within the regional ground water aquifer.

Available water quality information is summarized in Appendix A, Ground Water Quality Summary. The following discussions summarize important information relative to existing ground water conditions in the permit area.

pH - Field pH measurements range from 7.6 to 9.3, indicating neutral to moderately alkaline conditions. High pH values are relatively common in the arid western United States and are reflective of the geochemistry of the dominant stratigraphic units.

Electrical Conductivity (EC) - Ground water EC values vary widely, with field measurements ranging from approximately 1200 to 3,350 μmhos/cm. Generally, lower EC values are associated with near-surface ground water sources including alluvial/colluvial and perched ground water occurrences, while high EC values are associated with either relatively deep regional ground water sources or moderate to highly permeable marine sediments.

Total Dissolved Solids - Measured ground water TDS values range from 1,270 to 2,450 mg/l. Observed high EC values as described above are directly correlated to elevated TDS values. The observed variability in TDS values is a reflection of the highly variable lithologic composition of area bedrock. The more permeable sandstones with limited cementation have few soluble components and any ground water associated with these units will typically have very low TDS content. The more highly consolidated marine shales and fine-grained siltstones have low permeability and greater concentrations of salts and other soluble components resulting in longer residence times and greater potential for dissolution and salt loading.

Iron - Concentrations of dissolved and total iron range from <0.01 to 0.39 and 0.17 to 15.7 mg/l, respectively. Given that many of the lithologic units in the area show visible evidence of iron cementation, it is reasonable to assume that the observed iron concentrations are related to natural sources and processes of weathering and oxidation.

Magnesium - Concentrations of magnesium range from 19 to 140 mg/L, which are consistent with natural concentrations in sedimentary sequences in the southwest.

Oil and Grease - Oil and grease concentrations range from 1 to 6 mg/L. These values are at or slightly above the detection limit and may be a reflection of naturally occurring petroleum in the sedimentary sequence or constituents used during the construction and installation of the monitoring wells.

3.2.2 Surface Water

Both surface and ground water hydrologic features and regimes within the proposed lease and associated permit and adjacent areas are reflective of and strongly influenced by geologic structure, stratigraphy, lithology, and localized topography and climatic conditions.

The climate in the proposed lease and adjacent areas is arid to semi-arid. The area is in a mean annual precipitation belt of 13 to 25 inches (USGS, 1978). The mean annual precipitation for the area is approximately 14.84 inches. Average monthly precipitation ranges from 0.65 inches in June to 1.86 inches in September (Utah State University, 1994). Most of the precipitation falling as snowfall occurs during December, January, February, and March. Precipitation falling as rainfall, commonly high-intensity short-duration storms of limited areal extent (Butler and Marsell, 1972), occurs during spring, summer, and fall, with August, September, and October receiving the maximum moisture. Temperatures in the proposed lease area are seasonal, with the high mean monthly temperature occurring in July and the low mean monthly temperature occurring in January (NCC, 1975). Evaporation and infiltration rates in the proposed lease and adjacent areas vary with vegetation, soil type, and time of year. The average annual potential evaporation in central Utah is 40 inches per year (Geraghty, et al., 1973). Net infiltration rates for unfrozen soils under similar conditions to those found in the region are around 0.50 inches per day (Gray, 1973).

Generally, the topography in the area is very rugged, with high plateaus to the north and steep and narrow ridgelines cut by deep drainages in the permit area and surrounding areas to the east, west, and south. The rugged terrain and the characteristics of dominant soils and formations which outcrop in this area combined with the semi-arid climate influence the surface drainage configuration and flow characteristics. Most drainage channels contain no flowing water except during snowmelt or precipitation events. The steep slopes and numerous deep, narrow drainages result in rapid runoff rates. This rapid runoff from snowmelt and thunderstorm precipitation causes relatively brief, high velocity flows in the smaller drainages, and significant flow variation in the larger drainages. Velocities in natural stream channels during 100-year floods calculated for various representative stream channels in the area were found to range from 15 to 25 ft/sec (Earthfax Engineering, 1994). Measured stream flows in the area range from 1.0 to 450 cfs in the Price River, 0 to 11.4 cfs in Sulphur Canyon, and 0 to 335 cfs in Willow Creek (USGS, 1993). Runoff from storm events typically carries heavy sediment loads. During 1994, during ongoing surface water monitoring by CPMC, total suspended sediment concentration ranges of 1,150 to 3,790 mg/l were measured in area surface waters following large storm events. These intermittent high-velocity flows limit the deposition of alluvial material in area flow channels while the steep, rocky cliffs, which form a dominant topographic feature of the area, contribute to significant deposits of large, blocky colluvial material on the lower slopes and in the steep-sided drainage valleys.

Willow Creek drains an area of approximately 49,540 acres. The headwaters are east and north of the proposed lease area, draining the southern flanks of Reservation Ridge. Elevations range from approximately 9,100 feet to 6,100 feet at its confluence with the Price River. Willow Creek is one of the primary tributaries of the Upper Price River drainage. Total drainage length is approximately 9.3 miles. The average annual basin discharge for Willow Creek at its mouth is approximately 6,500 acre-feet (Earthfax, 1994).

3.2.2.1 Surface Water Resources

Other than the Price River, surface water resources in the permit area are limited. The principal perennial streams located within or adjacent to the permit area boundary include: 1) Price River, the dominant drainage; 2) Sulphur Canyon, which is tributary to the Price River upstream of the permit boundary; 3) Willow Creek, which is tributary to the Price River, and drains the majority of the permit area; 4) Mathis and Deep/Buck Canyons (certain reaches), and Antone Creek which are all tributary to Willow Creek within the permit area; and 5) Summit Creek, which is tributary to Willow Creek upstream of the permit area, but drains portions of eastern extremes of the permit area. Numerous intermittent and ephemeral channels drain the area, many of which normally exhibit continuous flow only in response to spring snowmelt and/or high intensity thunderstorms.

Presently, beneficial surface water uses in the area include domestic water supply, industrial uses, and agriculture. A number of existing water rights allow withdrawal of water from the Price River or from shallow alluvial wells on the Price River for beneficial use. Streams are classified as either 1C, "Protected for domestic purposes with prior treatment by complete treatment processes"; 3A, "Protected for cold water species of fish and other cold water aquatic life"; or 3C, "Protected for non-game fish, and other aquatic life".

3.2.2.2 Surface Water Quality

Water quality varies as a result of the different lithologic compositions of the area bedrock, the composition of contributing ground water, and the flow regime. Surface water conditions are typical of arid regions of the western United Sates. Seasonal or storm-event peak flows tend to dilute geochemical constituent concentrations. During low-flow periods, however, constituent concentrations tend to increase. For those constituents that appear to show elevated levels, it is reasonable to assume that the elevated levels are a result of natural sources and the processes of weathering, oxidation, erosion, evaporative concentration, and sediment transport.

Surface waters exhibit some variability, but in general, display a calcium-bicarbonate chemical type. Surface water in the Price River is a calcium-bicarbonate chemical type whereas surface water in Willow Creek is a mixed chemical type. Ephemeral/intermittent tributaries also have water exhibiting a calcium-bicarbonate chemical type. Springs/seeps are typically a calcium-bicarbonate type. However, some springs/seeps display a calcium-sulfate or sodium-bicarbonate chemical signature.

Surface water quality also varies temporally and variances generally appear to be flow dependent. Typically, constituent concentrations decrease during high flow periods and increase during low flow periods. Specific conductivity, total dissolved solids (TDS), and sulfate concentrations all appear to decrease during high-flow conditions and increase during low-flow conditions. Observed iron concentrations, however, do not show flow dependency, tending to increase with higher flows and decrease under low flow conditions.

The Price River exhibits slightly different water quality than that of Willow Creek and the intermittent/ephemeral tributaries. Generally, mean constituent concentrations are lower in the Price River than in other area surface waters. Most chemical constituents exhibit a flow dilution relationship and with increased flows, the concentrations tend to decrease. This process controls constituent concentrations in most surface waters and this relationship potentially skews the data to suggest that the Price River water is of better quality than that of other area surface waters.

Surface water quality is summarized in Appendix B, Surface Drainages - Water Quality Summary. The following discussions summarize important information relative to existing surface water conditions in the proposed permit area.

pH - Measured pH values range from 6.9 to 9.6, indicating neutral to moderately alkaline conditions. High pH values are relatively common in the arid western United States and are reflective of the geochemistry of the dominant stratigraphic units. When pH values for stations above and below existing mine disturbance areas are compared, available monitoring data indicates no significant variance and thus no significant impact from these activities.

Phenols - Elevated phenol levels in several samples cannot be traced to any known disturbance activities. Since phenols are one of the common reaction products resulting from natural oxidation and in-situ combustion of coal, it is believed that the observed elevated phenol levels may be due to natural processes.

Sulfate - Natural sulfur springs have been identified in Sulphur Canyon, Willow Creek, and a number of other area drainages and the presence of hydrogen sulfide gas (H_2S) has been documented in area wells. In essentially all cases, elevated sulfate values can be tied to natural upstream sources.

Total Dissolved Solids - Observed high TDS values appear to reflect two basic characteristics of area surface and ground water systems. The first contributing characteristic is the direct discharge of shallow perched ground water systems to surface drainages. As a component of the areas rugged terrain, many of the upper stratigraphic units outcrop in the deep natural drainages which divide the area. If these units have sufficient permeability to store and transfer ground water, they act as localized perched aquifers and commonly discharge to surface drainages within a relatively short distance from their recharge area. This mechanism results in direct transport of soluble minerals to the surface water system. The second contributing characteristic is the effect of extended dry periods which may significantly reduce stream flows, minimizing dilution of high TDS from ground water contributions and concentrating existing dissolved solids in remaining flows.

Total Suspended Solids - Given the topography and climate of the area, high TSS values may normally be expected during spring runoff and following major thunderstorms. Extremely steep natural slopes and channel gradients combined with short duration, high-intensity flows due to snowmelt and major thunderstorms result in significant surface erosion and sediment transport. Weathering and mass wasting of the exposed rock outcrops also results in significant colluvial deposition on the lower slopes and in drainages with the smaller fractions of the colluvium being mobilized and transported by storm runoff and resulting drainage flows.

Iron - Elevated iron values have been observed in surface water quality samples from several area drainages. Given that many of the lithologic units in the area show visible evidence of iron cementation and the direct correlation between elevated iron levels and high levels of suspended solids, it is reasonable to assume that in most cases the observed elevated iron levels can be correlated to natural sources and the processes of weathering, oxidation, erosion, and sediment transport.

3.3 SOIL RESOURCES

The USDA-SCS General Soils Map - Carbon County Area, Utah, shows the following three general soils types as occurring within the boundaries of the proposed lease area and the associated Mine permit area:

- Type 7 - Strych-Gerst-Travessilla: Shallow to very deep, well drained, nearly level to moderately steep soils, on outwash plains, benches and mesas
- Type 10 - Travessilla-Rock Outcrop-Midfork Family: Shallow to very deep, well drained, steep and very steep soils and rock outcrop, on mountain slopes and canyon sides
- Type 14 - Beje-Trag-Senchert: Shallow to very deep, well drained, gently sloping to moderately steep soils, on plateaus and mountain valley floors

Type 10 is found over approximately 85 percent of the planned permit area and is found in nearly all areas except a portion of the extreme northeast corner of the permit area and a narrow tier along the southern edge of the permit area. Type 10 soils are also the dominant soil type on the proposed coal lease area.

Mapping for all soils within the project area is presented in the USDA-SCS report, "Soil Survey of Carbon Area, Utah" (SCS, 1988). A detailed soil survey was conducted for the planned mine surface facilities area by Mr. Kent Crofts of Intermountain Environmental (IME) in 1994. The site-specific surveys involved identification of individual soil series as well as all existing disturbance at a mapping scale of 1- inch equals 200 feet. The most significant aspect of this mapping relative to accurate characterization of existing site soil conditions is the resulting documentation of the location and extent of previously disturbed soils.

3.4 VEGETATION

There is considerable variation in vegetation resources over the Mine permit area, with vegetation types ranging from low elevation salt desert shrub to montane coniferous stands. Changes in elevation, with associated moisture and temperature gradients have a major influence on vegetation types in the area. Topography, aspect, soil type, past and present land uses, historical grazing management practices, and historical range fires are also significant factors affecting plant community distribution. Vegetation in the proposed lease area is dominated by vegetation communities characteristic of steep, dry slopes and upland areas, although limited occurrences of all other vegetation types except disturbed communities are present.

Dominant vegetation types for the Book Cliffs area in the vicinity of the proposed lease area and the associated Mine permit area include Sagebrush-Grass, Mountain Brush, Pinyon-Juniper, Aspen, Conifer, Ponderosa Pine, and Riparian community types. The Riparian Community, typified by cottonwoods and willows, is generally found only along perennial and intermittent streams. The Mountain Brush Community is often interspersed with other vegetation types. The Pinyon-Juniper Community is most commonly found on lower elevation south-facing slopes. Conifer stands, dominated by Douglas Fir, Subalpine Fir and White Fir are found on protected north-facing slopes. Extensive areas of ledges, talus slopes and rock outcrops which typify the Book Cliffs result in many areas which lack any significant vegetation.

3.4.1 Vegetation Communities

A total of five major undisturbed vegetation types and a disturbed area classification have been identified as occurring within the area corresponding to the Mine permit area. The vegetation types identified as occurring within the area corresponding to the Mine permit area.

- Grass-Sage
- Mixed Brush
- Conifer
- Pinyon-Juniper
- Riparian Bottom
- Disturbed

The identified vegetation types are described in the following sections.

Grass-Sage Vegetation Type

The Grass-Sage vegetation type occurs on steep dry slopes and in the lower reaches of several of the small drainages in this area. Depending on site conditions, either Basin big sagebrush (*Artemisia tridentate spp. tridentate*) or Salina wildrye (*Elymus salinus*) are the dominant species. Along the banks of Willow Creek in the vicinity of the mine facilities area, Basin big sagebrush dominates. Along the eastern banks of the Price River and on most of the exposed knolls and ridges in this area, however, Salina wildrye is the dominant plan species. Other frequently occurring plants in this vegetation type are Western wheatgrass (*Agropyron smithii*), Cheatgrass brome (*Bromus tectorum*) and Fourwing saltbrush (*Atriplex canescens*).

Mixed Brush Vegetation Type

The Mixed Brush Vegetation Type generally occurs on relatively moist sites such as the bottoms of canyons, gulches and depressions and is typically found on moderate to well developed soils at the lower elevations near Willow Creek and along the Price River. At higher elevations however, such as in the eastern portion of the proposed permit area, it occurs over a wide range slope and aspect combinations. The visually dominant plant species for this type is Gambel's oak (*Quercus gambelli*), but Utah serviceberry (*amelanchier utahensis*) is often a co-dominant. Basin big sagebrush, Utah juniper (*Juniperus osteosperma*) and Pinyon pine (*Pinus edulis*) are often found on xeric (dry) sites, while more mesic (wet) sites frequently support Wolfberry, (*Symphoricarpos occidentalis*), Bigtooth maple (*Acer grandidentatum*) and quaking aspen (*Populus tremuloides*). Common understory plant associated with this vegetation type include Salina wildrye, cheatgrass brome, and Oregon grape (*Mahonia repens*).

Pinyon-Juniper Vegetation Type

Below the base of the Book Cliffs, such as in the area to the east of Kenilworth, this type occurs on level or gently sloping dry sites. The Pinyon-Juniper type may be characterized as open, pygmy forested type dominated by Pinyon pine and Utah juniper as the principle overstory species. Common understory shrubby species include Basin big sagebrush, Gambel's oak, Curleaf mountain mahogany (*Cerocarpos ledifolius*) and various species of Rabbitbrush (*Chrysothamnus spp.*). The most common grasses are Salina wildrye and various wheatgrasses.

Riparian Bottom Vegetation Type

The Riparian Bottom Vegetation Type is limited to the streambanks immediately adjacent to the Price River, a few small sites in the bottom of Crandall Canyon, and a very narrow zone along portions of Willow Creek in the vicinity of the proposed mine facilities area. Additionally, very limited occurrences may exist in portions of other small area drainages, although they have never been delineated or mapped.

The visually dominant tree species for this type include Narrowleaf cottonwood (*Populus angustifolia*) in the upper portions of the proposed facilities area and Fremont cottonwood (*Populus fremontii*) in the lower portions of this site. Coyote willow (*Salix exigua*) is the most common understory shrub, Redtop, (*Agrostis stolonifera*) is the most common grass species, and Yellow sweetclover (*Melilotus officinalis*) is the most common forb associated with this vegetation type.

Conifer Vegetation Type

In the general permit area, the Conifer Vegetation Type is typically found at higher elevations, on north-facing slopes, and in some drainage bottom areas. The most common tree species associated with this type is Douglas fir (*Pseudotsuga mezieii*), although Subalpine fir (*Abies lasiocarpa*) and White fir (*Abies concolor*) can be locally dominant depending on site conditions. The density of tree canopy cover is the primary influence on the site-specific composition for this vegetation type. Relatively dense conifer stands typically have a very sparse understory with understory species typically being limited to Wolfberry, Oregon grape, and Salina wildrye. Open conifer stands generally have relatively more shrubs and grasses in the understory and often resemble the Mixed Brush Vegetation Type in appearance.

Disturbed Vegetation Type

Mining and related activities have been conducted for over a century in the proposed surface facilities and nearby areas, resulting in a long sequence of development activities and significant related surface disturbance. Active mining operations in this area occurred more or less continuously from 1890 through 1972 when the final active mine closed.

Three basic categories of disturbance exist in this area: 1) Mining related disturbance which occurred prior to August 3, 1977 and which has not been further affected by subsequent mining or reclamation activities; 2) Areas disturbed or utilized for mining related activities after August 3, 1977; and 3) Non-mining related disturbances associated with highway, railroad, powerlines, utility, or other non-mine related development and activities. The 1981 Mariah Associates field investigations did not include sampling and characterization of the disturbed sites but the resulting report did include the following statement regarding these areas:

> "... most disturbed sites are in such condition that vegetation growth is limited, if it is allowed at all. Although isolated patches of species usually associated with the various natural vegetation types occur within and on the edges of adjacent disturbed areas, most species growing in these sites are primary successional species and are considered weeds: *Salsola kali, Kochia scoparia, and Convolvulus arvense. Chrysothamnus nauseosus,* a shrub species that invades disturbed sties, commonly grows on the edges of disturbed areas..."

3.4.2 Vegetation Types

Breaking the Disturbed Vegetation Community classification into the three disturbance categories noted in the preceding section, a total of seven vegetation types have been identified as occurring within the permit area. Occurrences of all of these types have been previously disturbed in connection with mining and related activities conducted by Price River Coal Company, Castle Gate Coal Company, Blackhawk Coal Company, and the AMR project in the facilities area. Four of these vegetation types (Grass-Sage, Mountain Brush, Pinyon-Juniper, and Conifer) were sampled in conjunction with the 1981 Mariah Associates vegetation studies and three more (Pre 8/3/77 Mining Disturbance, Post 8/3/77 Mining Disturbance, and AMR Reclaimed Sites) have been sampled as part of the supplemental 1994 field work.

A total of 282 different plant species have either been encountered in the previous vegetation sampling or have been reported in site-specific vegetation literature as occurring in association with the vegetation plant community types occurring with the Willow Creek Mine permit area. Of these 282 species, 239 (85 percent) are considered to be naturally occurring or native plants to this area. Forty three species (15 percent) of the flora of this site can be considered as introduced species which are not native to this area. Of the 43 introduced species, 10 are grasses, 28 are forbs, 4 are shrubs, and one is a tree.

3.5 FISH AND WILDLIFE

Because it is primarily an upland area, the proposed coal lease area does not offer any significant fish habitat other than that associated with the Price River near the western boundary of the area. The associated mine permit area, however, does provide a variety of fish and wildlife habitat values as described in the following sections.

3.5.1 Aquatic Resources

Site-specific aquatic studies were conducted on October 10 through 12, 1994, June 28 through 29, 1995, and October 10, 1995, to provide habitat, benthic macroinvertebrate, and fisheries information for Willow Creek. Six sampling locations were used to characterize aquatic biota, while seven locations were examined for aquatic habitat.

Fish

Willow Creek is considered to be a Class 4 fishery by UDWR, which is defined as a stream with low recreational fishing potential. Game fish species expected to occur in Willow Creek include rainbow trout (*Oncorhynchus mykiss*), Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), and brown trout (*Salmo trutta*). Two of these species, rainbow trout and Yellowstone cutthroat trout, were collected in at least one of the 1994 and 1995 site-specific surveys. Based on the electroshocking survey conducted at six locations on October 12, 1994, only one rainbow trout (total length = 8.5 inches) was collected. Subsequent fish population surveys on June 28 and 29, 1995, resulted in collection of four rainbow trout. Additional qualitative sampling for trout was conducted in the lower portion of Willow Creek during October, 1995. A total of six rainbow trout and one cutthroat trout were collected in a 500-ft section of the stream. Since spawning conditions are poor in this section of Willow Creek, the primary use by trout species is considered to be as a migration route (Phippen 1994). Rainbow and Yellowstone cutthroat trout are suspected to move from the Price River into Willow Creek and other tributaries during their spring spawning periods (usually early May through June for Yellowstone cutthroat and mid-March through June for rainbow). Brown trout move into tributary streams in October. After spawning, adult fish migrate back to the Price River. Trout in Willow Creek may also originate from upstream sources. Prior to 1994, fingerling rainbow trout were stocked in the upper portions of Willow Creek. UDWR may continue future stocking of rainbow trout in Willow Creek; however, no formal plan exists at this time (Christopherson 1994). During high flow periods, trout may be washed downstream into the lower portions of Willow Creek.

The Price River is also considered a Class 4 fishery. Game fish populations in the Price River downstream of the Willow Creek confluence are comprised of both warmwater and coldwater species. Game fish species include

brown trout, Yellowstone cutthroat trout, rainbow trout, and channel catfish (*Ictalurus punctatus*). The section of the Price River from Helper to Price is characterized by relatively low flows due to irrigation diversions. UDWR surveys have shown that trout numbers are relatively low in this stretch. Based on an electroshocking survey conducted near Helper in 1987, 7 and 28 trout were collected at two sampling locations (Janssen and Donaldson 1987). As a result of return flows, a more diverse fish community exists downstream of Wellington. Trout and channel catfish numbers are higher in this section of the Price River, compared to the section from Helper to Price (Christopherson 1994). Fingerling rainbow trout and brown trout are stocked in the Price River by UDWR. Yellowstone cutthroat trout, an introduced species, occurs in the small tributaries to the Price River. This species is no longer stocked in the Price River drainage.

Non-game fish species in Willow Creek consist of speckled dace (*Rhinicthys osculus*) redside shiner (Richardsonius balteatus) mountain sucker (*Catostomus platyrhynchus*), and bluehead sucker (*Catostomus discobolus*). The results of the October 1994 and June 1995 surveys indicated that species abundance varied from 5 to 30 individuals/300-ft section at the six sampling locations. Mountain sucker and speckled dace were the most widely distributed and abundant species during all surveys. Non-game fish species in the Price River downstream of the Willow Creek confluence are similar to regional lists. UDWR surveys have collected flannelmouth sucker, mountain sucker, bluehead sucker, mottled sculpin, carp, Utah chub, longnose dace, speckled dace, and redside shiner (UDWR 1981; Janssen and Donaldson 1987).

Macroinvertebrates

The results of the October 1994 macroinvertebrate sampling in Willow Creek revealed relatively low macroinvertebrate densities and number of taxa at all locations. Total densities ranged from 12.5 individuals/ft^2 to 53 individuals/ft^2. Using the rating criteria developed for fish food (i.e., macroinvertebrate) abundance by Binns (1982), total densities represented a rating of 0 (<25 individuals/ft^2) and a rating of 1 (25 to 99 individuals/ft^2). The number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa (referred to as the EPT Index) and the EPT abundances also were low at all locations. Since relatively low densities and few taxa were shown for these indicator groups, water quality and habitat conditions were considered low quality. The drought conditions in 1994 also likely contributed to the low macroinvertebrate productivity.

Sampling was repeated in October, 1995 to characterize the macroinvertebrate community during a year when persistent flow was present in Willow Creek. In comparison to 1994, macroinvertebrate abundance increased slightly at all locations in 1995, with mean densities ranging from 54 individuals/ft^2 to 138 individuals/ft^2. In spite of these increases, the Binns (1982) rating for macroinvertebrate abundance remained low (1). The increased macroinvertebrate abundance in 1995 was mainly the result of higher number of Ephemeroptra, Plecoptera, and Trichoptera. The number of taxa for these three groups also increased, as indicated by an EPT Index ranging from 8 to 14.

Shannon species diversity indices were calculated for each sampling location, which provided an indication of the density distribution among the various taxa. Diversity values less than 2 generally indicate a possible stressed biological community, as shown by the dominance of relatively few taxa. In October, 1994, the upstream locations showed mean diversities ranging from 1.78 to 2.31. In contrast, diversity indices at the downstream locations were lower, with values from 1.15 to 1.66. Species diversities also were relatively low in October, 1995, when indices ranged from 1.61 to 2.14.

3.5.2 Aquatic Habitat

Aquatic habitat in the lower portion of Willow Creek is limited due to the presence of a silt/clay layer on the rock surfaces, small size of the steam, relatively low flows during most months, and limited amounts of cover provided by substrates, instream debris, and overhanging riparian vegetation. The abundance and diversity of fish and macroinvertebrate communities in Willow Creek are a reflection of the limiting habitat conditions. The presence of the thick silt/clay layer on the stream substrates limited the development of a productive and diverse macroinvertebrate community. Drought conditions in 1994 also likely contributed to the low fish and

macroinvertebrate numbers and diversity although survey numbers were not significantly different during 1995, which was a much wetter year. Increased surface flows in average and wet years would provide some additional cover and habitat for fish and macroinvertebrate communities, although cover is still expected to be limited.

3.5.3 Wildlife

The proposed lease area, associated Mine permit area, and adjacent areas encompass a portion of the far western reach of the Tavaputs Plateau and drain to the Price River which is tributary to the Green River which in turn flows to the Colorado River. Potential vegetation communities and habitats in this area include the Douglas-fir forest (*Pseudotsuga*) at the higher elevations, pinyon-juniper woodland (*Juniperus-Pinus*) and Great Basin sagebrush (*Artemesia*) at mid-elevations, and saltbush-greasewood (*Atriplex-Sarcobatus*) and sagebrush steppe (*Artemesia-Agropyron*) at the lower elevations. In descending order these communities are encompassed by the montane (Canadian and Hudsonian life zones), sub-montane (Transition life zone), and cold desert (Upper Sonoran life zone) ecological associations. For each of these communities, wildlife occurrence and relative utility as habitat varies dependent on which wildlife species are being considered, however, riparian bottom areas generally offer the highest level and greatest diversity of habitat values. In addition to the identified vegetation communities and ecological associations two physical attributes common in this area: 1) Disturbed areas; and 2) Areas of exposed rock; either provide or limit distinct requisite habitat values.

Designated habitat values which exist in the vicinity of the project area include bald eagle wintering areas, sage grouse year-long range, elk winter range, crucial mule deer winter range, and high priority mule deer winter range. Bald eagle wintering areas are located several miles to the south of the proposed Mine permit area and the UDWR has indicated that no historic nesting activity has occurred in this part of Utah and foraging requisites for successful bald eagle nesting are not available in the immediate area. Sage grouse are year-round residents of the high plateau areas in the vicinity of the proposed lease and permit areas, however, the closest known sage grouse use areas are several miles north of the proposed permit boundary. Elk are occasional inhabitants of the West Tavaputs Plateau with substantial use areas being concentrated in the sub-montane and montane zones. While almost the entire proposed permit area falls within designated elk winter range, the UDWR has indicated that substantial elk use of areas other than the high plateaus (Douglas-fir forest), and high ridgelines (Piñon juniper and Great Basin sagebrush) would normally occur only on an occasional basis, typically as a result of unusually severe winter weather conditions. Mule deer are common year-round residents of this area and some vertical migration occurs in response to seasonal changes. The northeast portion of the proposed mine permit area is designated a crucial mule deer winter range and much of both the proposed lease and permit areas are designated as high priority mule deer winter range.

The proposed project and adjacent areas provide suitable habitat for a wide range of terrestrial wildlife. Based on a listing of potential inhabitants of the West Tavaputs Plateau, which encompassed both the proposed lease and Mine permit areas, 5 species of amphibians, 11 reptile species, 104 bird species, and 50 species of mammals are potential inhabitants of this area. Common inhabitants of this area include but are not limited to the great blue heron, golden eagle, blue grouse, ruffed grouse, skunk, porcupine, ground squirrel, cottontail rabbit, woodchuck, and mule deer.

It is important to note that, with the exception of mining-related subsidence, no mining-related surface disturbance will occur within the proposed lease area and surface disturbance within the proposed Mine permit area will be limited to an area of approximately 70 acres near Willow Creek, much of which has been previously disturbed. The previously disturbed areas provide substantially reduced life-requisite values for most indigenous wildlife. Native vegetation, micro-habitat and relief features, watering sources, and breeding requisites have, for most disturbed areas, been destroyed or significantly altered. In the area where the proposed mine surface disturbance will occur, habitat value and wildlife use are effectively constrained by the adjacent steep cliffs which may limit wildlife movements, previous disturbance, and proximity to Highways 191, 6 and 50, and the PacifiCorp Carbon Generating Station.

3.5.4 Threatened, Endangered, and Sensitive Species

In 1989, the UDOGM Abandoned Mine Reclamation Program (AMR) group initiated informal consultation with the USFWS regarding any listed Threatened, Endangered, or Candidate species potentially occurring within the AMR Willow Creek reclamation project area. (The AMR project area will be used as the face-up and primary facilities area for the proposed operations). In response, a listing of Federal Threatened, Endangered, and Candidate species potentially occurring in the vicinity of the AMR project area was provided by the U.S. Fish and Wildlife Service. Those species formally listed as Threatened, Endangered, or Candidates and potentially subject to project impacts, were identified as follows:

Listed Species

Bald Eagle	*Haliaeetus leucocephalus*
Humpback Chub	*Gila cypha*
Bonytail Chub	*Gila elegans*
Colorado Squawfish	*Ptychocheilus lucius*
Razorback Sucker	*Zyrauchen texanus*
Uinta Basin Hookless Cactus	*Sclerocactus glaucus*

Candidate Species

Creutzfeldt Catseye	*Cryptantha creutzfeldtii*
Yellow Blanketflower	*Guilardia flava*
Canyon Sweetvetch	*Hedysarum occidentale* var. *conone*

Terrestrial

Potential habitat for 13 Federal Candidate (Category 2) species and 5 listed Threatened or Endangered species exists within the permit area according to UDWR records and based on current listings. The five listed species include:

1) Bald eagle
2) Peregrine falcon
3) Gray wolf
4) Grizzly bear, and
5) Black-footed ferret

The black-footed ferret's habitat (prairie dog colonies) does not exist within the proposed permit area, therefore, there is no potential for existence of this species in this area. The grizzly bear has been eliminated from this part of Utah for many years, despite the existence of potential habitat. Therefore, the potential for this species to exist within the proposed permit area is also non-existent. The gray wolf was an historic resident of the West Tavaputs Plateau. At present, however, its numbers are so low that occurrence within the proposed permit area would be incidental at best, and given the animal's mobility the proposed mining and related activities would have little or no effect if a transient animal happened to take up residence in the region. The American peregrine falcon could potentially exist in the mine plan area and the steep escarpments of the Bookcliffs offer potential nesting habitat. The UDWR, however, has indicated that no nests or resident falcons are known to exist in the vicinity of the proposed permit area.

With regard to the northern bald eagle, critical wintering areas exist a few miles to the southwest of the permit area. At present, there are no known high-priority concentration areas or critical roost trees within proposed permit area boundaries, however, the proposed permit area has been classified as a substantial value use area for wintering eagles due to potential foraging opportunities. No historical nesting by bald eagles is known to have occurred in the immediate project vicinity.

Aquatic

Potential habitat for two Federal Candidate (Category 2) fish species, roundtail chub *(Gila robusta)* and leatherside chub *(G. copei)* exists in Willow Creek. Although these species historically occurred in the Price River and its tributaries, neither species has been recently identified or observed in Willow Creek (Christopherson, 1994). Sightings of leatherside chub have been reported recently in the Price River upstream of the Willow Creek confluence.

Seven Federally listed or Candidate fish species occur or could potentially occur in the Price River below the Willow Creek confluence. Potential habitat exists for three Federal Candidate Category 2 species: roundtail chub, leatherside chub, and flannelmouth sucker *(Catostomus latipinnis)*. The lower portions of the Price River near the Green River confluence contain potential habitat for four Federally listed Endangered species: humpback chub *Gila cypha)*, bonytail chub *(G. elegans)*, Colorado squawfish *(Ptychocheilus lucius)*, and the razorback sucker *(Xyrauchen texanus)*. Critical habitat also has been designated in the Green River downstream of the Price River confluence for the bonytail chub (Gray Canyon), humpback chub (Gray Canyon), Colorado squawfish (entire section between the Yampa and Colorado River confluences), and razorback sucker (entire section between the Yampa and Colorado River confluences) (USFWS, 1994). Additional critical habitat reaches also have been designated in the Colorado River downstream of the Green River confluence.

3.6 LAND USE

Land uses in the proposed lease and associated permit and adjacent areas are presently and have historically been constrained by location, topography, climate, and availability of important resource values. Rugged terrain, limited soil resources, low precipitation and seasonally harsh weather conditions, limited water resources, and existence of significant high-quality coal reserves are the primary factors which determine land use capabilities in this area. Generally, these factors limit land use options to mining, scattered oil and gas production, low-intensity grazing, wildlife habitat, limited timber production at the higher elevations, and dispersed recreational uses including hunting, fishing, hiking and similar activities. The PacifiCorp Carbon Generating Station, located adjacent to and on the west side of the permit area, represents a unique land use which is indirectly tied to the surface water and the coal resources available in the area. With the exceptions of the Carbon Station, historic and current mining activities, and limited grazing, there are no significant residential, commercial, or agricultural land uses in the permit area and adjacent areas.

The permit and adjacent areas are zoned by the Carbon County Planning department as mining and grazing, or "critical environmental". The critical environmental designation incorporates livestock grazing, wildlife habitat and certain recreational activities as the dominant uses but incorporates and does not preclude mining development.

3.7 CULTURAL RESOURCES/NATIVE AMERICAN RELIGIOUS VALUES

3.7.1 Cultural Resources

Because no surface disturbance is planned in the proposed lease area, this area was not inventoried for cultural resources, however, surface disturbance areas in the associated Mine permit area were evaluated. Generally, both pre-historic and historic use in this area have been limited to valley bottoms and the lower hillslopes by environmental factors including the arid climate, the resulting lack of significant vegetation on exposed upper slopes, and the rugged terrain. Given these factors, the potential for occurrence of any significant cultural resource values in the proposed lease area is low. Site-specific field inventories of surface disturbance areas associated with the planned Mine surface facilities were conducted during the months of June and August 1994. Field inventory work followed extensive research and review of previous studies of the area, historical accounts, and conversations with individuals familiar with the area. Field surveys involved coverage of an area of approximately 120 acres by a qualified archaeologist and a paleontologist using parallel pedestrian transects spaced at intervals of up to 50 feet to search for any evidence of cultural, historic, or paleontological values. In addition,

accessible rock outcrop exposures around the perimeter of the survey area were examined by the paleontologist for any evidence of paleontological values.

Cultural, historical, and paleontological investigations for the planned permit area resulted in identification of three previously recorded historic sites, one new cultural resource site, one new historic resource site consisting of several elements, and four new paleontological resource sites.

Research and review of previous site investigations indicated the existence of three previously recorded historic resource sites;

> **Site 42Cb580** - Located in Willow Creek Canyon on the north side of State Highway 191. a series of scattered coal waste piles and associated debris covering a total of approximately 5 acres and containing approximately 150,000 cubic yards of coal, coal refuse, and miscellaneous debris.
>
> **Site 42Cb581** - Located in Willow Creek Canyon on the north side of State Highway 191. Two large coal refuse piles mixed with fill material which have been graded and surfaced with gravel. The flat top surfaces of these piles are presently used as turn-outs along Highway 191.
>
> **Site 42Cb582** - Located in Willow Creek Canyon on the north side of State Highway 191. Four small coal piles adjacent to State Highway 191 which are presently used as vehicle pull-outs.

These sites were reclaimed in conjunction with the 1990 AMR program. These sites were not significant and therefore were not recommended for listing on the National Register of Historic Places (NRHP).

One new cultural resource site, a series of pictograph panels, was identified during the site specific field investigations. This site is described as follows;

> **Site 42Cb1001** - Located on the north side of State Highway 191. Three pictograph panels were found on a near-vertical sandstone face under a slight overhanging ledge. The three panels consist of a total of 27 human and geometric figures painted onto the sandstone surface with a reddish-brown pigment. The figures are not of the San Rafael Fremont style which is the most common rock art style found in this area, although they are similar in style to figures found at a site in Short Canyon, south of Price, Utah (Castleton, 1984 and Schaafsma, 1971).

Site 42Cb1001 contains certain distinctive characteristics and has the potential to yield important information on prehistoric of historic people and events and has been recommended as potentially eligible for NRHP listing.

One new historic resource site, including numerous elements related to the Castle Gate Mines and associated activities, was identified through site-specific field investigations. Additional features associated with both the Castle Gate Mines and Castle Gate townsite are located in Price Canyon within the existing approved Castle Gate Mine permit area but are not included under this site designation. This site and the component elements are described as follows:

> **Site 42Cb1000** - Located in Willow Creek Canyon on the north side of State Highway 191. This site consists of 42 separate features associated with historic mining activities at the Castle Gate Mines. All features or elements were included under a single site because they are temporally related. In certain cases spatial relationships also exist and the elements occur in a relatively undisturbed context, however, due to a long history of successive disturbance and more recent and extensive site reclamation efforts, most elements exist in a disturbed state and spatial relationships have been altered or destroyed.

Most of the features which make up Site 42Cb1000 retain integrity of location, materials, workmanship, and association. Although many of these features and adjacent areas have been significantly disturbed by a long sequence of mining, reclamation, and other activities, they are associated with significant historical events (i.e., the Castle Gate Mine disaster) and certain individual features exhibit distinctive characteristics and have the

potential to yield important information on historic people and events. The entire site has been recommended as potentially eligible for NRHP listing although it should be recognized that many areas of the site and even certain of the identified features have no historical importance and do not contribute to its cultural significance.

Four new paleontological localities, consisting of one or more trace fossils, were identified during site specific field investigations. These localities are described as follows:

Locality 42Cb127T - Located in a sandstone exposure within a small drainage valley on the north side of State Highway 191. An unidentified three-toed dinosaur track measuring approximately 23.5 inches long by 22.5 inches wide.

Locality 42Cb128T - Located on the north side of State Highway 191 in a sandstone outcrop above a thin coal seam overlooking Willow Creek. Several three-toed dinosaur tracks eroding out of the bottom of the sandstone exposure.

Locality 42Cb129T - Located in a large sandstone boulder at the bottom of a small natural drainage north of State Highway 191 and east of the existing face-up area. The boulder appears to have been "dino-turbated" and contains several unidentified three-toed dinosaur tracks.

Locality 42Cb130T - Located in the top of a minor coal seam outcrop which overlooks Willow Creek on the north side of State Highway 191. Several unidentified dinosaur tracks eroding from the top of the coal seam.

The individual paleontological localities do not contain unusual or unique fossil resources and so have not been recommended as eligible for NRHP listing. Since most fossils found in the Blackhawk Formation are associated with the coal seams, any unusual fossil remains (especially any fossil bone materials) encountered during mining may be important and should be evaluated if possible.

3.7.2 Native American Religious Values

Native American utilization of the project and other areas in the general vicinity covered an extended period beginning in approximately 4,000 B.C. and extending through the late 1800's. In the mid- to late-1800's the Utes, who are descended from the Numic/Shoshonean peoples, were displaced from this area by the arrival and settlement of the area by early Morman settlers. With settlement of the Utes on a reservation in the Uintah Basin, the general project area is no longer inhabited or utilized on any regular basis by Native American groups and no Native American religious sites are known to exist in the immediate area.

3.8 AIR QUALITY

The permit and adjacent areas lie within the central area of the Upper Colorado River Air Basin (Environmental Research and Technology, 1976). The central area has been divided into smaller sub-basins, each of which is characterized by meteorological conditions and related dispersion characteristics which are relatively homogeneous. The sub-basin concept, which assumes contained air flow within the basin, is generally applicable for normal air flow conditions but breaks down under storm conditions or other situations where strong regional air movements result in greater air turbulence and mixing between sub-basins and even major air basins.

Air movements in this area are strongly affected by natural drainage patterns and daily temperature variations. As local air masses cool at night, the denser cool air flows down valleys and other natural drainage channels. Generally, the winds associated with downslope movements are low to moderate, however, if the drainage alignment parallels the prevailing wind direction or if topographic features concentrate natural air flows, moderate to strong downslope winds and high intensity gusts may result. As natural warming occurs during the morning and early afternoon, warm air masses begin to move up-valley. Differential heating and upper level winds tend to have a greater impact on the upward air movements resulting in greater mixing and instability with resultant

variable winds and greater potential for gusty conditions. Normally, prevailing winds in the area are from the west and northwest, however during the winter, persistent high pressure cells which settle above the Wasatch Mountains to the north can shift the prevailing winds to the northeast for extended periods.

Carbon County, which encompasses most of the proposed permit area and adjacent areas, has been designated as an attainment area for all NAAQA primary pollutant levels indicating no significant existing air pollution problems in this area. Available monitoring data does indicate spot exceedences of secondary standards for total suspended particulates (TSP) for the areas of Price, Huntington, and Cedar Mountain, however, these exceedences are generally due to natural conditions of blowing dust and are not related to any specific development or operating activities.

3.9 SOCIOECONOMICS

Carbon County's estimated 1994 population was 21,100, which is about 2 percent more than the 1993 population and about 9 percent less than the county average in the 1980's. The State Population Estimates Committee indicates that Carbon's population peaked in 1982 at 24,300. The decline since 1982 has been a significant 3,200 or 13 percent. The county experienced out-migration annually between 1982 and 1990. Since then, population has stabilized and begun a slow increasing trend. Population projections for the County by the Utah Office of Planning and Budget show a very modest population increase of less than 5 percent by year 2000.

The economy of Carbon County is dominated by mining (primarily coal mining), sales of goods and services, agriculture, and tourism, while public sector employment, including government services and education, make up a smaller yet important segment of the economy. Mining is a major contributor to the economy of Carbon County, making up approximately 15 percent of the County's total earnings and accounting for approximately 14 percent of total employment. Recent trends in the Utah coal mining industry, however, have significantly affected employment rates in this sector. While coal production in the State of Utah increased by approximately 84 percent from 11.8 million tons/year to 21.7 million tons/year between 1983 and 1993, coal mining employment decreased by approximately 50 percent during the same period (from 4,296 to 2,162 employees) due to improvements in coal mining technology that have decreased the amount of direct labor required. Annual coal production in the State of Utah was approximately 25 million tons in 1995, but estimates for coal mining employment are not available.

CPMC's current Star Point Mine operations employ approximately 250 to 300 full-time workers; generate payroll and benefits of approximately $15 million annually; result in annual tax payments of approximately $50 million; and involve annual purchases of materials and services of approximately $25 million and royalty payments of $5 million. Based on an economic multiplier of 3:1, indirect economic benefits resulting from wages, benefits, and purchases of goods and services for the current Star Point Mine operations are estimated at $120 million.

3.10 TRANSPORTATION

The rugged terrain of the area limits routing options for major roads and utility transmission lines, consequently roads and utility lines typically follow the existing natural drainage valleys. Within the permit area, State Highway 191 follows the Willow Creek Valley from Castle Gate Junction northeast to the summit of Greyhead Peak. The highway is a paved two-lane, all-weather road which presently carries approximately 450 vehicles per day (UDOT, 1995) and has a design capacity of approximately 5,000 vehicles per day. Similarly, U.S. Highway 6 and 50 follows the Price River Valley on the western side of the proposed permit area. A major north-south rail line and several water distribution pipelines parallel Highway 6 and 50, and several electrical power transmission lines parallel the alignments of both Highways 191, and 6 and 50. An existing power transmission line extending up Barn Canyon crosses the proposed lease area. Due to access considerations and practical construction constraints, transportation and utility related development is also concentrated in valley bottom and adjacent lower valley slope areas. The narrow configuration of area drainage valleys and existing developed transportation and utility infrastructures generally precludes any significant additional development or use for this land use category.

3.11 RECREATION AND AESTHETICS

Portions of the proposed lease and associated permit and adjacent areas are utilized on a limited basis for hunting, fishing, hiking, and other dispersed recreational uses. Generally, these activities occur on a seasonal basis primarily on public lands in the area. Similar to many of the other potential uses, rugged terrain and limited access tend to minimize recreational use in this area. Availability of and proximity to much more desirable recreational areas along the Wasatch Front and in Canyonlands National Park to the south are also limiting factors. Given existing low use levels and the various limiting factors, the potential for expanded recreational use of this area is small. The closest recreational facilities are Scofield Reservoir, located approximately 25 miles northwest of the mine area, and the Price Canyon Recreation Area, located across both the Price River and U.S. Highway 6 and 50 approximately 1 mile west of the proposed permit boundary. State Highway 191, which passes by the mine surface facilities area and intersects the permit area on a northeast-southwest diagonal, is designated as a State Scenic Byway. Highway 191 runs from Duchesne to Castle Gate Junction, passing through varying terrain including the cliffs and high meadows of the Book Cliffs plateau, forested areas within Ashley National Forest, and scenic portions of Willow Creek Canyon.

The BLM characterizes the aesthetic qualities of areas under Federal management using a Visual Resource Management (VRM) rating which considers form, line, color, and texture and compares these parameters for existing conditions with anticipated values following development.

The proposed Mine facilities area is rated as a VRM Class IV area, while other areas further up Willow Creek Canyon and surrounding undisturbed areas are ranked as VRM Class III areas. The following summarizes the relevant VRM classifications and management objectives:

Class III - Moderate visual quality, partially retain existing character of the landscape, allowable modifications include moderate changes which may attract attention but do not dominate the view, changes should repeat the basic line, form, color, and texture of the landscape.

Class IV - Moderate to low visual quality, provides for management of activities involving major modification of the landscape, changes may dominate the view but efforts should be made to minimize visual impacts and repeat the basic visual elements to the extent possible.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

It is important to recognize that approval of the pending coal lease application will not, in itself, result in any direct environmental consequences. The purpose of the coal leasing application, however, is to provide access to the subject Federally owned coal reserves for mine development and coal recovery which will have potential direct, indirect, and cumulative environmental consequences. The discussions of mine development, operations, and reclamation in Chapter 2.0 and environmental resource values in Chapter 3.0 provide the basis for evaluation of the effects of coal leasing and the reasonably foreseeable related mining operations and powerline relocation which would occur as the indirect but logical consequence of coal lease application approval. Given the nature of possible powerline relocation activities and that the project proponent would be PacifiCorp rather than CPMC, analysis of related environmental impacts would be addressed under a separate EA.

The following sections summarize potential direct, indirect, and cumulative impacts of the No-Action Alternative and coal leasing as the Proposed Action. The evaluation of potential impacts takes into consideration the nature and duration of the Proposed Action and reasonably foreseeable related actions, the current condition and distribution of potentially affected environmental resources, and the nature and effectiveness of planned control and mitigation measures associated with the Proposed Action and reasonably foreseeable related actions.

4.2 NO-ACTION

The No-Action Alternative precludes issuance of the coal lease but would not limit planned development, operation, and reclamation of the Mine on existing fee and leased Federal, State, and County lands. With the planned development, essentially all of the indirect and cumulative impacts under the Proposed Action would still occur. The only significant differences between the Proposed Action and No-Action Alternatives would be that the area of concern for geologic and ground water hydrologic impacts would be reduced; royalty payments associated with the proposed coal lease would be forfeited; and the life of the mine and duration of associated employment and economic benefits would be reduced under the No-Action Alternative. It is important to note that bypassing the proposed lease tract at this time would probably result in effective sterilization of the associated reserves since the lease tract does not contain sufficient reserves to support development of a separate mine and effective mine development would probably be precluded by the significant depth of the coal seams in this area and the lack of readily accessible outcrop exposures from which mining development could occur.

4.3 PROPOSED ACTION

The Proposed Action, as described in Chapter 2.0, is approval of the pending coal lease application covering an area of approximately 2,300 acres of land owned by the United States of America and managed by the Price Resource Office of the BLM. Inherent in the proposed action are the indirect and cumulative effects of the underground coal mining and related operations and powerline relocation which represent reasonably foreseeable related future actions.

4.3.1 Geology

Potential indirect and cumulative effects of the proposed action relative to geologic resources will include extraction of the economically recoverable coal resource and consequent disturbance of the overlying rock strata due to the effects of mining-induced subsidence. Coal extraction is not considered to be an adverse environmental effect and is consistent with both applicable Federal land management regulations and policies and the existing BLM Management Framework Plan for this area.

Subsidence is an unavoidable consequence of underground coal mining operations and, as described in Section 2.1.2.5, Subsidence Control and Monitoring, the planned mining operations have been designed and will be implemented and monitored to both minimize and provide for controlled ground subsidence. Coal extraction thickness will range from approximately 5 to 13 feet resulting in potential maximum subsidence of 3.5 to 9.1 feet assuming the projected maximum subsidence rate of 0.7 times extraction thickness. It is important to note that this is the maximum potential subsidence with full extraction. In reality, practical operational limitations on coal extraction, increased mining depth, and the massive sandstones previously discussed will probably result in actual subsidence which is considerably less than this maximum value.

Surface evidence of mining-related subsidence is expected to be minimal since most of the planned mining will occur at depths of 700 to over 2,000 feet, averaging approximately 1,800 feet and the occurrence of several relatively massive high-strength sandstone units in the overlying stratigraphic sequence which will probably limit vertical deformation. Use of the planned longwall mining method inherently provides the greatest amount of control over the area and rate of subsidence. Associated subsidence is typically uniform, consistent with a relatively uniform coal recovery thickness and occurs progressively with panel extraction, minimizing potential differential settlement. Experience indicates that approximately 90 percent of longwall-related subsidence occurs within 2 to 3 years following completion of mining.

No significant material damage or diminution of use of either existing structures or renewable resource lands due to mining-related subsidence is anticipated. The only structure which will potentially be impacted by mining subsidence is an existing power transmission line extending up Barn Canyon. This line will be relocated to an adjacent canyon which will not be affected by mining activities. In the unlikely event that any other significant damage or diminution of use does occur, CPMC will repair or mitigate the damage or diminution of use to the extent technologically and economically feasible within reasonable limits. This may involve repairing, replacing, or providing reasonable compensation for any damaged structure and restoring the land or providing alternate lands or compensation consistent with the value and reasonably foreseeable use of the affected lands.

In the proposed coal lease area the potential for any significant surface effects due to mining-related subsidence is expected to be minimal due to the relatively high overburden cover depths in this area and normal subsidence mechanisms. Any minor surface subsidence which does occur should not adversely effect environmental resources since the proposed lease area is an relatively rugged upland area utilized primary as wildlife habitat and no critical resource values are known to exist in this area.

Gradual depletion of area coal resources due to ongoing coal mine development and extraction will be the primary potential cumulative impact relative to geologic resources under either the No-Action or Proposed Action Alternatives. While resource depletion is a concern, there is an estimated reserve base of approximately 737 million tons of in-place reserves in the immediate area and 1.907 billion tons of coal reserves for the Uintah - Southwestern Utah Coal Region (Uintah - Southwestern Utah Coal Region Draft Environmental Impact Statement, BLM, 1983). To put the resource depletion concern in perspective, the coal reserves contained in the proposed lease tract constitute less than 3 percent of the known coal reserves in the immediate area and less than 1 percent of estimated regional reserves. Resource depletion considerations will be addressed to the extent reasonably feasible by optimizing recovery and utilization of available coal reserves.

4.3.2 Hydrology

Given the nature and extent of the associated planned mining and related operations there is a potential for both indirect and cumulative impacts on surface and ground water resources relative to coal leasing approval and related actions. Potential hydrologic impacts include the following:

<u>Ground Water</u>

- Alteration of ground water flow patterns
- Drainage of seeps and springs
- Alteration of recharge/storage/discharge relationships
- Increases in the concentrations of TDS and certain individual chemical constituents

Surface Water

- Temporary increases in runoff from surface disturbance areas
- Minor reductions in surface flows and alteration of flow patterns due to operation of sedimentation structures and flow reductions due to water supply withdrawals
- Changes in surface water chemistry
- Increases in the levels of TDS, TSS, and certain individual chemical constituents

These impacts and related mitigation measures are discussed in the following sections.

4.3.2.1 Ground Water

Potential mining-related hydrologic consequences for ground water resources in the Mine permit area (including the proposed lease area) will be limited by the lack of significant ground water recharge in the area, the existence of a thick sequence of low permeability bedrock layers between the coal seams to be mined and the ground surface, the general lack of significant regional ground water movement due the absence of well defined regional aquifers, and very limited beneficial ground water use in the permit and adjacent areas.

Alteration of Ground Water Flow Patterns - Alteration of ground water flow patterns will occur as a result of underground mining excavation and consequent mine drainage. These activities will reduce the potentiometric surface in the immediate vicinity of the mine workings, which will induce ground water flow into the underground workings as the hydrologic system adjusts to reestablish a balanced potentiometric surface. Natural ground water flows in the immediate vicinity of the underground mine workings will tend to be deflected toward the mine workings under the influence of the cone of depression. This deflection of flow will provide some natural mitigation of flow alteration as flow lines converge beyond the active mining area to reestablish downgradient flow continuity at some point downdip from the mine workings. In general, reduction of the potentiometric surface near the mine workings is expected to be both minor and localized due to the relatively low permeability of the associated stratigraphic units. Additionally, ground water flow patterns in the overlying perched aquifer system may also be affected by downward leakage through subsidence fractures. This may result in partial or full drainage of the perched aquifers and may affect the discharge of springs and seeps. Impacts on perched aquifers and associated springs and seeps due to secondary subsidence effects are not expected to be significant since the perched aquifers are very limited in areal extent, potential subsidence areas represent a relative small portion of the total permit area, and beneficial use from this system is limited to a single spring (B41) located in Section 26, T12S, R10E, in the eastern portion of the permit area and well outside the propose lease area.

Upon completion of operations and final mine reclamation and closure, the underground workings will gradually fill with water, resulting in reestablishment of a potentiometric surface at approximately the same level which existed prior to mining. Any minor changes in the potentiometric surface which may occur are not expected to be significant since the overall hydrologic balance within the ground water basin will not be effected.

Reductions in the quantity and availability of ground water as a result of alterations to the ground water flow patterns are expected to represent a minor percentage of total ground water flows within the basin, will be limited in areal extent, and should be temporary in nature. In addition, reductions in ground water flows are not expected to adversely impact ground water users since primary beneficial ground water use within the permit area is limited to a single spring and general ground water use within the regional ground water basin involves stratigraphic units which are well above and are effectively hydraulically isolated from the sequence which may be impacted, by a significant thickness of low permeability bedrock.

Drainage of Seeps and Springs - The planned Willow Creek mining activities may result in some drainage and dewatering of overlying perched ground water aquifers as a result of vertical seepage through subsidence fractures. Consequently, springs and seeps discharging from those stratigraphic units containing perched ground water may be effected. Effects, however, are expected to be minimal since a detailed spring and seep survey of the entire 14,670 acre permit area identified only 3 seeps and 12 minor springs. These potential effects are not

expected to extend to the proposed coal lease area since no springs or seeps are known to exist within the proposed lease area.

Alterations to recharge/storage/discharge relationships - The planned mining, processing, and related activities are not expected to have any significant effect on recharge, storage, or discharge relationships. Recharge within the ground water basin occurs primarily along the outcrop of the various stratigraphic units as a result of direct precipitation and infiltration in outcrop areas. CPMC's operations are both limited in areal extent and are not located within any major recharge area. Mining will result in some drainage of existing stored mine water and dewatering of any saturated units encountered during mining operations, potentially affecting ground water storage relationships. However, this effect will be localized and temporary, as discussed above. Upon completion of operations and abandonment of the mine, ground water will once again accumulate in both the old and new mine workings and equilibrium ground water storage relationships will be reestablished. Discharge relationships will also be minimally affected with some temporary reduction in downgradient ground water flows as a result of filling of the underground mine workings as well as localized alterations in ground water flow patterns. The quantity of ground water discharge which will be effected is a relatively small percentage of the total volume within the ground water basin.

Increases in Chemical Constituents - As ground water encounters freshly exposed subsurface materials in the mine, oxidation and weathering will cause changes in ground water chemistry including increases in TDS and the concentrations of individual chemical constituents. Over time, these increases will stabilize and start to decrease as available soluble chemical constituents are depleted and chemical concentrations in the mine water and the exposed rock reach equilibrium. Gradual filling of the mine workings will also have a beneficial water quality effect, displacing oxygen and reducing the oxidation potential as flooding of the abandoned workings occurs.

As described in Section 3.2.1, Ground Water, ground water in both the Willow Creek permit and adjacent areas is a weak calcium-sulfate or sodium-sulfate chemical type. Increases in both sodium and sulfate constituents will not change ground water chemistry although they could result in a shift toward a more dominant sodium-sulfate ground water type. While various chemical constituents of the ground water may increase as a result of mine drainage, these increases will not affect ground water use. Due to the limited volume of ground water drainage relative to total flows within the ground water basin, minor changes in ground water chemistry and levels of certain constituents are not expected to significantly effect overall ground water quality. Use of ground water from the permit area is limited to a single surface spring and ground water use in adjacent areas is very limited due to the availability of more accessible and higher quality surface water sources. There are no known springs, seeps, or water supply wells in the immediate project vicinity which are used as domestic water supplies, therefore, no mining related impacts on water supplies or users are anticipated. As noted in section 2.4.1.3, Mining and Related Operations, CPMC does not anticipate the need to discharge mine water inflows to the surface since water recycling and underground storage should be adequate to address anticipated inflow volumes.

4.3.2.2 Surface Water

In general, potential hydrologic consequences for surface water resources resulting from coal leasing will be negligible since no direct surface disturbance within the coal lease area is proposed. Indirect impacts due to the related mining operations and associated minor surface disturbance will be limited by the generally arid climate, specific control and mitigation measures, and compliance with applicable regulatory effluent standards as administered under the UPDES program.

Temporary Increases in Runoff From Surface Disturbance Areas - Surface disturbance will result in removal of existing vegetation and consequent increases in surface runoff potential. Increased disturbed area runoff will be addressed by minimizing the area of surface disturbance, diverting upgradient runoff around mine disturbance areas, intercepting disturbed area runoff as close to its source as reasonably practicable and routing it through designed collection ditches to sedimentation ponds, and reclaiming disturbed areas as soon as operationally feasible following completion of mining. Given the relatively limited proposed surface disturbance area, potential increases in runoff will be negligible when compared with total runoff volume for the contributing drainage basin

and disturbed area runoff contributions will be buffered by detention and controlled release from the designed sedimentation ponds.

Minor Reductions in Surface Flows and Alteration of Flow Patterns - Surface flow contributions from mine surface disturbance areas may be temporarily reduced or deferred due to operation of the mine sedimentation control system which will include designed collection ditches and sedimentation ponds. Any reduction or deferral of flow, however, will be minor since total long-term storage capacity for all ponds is limited to 0.73 acre-feet and the maximum discharge interval for the ponds is 3.4 days.

Surface flows in the Price River may be slightly reduced due to withdrawal of water under existing active water rights to meet mine water supply requirements. Maximum mine water supply requirements are estimated at 730 acre-feet per year (1.0 cubic feet per second) which is well within the limits of existing water appropriations and represents a negligible reduction in total flow even under low flow conditions for the Price River.

Changes in Surface Water Chemistry - Surface waters in the project area are generally a calcium-bicarbonate water type. Exposure of surficial materials by mining-related surface disturbance and subsequent leaching may result in minor changes in the chemistry of disturbed area runoff. The most probable potential change in surface water chemistry would be a shift in water chemistry from a strong calcium-bicarbonate type toward a sodium-sulfate type. It should, however, be noted that this change would occur only for runoff from the relatively limited mine surface disturbance area and that dilution effects due to mixing with other surface runoff and natural streamflows would render any minor localized chemical changes negligible with no overall impact on the chemical character of area streams anticipated.

Increases in Chemical Constituents - Similar to the general water chemistry impacts discussed in the previous section, contact between disturbed area runoff and exposed surficial materials may result in increases in TDS, TSS, and other chemical constituents in the disturbed area runoff. Potential increases in TSS will be addressed during construction and operations through implementation and operation of appropriate drainage and sediment control measures and following active operations through reclamation of all mine surface disturbance areas. Increases in TDS and other chemical constituents should be negligible due to the limited disturbance area, the temporary nature of the proposed mining operations, and the buffering effects of natural mixing and dilution. TSS, TDS, and certain other chemical parameters will be monitored for any mine discharges and must meet applicable effluent limitations under the terms of the Mine's UPDES Permit. Since all mine discharges must pass through designed sedimentation ponds, any elevated constituents can be addressed, if necessary, using appropriate treatment measures prior to discharge to the natural drainages. As previously noted, CPMC does not anticipate the need to discharge mine water inflows to the surface system. In the unlikely event however, that such discharge would become necessary, the discharge would be passed through the mine drainage and sediment control system and would be sampled for compliance with applicable effluent standards prior to discharge to receiving waters. Given concerns relative to potential hazards to aquatic biota associated with emulsified longwall fluids, any mine water discharge would also be sampled for the presence of this material.

4.3.2.3 Cumulative Hydrologic Impacts

Ground water impacts resulting from the proposed coal leasing and associated planned mining and related activities will be minimal due to limited ground water occurrence, low overall permeabilities and consequent limitations on the effective area of influence, and the lack of beneficial ground water use in the area. Similarly, there will be no surface disturbance in the coal lease area and surface disturbance associated with the Willow Creek mining and related operations will involve such a small area that potential mining related surface water impacts will be negligible. Any potential surface water impacts will be effectively mitigated through effective control of mine water supply withdrawals, operation of a comprehensive drainage and sediment control system, compliance with applicable monitoring requirements and discharge effluent standards under the required UPDES permits, and reclamation of surface disturbance areas and restoration of surface drainage characteristics.

The cumulative impact area for evaluation of potential cumulative ground water impacts includes the permit area along with any upgradient areas which could be impacted by mining-related drawdown and downgradient areas

which could be impacted by any mining-related changes in ground water flow or quality. Given the characteristic low permeability of the geologic sequence, the limited volume and flow of ground water, and the consistent flat dip of the geologic units to the northeast, the ground water cumulative impact area can be defined by the Price River on the west and a boundary extending one mile beyond the northern, eastern, and southern permit boundary. Other activities which could result in possible contributing ground water impacts within this area are limited to contributions from the existing abandoned underground mine workings in the area; the Andalex Resources Pinnacle Mine located near the southeast corner of the permit area; and the Cockrell Oil Company coalbed methane project located to the northeast of the permit area.

A cumulative impact area for evaluation of potential cumulative surface water impacts includes the permit and adjacent areas and downstream waters which could be impacted by mining-related changes in surface water flows or quality. Given these constraints and the nature of general surface drainage patterns in the area, the surface water cumulative impact area can be defined as a boundary extending one mile beyond the northern, eastern, and southern permit boundaries and the Price River to the west from the point where the northern cumulative impact boundary intersects the river to the confluence of Hardscrabble Canyon with the Price River near Martin, approximately 2 miles downstream from any mining related surface disturbance associated with the Mine. There are a number of activities within the cumulative impact area which could result in potential contributing surface water impacts including; operation of the Price City/Price River Water Improvement District water supply and treatment plant on the Price River near Royal; the PacifiCorp Carbon Generating Station; railroad operations in the Price River Canyon; surface runoff contributions from U.S. Highways 6 an 50 and State Highway 191; the Cockerell Oil Company coalbed methane project, and mine discharge and surface runoff from the numerous historical mining operations in the area.

Within the defined surface and ground water cumulative impact areas the minor impact contributions associated with the planned mining and related operations are not significant as described under the discussions of individual impacts presented above on either an indirect or cumulative level.

4.3.3 Soil Resources

Potential indirect and cumulative effects of the proposed action on soils resources will be limited to disturbance, loss, and alteration of the physical and chemical characteristics of soils in any areas subject to new surface disturbance. Since no surface disturbance is planned in the proposed coal lease area there will be no direct, indirect, or cumulative soils impacts for this area. Potential indirect soils impacts for the associated Mine permit area will generally be limited to the planned mine surface facilities area of approximately 70 acres which will be the only area where direct new surface disturbance will occur. Potential soils impacts in the mine facilities area will be minimized by the fact that most of the area has been extensively disturbed by previous historic mining activities and by recovery, stockpiling, and replacement during reclamation of all available soil material. Relative to potential cumulative soils impacts, the area and volume of affected soils is so small as to negligible.

4.3.4 Vegetation, Wildlife, and Wildlife Habitat (Includes Sensitive Species and Associated Habitat Values)

Since no direct surface disturbance is planned in the proposed coal lease area, there will be no direct, indirect, or cumulative vegetation or wildlife impacts in this area. Potential indirect and cumulative impacts on vegetation, fish, wildlife, and related habitat values resulting from the foreseeable related mining operations and powerline relocation may include:

<u>Vegetation and Terrestrial Wildlife</u>

- Redisturbance of approximately 48.9 acres of disturbed vegetation and habitat occurring on previously disturbed areas
- Temporary loss of approximately 6.9 acres of previously undisturbed vegetation and habitat

- Displacement of mobile resident wildlife to nearby areas providing similar habitat and adequate carrying capacity
- Direct mortality of non-mobile wildlife
- Increases in indirect wildlife disturbance due to increased human activity in the area
- Increased potential for accidental wildlife losses through electrocution or traffic related mortality
- Localized reduction or elimination of certain vegetation types and altered wildlife behavioral and use patterns if existing watering sources such as springs are lost due to subsidence related interruption of ground water flow

Fish and Aquatic Habitat

- Limited sedimentation from construction activities
- Temporary loss of low quality habitat and limited riparian vegetation as a result of realignment of portions of the Willow Creek channel and construction disturbance replacement of an existing culvert crossing
- Any significant changes in stream water quality or flow rates
- Risks associated with any petroleum spills or leaks from equipment used near the stream during construction

4.3.4.1 Vegetation and Terrestrial Wildlife Resources

In general, potential mining-related impacts to vegetation and terrestrial wildlife resources will be minimized by practical limitations on wildlife use of the proposed mine facilities area, the relatively small area which will be affected by mining-related surface disturbance, the limited period of actual mining use, and effective restoration and enhancement of mine disturbance areas through site reclamation. Vegetative cover and production within the proposed lease and mine permit area is low, and no known threatened, endangered, or sensitive vegetation or wildlife species exist within, or utilize proposed surface disturbance areas for their basic life requisites. Some of the proposed lease and mine permit areas have, however, been designated as critical habitat (winter/summer range) for mule deer. Proposed disturbance will be limited to approximately 133 acres, of which 127 acres have been previously disturbed and only approximately 6 acres will represent new disturbance. The total surface disturbance, and particularly the new disturbance, are so small as to be considered negligible. In addition, extensive areas of undeveloped lands exist in the vicinity of the Proposed Action. These undeveloped areas generally provide comparable or better potential wildlife habitat than the proposed lease and mine permit disturbance areas. Following completion of mining (approximately 20 years), all surface disturbance areas will be reclaimed to conditions and values comparable to or better than the existing conditions. Both upland and riparian plant communities will be established on reclaimed lands utilizing primarily native species to provide effective cover and forage values.

Displacement of mobile wildlife due to mining-related surface disturbance will largely affect only those species and individuals animals which utilize the limited area encompassed by the mine surface facilities area. At this time, terrestrial wildlife use of this area appears to be limited to a few rodent species, lagomorphs, mule deer, and a limited number of bird and bat species. Most other terrestrial wildlife have already been displaced by prior disturbance and do not appear to have reestablished in the area due to limiting habitat values and existing levels of human activity. Given that the numbers of potentially displaced wildlife will be extremely small due to limited populations and the small total surface disturbance area, the ability of the surrounding habitats to absorb these immigrants should be more than adequate. Increased levels of human activity may result in indirect wildlife impacts including some alteration of diurnal and seasonal animal movements. The impacts of increased human activity will be minimized by limiting both the total area of surface disturbance and by limiting essentially all surface activities to this area.

CPMC has designed and will construct any mine-related power transmission lines in accordance with applicable guidelines. These guidelines specify pole and transmission line configurations which isolate the ground wire minimizing the potential for simultaneous contact with a live and ground wire, by a raptor or other bird approaching or landing on the support poles or cross beams. Recognizing that deer and other large mammals may move through and temporarily utilize the proposed surface facilities area, CPMC has designated conveyor structures to provide at least 40-inches of clearance so they are not a barrier to animal movements; will limit

speeds on mine roads to 25 miles per hour to minimize the potential for vehicle-deer collisions; and have modified the seed mixture for areas adjacent to the highway to avoid attracting wildlife to this area.

During the period of active operations, CPMC will work closely with UDWR biologists from the local Price Office to develop and maintain a program for reporting any significant wildlife observations in the proposed permit area. As part of an ongoing employee training and communication program, CPMC employees will be instructed to report any incidents of accidental wildlife mortality or eagle sightings to the Willow Creek Environmental Coordinator. CPMC will also coordinate with UDWR and private sector biologists to perform periodic raptor monitoring surveys if it is determined that mining and related activities have significant potential to adversely affect raptor breeding in the area.

While there are no known raptor nests within the proposed lease area, six known golden eagle nests are within a half-mile of the proposed mine surface facilities area. Limitations on construction activities in proximity to these nests during the nesting period could have a major impact on the overall development and construction schedule. Given potential construction and future operations-related impacts to these nests, CPMC initiated formal consultation with the USFWS and UDWR. Based on initial consultation, CPMC will evaluate visibility from the nest sites of both proposed construction sites and Highway 191; evaluate elevation differences between the nests and the proposed construction sites; evaluate possible scheduling options for specific construction activities; evaluate the need for one or more "takings permits" which would involve the use of physical deterents (mesh covering or other) to temporarily prevent use of a nest; and develop a plan to address potential eagle nesting impacts and concerns.

A portion of the potentially disturbed area falls within critical or important winter range for mule deer. While all disturbed areas would be on fee land, wildlife mitigation would be performed by CPMC to reduce impacts. A number of mitigation options have been identified and are being evaluated by CPMC in conjunction with the UDWR. These options include the following:

- Retreatment of an old chained area in critical winter range east of the town of Kenilworth: This area is on BLM land and was chained many years ago. Shrubs, pinion, and juniper are reinvading the area and reducing its usefulness for wildlife. Treatment would include roller chopping the shrubs and trees and reseeding the area. An EA, which could involve one to two years of analysis, would be required for these activities. This option would not meet the mitigation schedule for the Willow Creek Mine.

- Reseeding one or two areas of land in critical winter range in the Gordon Creek area: This area is on UDWR land. Enhancement of the vegetation is desirable to provide winter feed for deer and elk in the area. Treatment would consist of seeding the areas with native and wildlife desirable plant species to enhance the range. Treatment could be accomplished during the spring and fall of 1996.

- Placement of water harvesting devices in summer range on the ridge south of the mine site: This area is on CPMC land south of Highway 191 in summer range for deer and elk. There is minimal water in the area and use by deer and elk is limited. Treatment would include placing several water harvesting devices (such as guzzlers) in areas that would extend the range for wildlife. This project could be completed during 1996.

- Willow Creek stream enhancements: This area includes Willow Creek in the vicinity of the mine site or upstream of the mine site. Treatment could include removing barriers to fish migration or other habitat enhancements to the stream. Specific elements of this option are still being considered by UDWR.

CPMC will continue to discuss mitigation options with the UDWR with the commitment to conduct mitigation activities during the summer/fall of 1996. This time period corresponds with the planned construction period for the Willow Creek Mine facilities.

The potential also exists for reduction or elimination of certain vegetation types and alteration of patterns of wildlife behavior, use, and movement in certain areas if historic watering sources such as springs dry up due to subsidence related changes in ground water flow. The potential for adverse effect would be very site specific and would depend on the flow volume, normal flow period, and the existence of other potential water sources in the immediate area for given vegetation types and herds, groups, or species of wildlife. The potential for such effects as evaluated through baseline studies, ongoing hydrologic monitoring, and mine planning and associated subsidence predictions are negligible for the proposed lease area since no springs or seeps have been identified in this area and are minor for the associated mine permit area as discussed in Section 4.3.2.1, Ground Water.

4.3.4.2 Aquatic and Riparian Resources

With the exception of a short segment of the Price River which forms the western boundary of the proposed coal lease area and which will not be disturbed, there are no aquatic or riparian resources in the coal lease area and, consequently, there is little or no potential for direct, indirect, or cumulative impacts on resources in these categories due to coal leasing. Realignment of two short segments of Willow Creek, and the construction activities associated with replacement of the existing culvert crossing would result in localized surface disturbance, increased runoff, and possible increased sedimentation to Willow Creek and the Price River for a short period. Scheduling of required construction activities to avoid disturbance of the natural channel during the peak flow period and the use of alternative sediment controls should effectively minimize potential sediment contributions. The construction of other mine surface facilities may result in minor temporary increases in runoff and erosion. Sediment contributions, however, will be controlled by a combination of designed drainage and sediment control structures established prior to construction disturbance and temporary control measures.

Construction of the realigned stream segments will result in the temporary loss of low quality habitat and limited riparian vegetation in the two existing stream segments which will be affected. Construction activities for replacement of the existing culvert crossing will result in relatively limited, temporary disturbances to aquatic and riparian habitat values. The existing segments of the Willow Creek channel which will be replaced represent habitat for benthic macroinvertebrates, resident fish (mountain sucker and speckled dace), and migratory routes for several trout species (brown trout, Yellowstone cutthroat trout, and rainbow trout) and support very limited riparian vegetation in a thin zone bordering the channel margins. The loss of existing marginal stream habitat values and limited riparian vegetation due to stream realignment will be effectively mitigated by construction of designed channel segments and revegetation with riparian and other suitable vegetation species. The designed channel segments will have similar hydrologic and geomorphic characteristics as the existing stream segments which they will replace but they will incorporate specific design considerations and construction practices which will result in significant overall enhancement of long-term channel stability, aquatic habitat values, fish resting and feeding habitat, and increases in the extent of valuable riparian vegetation.

Aquatic and terrestrial wildlife mitigation and enhancement measures associated with proposed realignment of two channel sections and replacement of the existing culvert crossing will include the following:

- Replacement of a marginal stream channel and very limited floodplain with a well defined channel and expanded floodplain zone (results in a net increase of approximately 6,200 square feet of floodplain and riparian habitat)
- Replacement of shallow riffle-dominated zones with a series of riffle-pool and step-pool zones which are more conducive to both macroinvertibrate and fish establishment and development
- Placement of a rock substrate and selective placement of large boulders designed to address the limiting habitat conditions of the existing silty-clay substrate and provide fish resting and feeding and aquatic macroinvertibrate habitat
- Expanded riparian plantings to enhance aquatic and fisheries habitat by providing thermal and hiding cover and increase overall biologic diversity while establishing an effective riparian zone for use by both semi-aquatic and terrestrial wildlife species.

- Design of the culvert gradient to limit flow velocities during normal fish migration periods, the use of baffles within the culvert and a plunge pool at the culvert outlet to provide deeper still water to facilitate upstream fish movement, and installation of skylights in the culvert to limit the non-daylighted length.

The use of construction equipment near the Willow Creek stream channel represents a minor risk with a potential for a petroleum spill or leak which could result in steam contamination and potential toxic effects on fish and macroinvertebrates. The magnitude and duration of the impact would depend on the location and amount of the spill, the type of material spilled, and flow conditions at the time of the spill. Potential impacts due to the use of equipment in the vicinity of the stream will be mitigated by establishment of a stream buffer zone up to 100 feet wide where feasible, prohibition of equipment lubrication or fueling within this zone, utilization of localized drainage control measures for all disturbance areas within the Willow Creek floodplain, and development and implementation of a Spill Prevention, Control, and Countermeasures Plan consistent with applicable requirements under the Clean Water Act.

Prior to reclamation, stormwater runoff from disturbed areas would be a potential source of additional sediment contributions to Willow Creek. Sediment contributions will, however, be effectively controlled by construction, operation, and maintenance of an integrated drainage and sediment control system including diversion and collection ditches, sedimentation ponds, and alternative sediment control measures.

Mine water supply requirements for sanitary use, surface dust control, fire fighting reserve, and operational mine water will be addressed through a combination of direct withdrawals from the Price River under existing active water rights, culinary supply from the existing culinary water line, and collection and recycling of both mine water and mine inflows. Any use of surface water from the Price River may result in potential temporary minor reductions in stream flow, however, any reductions will be on the order of the historic reductions associated with the Castle Gate Mine and previous mine operations. Maximum anticipated withdrawals from the Price River will be limited to approximately 730 acre-feet annually (1.0 cubic feet per second) which is well within the limits of designated appropriations for the existing active water rights and represents a negligible change in overall flow rate. For this reason, it is anticipated that the incremental mining related withdrawals will have no measurable effect relative to potential downstream surface water depletion in the Price or Green River drainages.

4.3.4.3 Cumulative Vegetation, Fish, and Wildlife Impacts

Potential vegetation and wildlife impacts are directly related to surface disturbance and aquatic and fisheries impacts are directly related to surface water impacts. Since no surface disturbance is planned in the proposed coal lease area and no significant direct surface water impacts are anticipated for this area, coal leasing is not expected to directly result in any cumulative vegetation, fish, or wildlife impacts. Potential cumulative impacts for the associated mining and related operations will be limited by the relatively small surface disturbance area and specific operational control and mitigation measures. Given the extensive areas of undeveloped land in this general area, minor localized changes in wildlife population or habitat such as those potentially resulting from the planned operations will not have any significant adverse effect.

4.3.5 Land Use

Approval of the pending coal lease application will result in a change in land use designation for lands which are the subject of the lease application from undeveloped grazing and wildlife habitat to coal mining. This change is compatible with the BLM's applicable Management Framework Plan and, in reality, may result in little or no change in surface land uses for the area. Potential indirect and cumulative effects of the associated planned mining and related operations relative to land use will involve restoration of the historical mining use

for the areas to be disturbed and utilized for the planned mine surface facilities area and a change in land use designation from wildlife/grazing to mining for other areas within the mine permit boundaries. While the land use designation for these areas will change, actual physical land use for all areas except the mine surface facilities area is expected to remain essentially the same.

4.3.6 Cultural Resources

Since the Proposed Action, approval of the pending coal lease application, will not involve any direct surface disturbance in the coal lease area, no direct cultural resource impacts are anticipated. Indirect and cumulative cultural resource impacts resulting from the associated planned mining and related operations will be limited to potential disturbance of existing cultural, historic, and paleontological resources within the mine surface facilities area. Impacts on the one known cultural resource site and the single historic resource site will be mitigated through either avoidance or documentation, resource recovery, and recordation in consultation with the State Historic Preservation Office.

4.3.7 Air Quality

Obviously, since no surface disturbance is planned within the proposed coal lease area there will be no direct related air quality impacts. Indirect and cumulative air quality impacts resulting from the associated mining and related operations are expected to be minor. Given that the Willow Creek Mine will be an underground mining operation, potential air emissions resulting from the mining and related operations will be limited to fugitive dust and minor combustion and vehicular emissions. Potential fugitive dust sources will include construction activities in the mine surface facilities area; unpaved mine roads and surface operations areas; coal, refuse, and topsoil stockpiles; conveyors and associated coal handling systems; coal processing equipment; coal loadout operations; mine ventilation fans; wind erosion on disturbed and exposed surface areas; and site reclamation activities.

The only source of potential combustion emissions will be a small used oil boiler which will be used to heat the maintenance shop facility. Potential mine-related vehicular emissions will be limited to construction equipment during the initial construction phase; employee and supplier traffic to and from the mine and operation of a small fleet of surface maintenance and support vehicles during operations; and emissions from reclamation equipment during the final reclamation and closure phase. All mining and related operations will be conducted in compliance with applicable provisions of both the Federal Clean Air Act and Utah air emission laws and regulations. The Willow Creek permit area falls within an area presently classified as an attainment area under the primary pollutant standards as defined by the National Ambient Air Quality Standards (NAAQS). Given this classification, Federal air emission requirements are not applicable except to the extent that they provide for State responsibility for protection of air quality and application of Best Available Control Technology (BACT) for potential emission sources.

4.3.8 Socioeconomics, Transportation, Recreation, and Aesthetics

The proposed coal leasing action will have limited direct socioeconomic, and aesthetic impacts. Royalties of approximately $30 million would be paid for use of Federal lands and the coal extracted. In addition, the life of the mine and all associated employment and economic benefits (refer to Section 3.9) would be extended by approximately 3 to 5 years. In conjunction with the associated planned mining and related activities, however, the following indirect and cumulative impacts are anticipated:

- Temporary increases in the demand for rental housing and medical and social services associated with the temporary work force required for Mine construction (approximately 75 to 125 workers for a period of 8 to 12 months)

- Continued long-term demand for housing, utilities, and educational, medical, and social services in conjunction with the long-term Mine work force

- Increases in traffic levels on U.S. Highways 6 and 50 and State Highway 191 between Price and Helper and the Mine, and between Duchesne and the Mine
- Minor decreases in dispersed recreational use in the vicinity of the Mine
- Temporary minor adverse visual impacts associated with the mine surface facilities

With the exception of traffic impacts, all of the noted indirect and cumulative effects are minor, and in most cases, temporary in nature. Based on projected employment of 250 to 300 employees, a two-shift per day operating schedule, and the assumption that most employees will carpool with an average of three employees per vehicle, mine operations will result in approximately 80 to 100 additional employee vehicle trips per day. Assuming that most management and support personnel will work day shift, peak employee traffic levels (would normally occur at shift change) are projected at a maximum of 65 vehicles. In addition, approximately 20 to 30 daily delivery vehicle trips are anticipated with deliveries distributed throughout daylight hours. Assuming that 20 percent of delivery traffic would occur during peak traffic periods, maximum total traffic load would be approximately 130 vehicles and maximum peak traffic load would be approximately 75 vehicles. U.S. Highway 6 and 50 are adequate to handle the increased traffic loads without any significant modification. State Highway 191 is generally adequate to meet projected traffic requirements except in the immediate mine facilities area. In this area, increased traffic levels and turning requirements to enter and exit the mine facilities dictate specific highway modifications as a traffic flow and safety consideration. In order to mitigate traffic concerns in this area, Highway 191 has been widened to provide three lanes, one lane for through traffic in each direction and a middle turn lane, adequate shoulders and more effective sight lines in the vicinity of the Mine facilities area.

Given that no direct surface disturbance will occur in the proposed lease area and that indirect effects would be limited to mining-related subsidence which would not result in discernable aesthetic impacts, aesthetic characteristics of the lease area would not be impacted by the Proposed Action. The only surface disturbance which would occur would be development of the Mine surface facilities area as a reasonably foreseeable related action. Given that this area is currently designated as a VRM Class IV area, the proposed facility development activities are compatible with both this designation and the associated VRM objectives which indicate that, "...changes may dominate the view but efforts should be made to minimize visual impacts and repeat the basic visual elements to the extent possible."

Visual impacts will be mitigated in part by the surface facilities design which consolidates the required facilities into the smallest possible area, configures the facilities so that they are compatible and blend with the natural terrain, and utilizes colors which are consistent with natural hues.

4.4 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS AND RESIDUAL ADVERSE EFFECTS

The only irreversible and irretrievable resource commitment associated with the Proposed Action is the depletion of existing coal reserves which will result from the associated mining operations. Residual adverse effects resulting from coal lease approval and issuance would include indirect and cumulative geologic and hydrologic effects for those areas within the coal lease tract affected by mining. Residual adverse effects could include minor surface subsidence, localized alteration of ground water flow patterns, and increases in ground water TDS and concentrations of other individual chemical constituents as previously described in this section. None of the potential residual adverse effects are expected to result in any significant long-term environmental hazards nor are they expected to adversely affect human health or safety.

4.5 MONITORING

Detailed mining and reclamation plans submitted the UDOGM, as the primary responsible jurisdictional agency for coal mining operations in the State of Utah include specific plans for monitoring of surface and ground water and mining-related subsidence. These plans and associated evaluation and reporting requirements are designed to identify, quantify, and document any significant changes in the monitored systems as a basis for review and modification, if indicated, of the approved mining, reclamation, and associated activities to effectively control and mitigate any significant adverse impacts. Hydrologic monitoring has been initiated and will continue through the reclamation liability period. Subsidence monitoring will be initiated prior to initial underground mining disturbance and will continue for a reasonable period following completion of mining operations in any given area.

5.0 CONSULTATION AND COORDINATION

5.1 LIST OF PREPARERS

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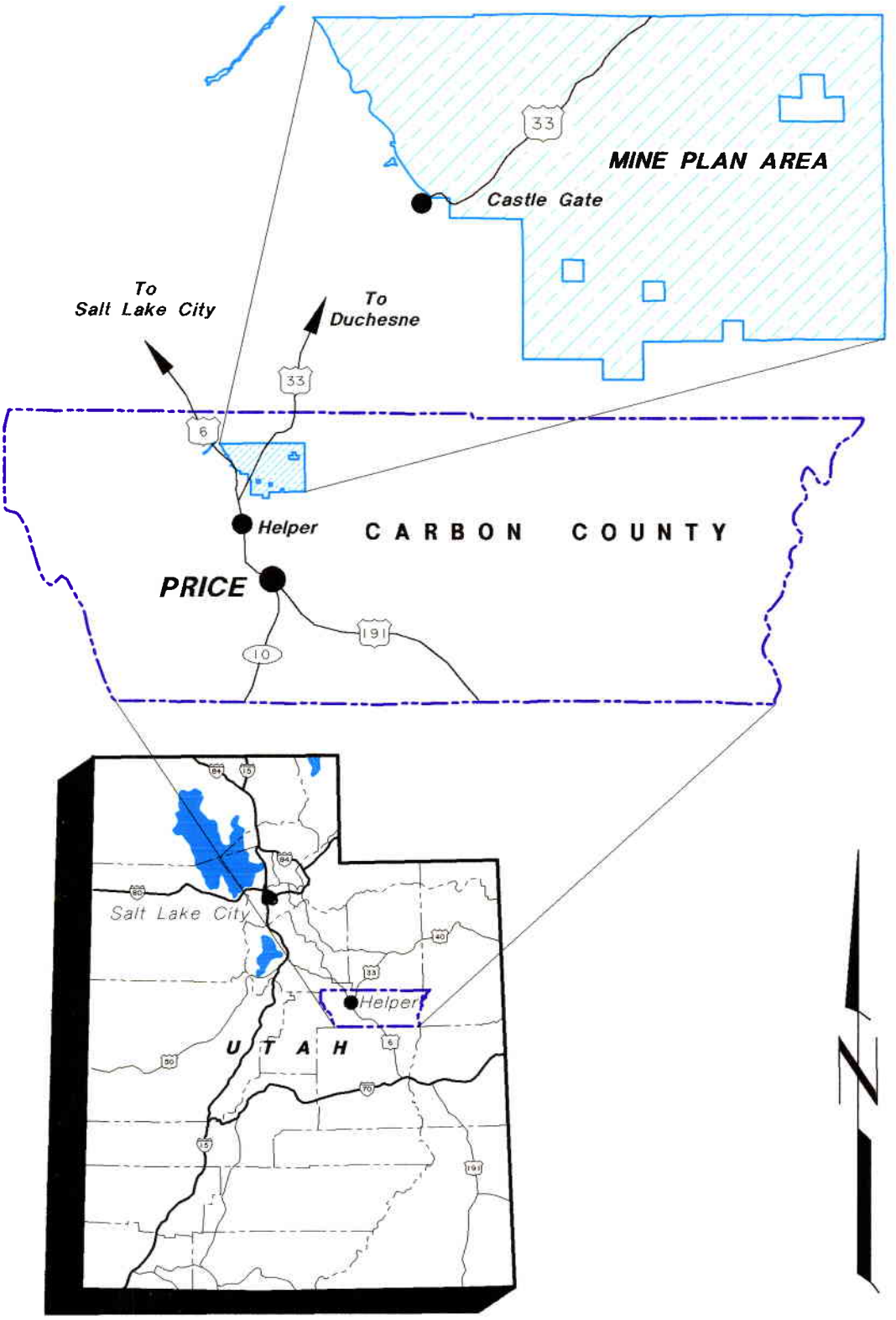
FIGURES



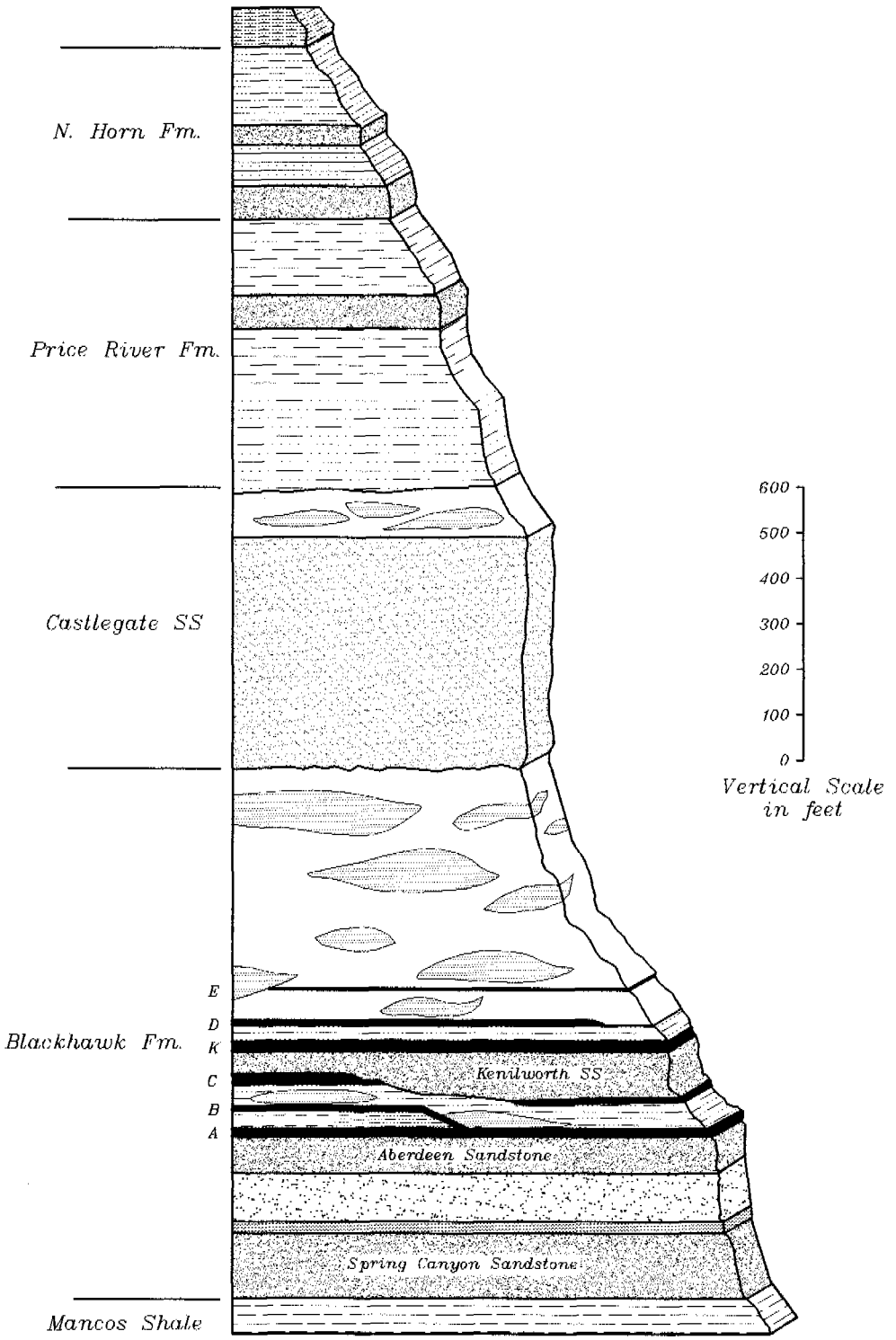
Project No.: 500-5000	Design By: J.NETTLETON	Scale: NOT TO SCALE
File: NEWPGLOC.DWG	Drawn By: K.CONRATH	Date: MARCH 1994

CYPRUS Plateau Mining

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

FIGURE 1.0-1

GENERAL LOCATION MAP



Project No.: 866-2200	Design By: J.NETTLETON	Scale: AS SHOWN	CYPRUS Plateau Mining
File: STRAT2.DWG	Drawn By: K.CONRATH	Date: JANUARY, 1995	GENERAL STRATIGRAPHIC COLUMN
TerraMatrix Engineering & Environmental Services, 1475 Pine Grove Road, P.O. Box 774018, Steamboat Springs, Colorado 80477	FIGURE 3.0-1		

APPENDICES

APPENDIX A

GROUND WATER QUALITY SUMMARY

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

MONITORING WELLS
WILLOW CREEK

MONITORING STATION (1)	B-51			B-121			B-331 (2)			B-331A (3)		
LOCATION	PANTHER CANYON WELL			ALRAD CANYON WELL			DRY CANYON WELL			DRY CANYON WELL		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (4)	10/94 - 3/95			10/94 - 3/95			10/94 - 3/95			10/94 - 3/95		
Field Measurements												
- Water Level Elevation (ft)	6709.2	6722.5	6712.7	6997.8	6997.8	6997.8	6274.3	6333.8	6312.77	6806.9	6811.9	6312.77
- Temperature (degrees C)			15.5			14.3			14.33			10
- pH (s.u.)			7.58			9.3			8.81			8.19
- Specific Conductivity (umhos/cm)			3020			1226			3350			1815
Laboratory Parameters (5,6)												
- Specific Conductance			3250			1570			3700			1728
- Total Dissolved Solids			2450			1270			2070			1300
- Nitrogen (Ammonia)			2			1.1			2.01			0.33
- Nitrate (NO3 - N)			0.04			0.04			0.14			-0.02
- Nitrate-Nitrite (NO3/NO2)			0.04						0.15			-0.02
- Nitrite (NO2 - N)			-0.01			-0.01			0.01			0.01
- Oil and Grease			2			3			6			1
- Alkalinity (as CaCO3)			420			52			760			392
- Bicarbonate (as HCO3)			420			28			760			392
- Carbonate (as CO3)			0			24			0			0
- Chloride (Dissolved)			164			28			720			50
- Sulfate			1240			820			64			611
- Phosphate (Ortho)			-0.005			-0.005			-0.005			0.013
- Aluminum (Dissolved)			-0.05			-0.03			-0.05			-0.05
- Arsenic (Dissolved)			-0.001			-0.001			0.011			0.004
- Boron (Dissolved)			2.22			0.08			0.33			0.1
- Cadmium (Dissolved)			-0.005			-0.005			-0.005			-0.005
- Calcium (Dissolved)			131			222			63			177
- Copper (Dissolved)			-0.01			-0.01			-0.01			-0.01
- Hardness (as CACO3)			902			633			469			930
- Iron (Dissolved)			0.39			-0.01			0.02			-0.02
- Iron (Total)			15.7			9.9			6.49			0.17
- Lead (Dissolved)			-0.02			-0.02			-0.02			-0.02
- Magnesium (Dissolved)			140			19			76			119
- Manganese (Dissolved)			0.86			-0.005			0.23			0.44
- Manganese (Total)			0.89			0.16			0.28			1.08
- Molybdenum (Dissolved)			0.04			0.07			-0.01			-0.01
- Potassium (Dissolved)			27			18			17			13
- Selenium (Dissolved)			-0.001			-0.001			-0.001			0.001
- Sodium (Dissolved)			449			100			677			68
- Zinc (Dissolved)			-0.01			-0.01			-0.01			NA

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Dry Canyon well installed to monitor the Aberdeen Sandstone aquifer
(3) Dry Canyon well installed to monitor the Upper Blackhawk Formation
(4) Monitoring wells B-51, B-121, B-331 and B-331A have been sampled for groundwater quality on a single event
(5) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(6) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

SPRINGS AND SEEPS

MONITORING STATION (1) LOCATION	B-41 DRY CANYON			B-71 PANTHER CANYON			B-161 SPRING NEAR KENILWORTH ADIT			B-241 POSSIBLY HISTORIC ROBB SPRING
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min Max Mean
Period of Record (2)	6/94 - 3/95			6/94 - 3/95			6/94 - 3/95			6/94 - 3/95
Field Measurements										
- Flow (cfs)	0.001	0.002	0.002	0.001	0.005	0.002	0.004	0.018	0.01	0.001
- Temperature (degrees C)	3.6	10.2	6.9	7.5	16.7	11.4	9.5	15.5	12	8.5
- pH (s.u.)	7.1	8.6	7.9	7	7.3	7.2	7.1	8.3	7.71	7.6
- Specific Conductivity (umhos/cm	469	469	469	416	4230	2855	410	4090	2833	688
Laboratory Parameters (3,4)										
- Specific Conductance (Lab)	567	568	567.5	3700	4200	4033	4040	4230	4146	606
- Total Dissolved Solids	328	338	333	3430	4104	3827	2732	2890	2824	340
- Ammonia - (NH3-N)	-0.05	0.07	0.05	0.16	0.44	0.33	0.05	0.07	0.06	-0.05
- Nitrate (NO3 - N)	0.77	1.1	0.92	5.8	7.7	6.6	0.03	0.13	0.073	0.04
- Nitrate-Nitrite (NO3/NO2)	0.77	1.1	0.92	5.8	7.7	6.6	0.03	0.12	0.07	0.04
- Nitrite (NO2 - N)	-0.01	0.01	0.008	-0.01	0.01	0.007	-0.01	-0.01	-0.01	-0.01
- Oil and Grease	-1	-1	-1	-1	4	1.67	-1	17	6	-1
- Alkalinity (as CaCO3)	210	212	211	520	577	543	1054	1200	1142	300
- Bicarbonate (as HCO3)	210	212	211	508	577	540	914	1100	1013	300
- Carbonate (as CO3)				-2	12	6.5	110	148	133	0
- Chloride (Dissolved)	9	10	9.5	70	87	81	151	180	165	12
- Sulfate	84	97	91	2000	2531	2322	1100	1152	1129	29
- Phosphate (Ortho)	-0.005	0.018	0.01	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	0.147
- Aluminum (Dissolved)	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
- Arsenic (Dissolved)	-0.001	-0.001	-0.001	-0.01	-0.01	-0.01	-0.001	0.003	0.001	-0.001
- Boron (Dissolved)	0.02	0.04	0.03	2.9	3.4	3.2	6.1	6.8	6.4	0.04
- Cadmium (Dissolved)	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
- Calcium (Dissolved)	61	72	66.5	240	302	275	21	27	24.6	64
- Copper (Dissolved)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Hardness (as CACO3)	276	319	298	2246	2871	2616	561	654	619	279
- Iron (Dissolved)	-0.02	-0.02	-0.02	-0.01	0.16	0.11	-0.01	0.06	0.04	-0.02
- Iron (Total)	0.1	0.32	0.21	0.04	0.14	0.07	0.07	0.3	0.21	0.73
- Lead (Dissolved)	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
- Magnesium (Dissolved)	30	34	32	400	516	469	124	143	135	29
- Manganese (Dissolved)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Manganese (Total)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Molybdenum (Dissolved)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Potassium (Dissolved)	2	2	2	43	45	44	37	40	38	2
- Selenium (Dissolved)	-0.001	-0.001	-0.001	0.007	0.012	-0.01	-0.001	-0.001	-0.001	0.003
- Sodium (Dissolved)	12	12	12	100	133	121	730	783	750	30
- Zinc (Dissolved)	-0.01	0.01	0.008	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Station B-241 sampled a single time.
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

SEEPS AND SPRINGS

MONITORING STATION (1)	B-261			B-262			B-341			B-342		
LOCATION	PACE SPRING			BUCK/DEEP CANYON			MATHIS CANYON SPRING			MATHIS CANYON SPRING		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (2)	6/94 - 3/95			7/94 - 3/95			6/94 - 3/95			6/94 - 3/95		
Field Measurements												
- Flow (cfs)		0.002		0.002	0.009	0.006	0.001	0.002	0.001	0.002	0.005	0.004
- Temperature (degrees C)		8.8		10	10.9	10.3	3	8.2	5.3	7	13.1	10.1
- pH (s.u.)		7.39		7.02	7.78	7.47	7.5	8	7.7	7.5	8.3	7.9
- Specific Conductivity (umhos/cm)		630		645	845	7.14	748	848	802	750	842	796
Laboratory Parameters (3,4)												
- Specific Conductance (Lab)		556		637	759	679	722	752	738	630	639	635
- Total Dissolved Solids		290		320	418	358	398	422	409	352	360	356
- Ammonia - (NH3-N)		0.06		-0.05	0.07	0.04	-0.05	-0.05	-0.05	-0.05	0.05	0.038
- Nitrate (NO3 - N)		0.35		0.05	0.16	0.1	0.13	0.23	0.18	0.08	0.1	0.09
- Nitrate-Nitrite (NO3/NO2)		0.34		0.05	0.16	0.1	0.13	0.22	0.18	0.08	0.09	0.09
- Nitrite (NO2 - N)		-0.01		-0.01	0.01	0.007	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Oil and Grease		-1		-1	15	5.3	-1	23	8	-1	-1	-1
- Alkalinity (as CaCO3)		300		330	412	358	322	368	345	300	320	310
- Bicarbonate (as HCO3)		300		330	412	358	322	368	341	280	312	296
- Carbonate (as CO3)		0							12	8	20	14
- Chloride (Dissolved)		3		7	10	8	4	5	4.33	4	5	4.5
- Sulfate		6		12	47	26	64	74	68	35	47	41
- Phosphate (Ortho)		-0.005		-0.005	0.011	0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
- Aluminum (Dissolved)		-0.05		-0.05	0.06	0.037	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
- Arsenic (Dissolved)		-0.001		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.01	-0.01	-0.001
- Boron (Dissolved)		0.02		0.03	0.04	0.04	0.04	0.05	0.05	0.03	0.04	0.035
- Cadmium (Dissolved)		-0.005		-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
- Calcium (Dissolved)		81		77	85	81	68	75	71	80	82	81
- Copper (Dissolved)		-0.01		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Hardness (as CACO3)		309		320	393	347	285	311	294	327	336	332
- Iron (Dissolved)		-0.02		-0.02	0.03	0.17	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
- Iron (Total)		0.07		-0.02	1.14	0.41	-0.02	-0.02	-0.02	0.07	0.11	0.09
- Lead (Dissolved)		-0.02		-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
- Magnesium (Dissolved)		26		31	44	35	28	30	29	31	32	31.5
- Manganese (Dissolved)		0.19		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Manganese (Total)		0.22		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.02	0.013
- Molybdenum (Dissolved)		-0.01		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Potassium (Dissolved)		1		1	2	1	-1	-1	-1	-1	1	0.75
- Selenium (Dissolved)		-0.001		-0.001	0.002	0.001	0.003	0.005	0.004	0.002	0.003	0.003
- Sodium (Dissolved)		8		17	25	19	54	63	59	14	16	15
- Zinc (Dissolved)		-0.01		-0.01	0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Station B-261 sampled a single time
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

SEEPS AND SPRINGS

MONITORING STATION (1)	B-351			B-321			B-32			B-33		
LOCATION	MATHIS CANYON SPRING			WILLOW CREEK SPRING			MATHIS CANYON SPRING			MATHIS CANYON SPRING		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (2)	6/94 - 3/95			9/94 - 3/95			6/80 - 10/83			5/78 - 6/79		
Field Measurements												
- Flow (cfs)		0.001			0.009		0.004	0.04	0.02	0	0.06	0.02
- Temperature (degrees C)		9			10		6	25	15.6	3	7.5	5.4
- pH (s.u.)		7.34			7.14		7.5	8.5	7.9	7.4	8.3	7.8
- Specific Conductivity (umhos/cm)		643			1563		270	529	453			
Laboratory Parameters (3,4)												
- Acidity							-0.01	20	8.6	-0.1	20	4
- Specific Conductivity (Lab)		567			1567							
- Total Dissolved Solids		294			1090		288	352	313	255	396	338
- Nitrogen (Ammonia)		0.06			0.24							
- Nitrate (NO3 - N)		0.94			-0.02		-0.01	1.4	0.63	-0.01	1.1	0.39
- Nitrate-Nitrite (NO3/NO2 - N)		0.93			-0.02							
- Nitrite (NO2 - N)		-0.01			-0.01					-0.01	-0.01	-0.01
- Oil and Grease		-1			-1		-0.1	3.2	1.4	-1	4.6	1.6
- Alkalinity (as CaCO3)		284			350		196	276	224	204	348	265
- Bicarbonate (as HCO3)		284			350		239	322	270	236	476	300
- Carbonate (as CO3)		0			0							
- Chloride (Dissolved)		3			45		1.4	13.1	7.3	2.7	17.4	9.9
- Fluoride							0.2	0.36	0.25	0.17	0.26	0.23
- Sulfate		29			463		43	81	64	24	136	66
- Phosphate (Ortho)		-0.005			-0.005		0.04	0.5	0.16	0.02	0.024	0.022
- Aluminum (Dissolved)		-0.05			-0.05							
- Arsenic (Dissolved)		-0.001			0.001		-0.001	0.01	0.002	-0.001	-0.001	-0.001
- Barium (Dissolved)							0.03	0.08	0.05	0.04	0.16	0.075
- Boron (Dissolved)		0.02			0.08							0.077
- Cadmium (Dissolved)		-0.005			-0.005		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Calcium (Dissolved)		72			156		40	62	53	40	63	52
- Copper (Dissolved)		-0.01			-0.01		-0.001	0.04	0.02	-0.001	0.04	0.011
- Hardness (Total)		291			821							
- Iron (Dissolved)		-0.02			0.02							0.02
- Iron (Total)		0.63			0.08		0.04	1.2	0.57	0.006	1.2	0.3
- Lead (Dissolved)		-0.02			-0.02		-0.001	0.002	0.001	-0.001	0.002	0.001
- Magnesium (Dissolved)		27			105		25.92	38.4	30.9	24.5	52.8	37.5
- Manganese (Dissolved)		-0.01			0.81					-0.001	0.01	0.006
- Manganese (Total)		0.03			0.78		-0.01	0.03	0.02			
- Mercury (Dissolved)										-0.0002	-0.0002	-0.0002
- Molybdenum (Dissolved)		-0.01			-0.01							
- Phenols (Dissolved)							-0.001	0.1	0.03	-0.001	0.03	0.008
- Potassium (Dissolved)		1			9		1	1.5	1.3	1.1	2.3	1.5
- Selenium (Dissolved)		-0.001			-0.001		-0.001	0.004	0.001	-0.001	-0.001	-0.001
- Silver (Dissolved)							-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Sodium (Dissolved)		8			59		8.5	38	18.5	3.5	33.5	17.8
- Zinc (Dissolved)		-0.01			-0.01		0.007	0.035	0.022	0.002	0.049	0.02

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Sampling sies B-351 and B-352 sampled a single time
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

MONITORING WELLS
WILLOW CREEK

MONITORING STATION (1)	BM-25			BM-26			BM-27			BM-28		
LOCATION (2)	BOTTOM OF ROYAL MINE			ROYAL MINE (3)			ROYAL MINE (4)			ROYAL MINE (5)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record	6/77 to 4/78			6/77 to 4/78			6/77 to 4/78			6/77 to 4/78		
Field Measurements												
- Mine Inflow (cfs)				0.01	0.01	0.01	0	0.002	0.001			0.005
- Temperature (degrees C)	12	13	12.5	8	9	8.25	9	9	9	4	7	5.75
- pH (s.u.)	6.9	8.16	7.48	7.33	8.2	7.78	7.63	8	7.8	7.2	7.9	7.61
- Specific Conductivity (umhos/cm	1390	2050	1646.3	1050	1990	1312.8	1200	1790	1509.5	1380	1850	1538.6
Laboratory Parameters (6,7)												
- Acidity												
- Total Dissolved Solids	906	1350	1080.6	700	1300	861	964	1200	1082.5	898	1240	1007.2
- Total Suspended Solids	32	1900	354.4	100	1228	633.67	4	14	10.25	7	31	14.6
- Nitrogen (Ammonia)	0.15	8	1.44	0.1	8	7.38	-0.01	0.36	0.23	0.05	0.35	0.154
- Nitrate (NO3 - N)	0.02	9	1.479	0.05	0.84	0.14	0.06	0.7	0.3	0.03	0.6	0.224
- Nitrite (NO2 - N)	1.02	1.05	1.035	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01
- Oil and Grease	3.4	4070	599.26	1.7	13.6	6.9	-1	5.2	2.75	-1	7.4	3.18
- Alkalinity (as CaCO3)	2.54	490	366.29	168	277	187	164	358	219	374	400	383.2
- Bicarbonate (as HCO3)	268.4	558.76	427.57	204.96	270.8	228.12	200	436.7	267.4	456.28	488	467.5
- Carbonate (as CO3)	-0.001	19.2	2.75	-0.001	-0.001	-0.001	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Chloride (Dissolved)	46	150	99.14	24	32	24.33	28	34	31	20	32	26.8
- Fluoride	0.5	0.66	0.57	0.36	0.51	0.43	0.38	0.5	0.435	0.33	0.44	0.384
- Sulfate	400	580	362	360	640	430	560	560	590	360	460	404
- Phosphate (Total)	0.09	2.8	0.645	0.15	2.3	0.91	0.06	2.3	0.664	0.04	0.74	0.18
- Phosphate (Ortho)	0.02	0.54	0.205	0.04	0.15	0.09	0.015	0.04	0.024	-0.01	0.03	0.018
- Aluminum (Dissolved)	-0.001	0.036	0.019	-0.001	-0.001	-0.001						
- Arsenic (Dissolved)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.014	0.004
- Barium (Dissolved)	0.005	0.11	0.053	0.012	0.055	0.03	0.05	0.07	0.055	0.025	0.057	0.04
- Boron (Dissolved)	-0.001	0.3	0.149	-0.001	0.3	0.18	0.13	0.25	0.19	0.075	0.2	0.14
- Cadmium (Dissolved)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Calcium (Dissolved)	80	123.2	7	88	112	100.67	152	170.4	162.14	180	316	207.04
- Chromium (Dissolved)	-0.001	0.013	0.003	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Copper (Dissolved)	0.004	0.005	0.0043	-0.001	0.005	0.003						0.004
- Hardness (Total)	530	600	565.43	470	522	498.67	740	810	762.5	660	830	776
- Iron (Dissolved)												
- Iron (Total)	0.072	3.42	1.076	0.051	16.43	6	0.149	0.409	0.32	0.438	4.39	2.92
- Lead (Dissolved)	-0.001	0.004	0.002	-0.001	0.003	0.001	-0.001	0.005	0.003	-0.001	0.004	0.002
- Magnesium (Dissolved)	60.94	79.2	71.59	55.2	62.4	59.28	84	92.16	87.24	-0.01	96.48	62.02
- Manganese (Total)	0.023	0.218	0.073	0.021	0.227	0.13	0.004	0.156	0.05	0.395	0.039	0.28
- Mercury (Dissolved)	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
- Molybdenum (Dissolved)	-0.001	0.029	0.015	0.002	0.002	0.002						
- Nickel (Dissolved)	-0.001	0.169	0.085	-0.001	-0.001	-0.001						
- Phenols (Dissolved)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001						
- Potassium (Dissolved)	6.52	17.8	10.33	6	15.51	6.65	5.82	9.11	7.79	4.76	7.03	6.11
- Selenium (Dissolved)	-0.001	-0.001	-0.001	-0.001	0.005	0.003	-0.001	-0.001	-0.001	-0.001	0.004	0.002
- Silver (Dissolved)	-0.001	0.051	0.008	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Sodium (Dissolved)	6.5	185	137.14	18.5	65	42.84	23	102	51.48	15	56	28
- Zinc (Dissolved)	0.011	0.408	0.091	0.093	0.408	135.72	0.02	0.082	0.056	0.012	0.074	0.037

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Mine discharge/inflow stations BM25, BM26, BM27, and BM 28 are located in the western coal reserve area.
(3) Royal Mine 20 feet above bottom
(4) Royal Mine at Crosscut # 3
(5) Royal Mine 40 feet below ground surface
(6) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(7) "-" indicates result below laboratory detection limit

APPENDIX B

SURFACE DRAINAGES WATER QUALITY SUMMARY

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

PRICE RIVER

	B-21 (2)			B-20 (2)			B-5			B-6		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record	6/78 - 10/83			2/80 - 10/83			6/78 - 3/95			6/78 - 3/95		
Field Measurements												
- Temperature	0	18	9.3	0	20	7.8	0.2	20.4	8.7	1	20	9
- pH	6.8	9.1	7.9	6.7	9.5	8.1	7	9.6	8.2	7.1	9.5	8.1
- Specific Conductivity	250	809	477.8	235	575	380	253	795	447	250	710	435
- Dissolved Oxygen	7.2	10.2	8.8	7.2	12	10	4.9	12	8.9	5.7	12	8.9
Laboratory Parameters (3,4)												
- Specific Conductance							367	631	505	361	634	511
- Acidity	-0.01	16	2.6	-0.01	24	4.4	-0.01	30	6	-0.01	34	6.9
- Chemical Oxygen Demand												
- Dissolved Oxygen												
- Total Dissolved Solids	252	945	356	189	880	314	198	1080	329	190	910	319
- Total Suspended Solids	1	1945	192.9	1	1278	205.9	-1	1604	188.6	0.5	1633	200
- Total Settleable Solids							-0.4	-0.4	-0.4	-0.1	-0.1	-0.1
- Turbidity												
- Nitrogen (Ammonia)							-0.05	0.17	0.073	-0.05	0.3	0.117
- Nitrate	-0.01	0.23	0.06	-0.01	0.56	0.118	-0.01	0.64	0.158	-0.01	0.63	0.14
- Nitrite	-0.01	-0.01	-0.01				-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Oil and Grease	-0.1	18.8	1.8	-0.1	57	4.4	-1	40	3.02	-0.1	28.4	2.5
- Alkalinity	7	320	214.4	10	266	199	150	298	222	142	334	219
- Bicarbonate	203.5	390.4	298.7	12	322	241	150	363	261	150	407	259
- Carbonate	-0.01	-0.01	-0.01				8	8	8	4	4	4
- Chloride	3.5	107.9	13.9	4	45.3	13.1	3	45.3	14	4	26	12.2
- Fluoride	0.13	0.24	0.18	0.1	0.36	0.17	0.1	0.28	0.16	0.1	0.28	0.167
- Sulfate	4	500	69.03	10	455	71.9	13	590	62.9	2.6	460	59.8
- Phosphate (Ortho)	-0.01	1.52	0.33	0.005	0.9	0.28	0.03	1.7	0.28	0.02	1.08	0.25
- Aluminum							-0.03	-0.05	0.02	-0.03	-0.03	-0.03
- Arsenic	-0.001	0.027	0.005	-0.001	0.029	0.004	-0.001	0.038	0.003	-0.001	0.03	0.003
- Barium	0.05	0.36	0.148	0.06	0.35	0.14	0.03	0.4	0.127	0.01	0.95	0.14
- Boron				0.03	0.35	0.13	0.03	0.45	0.11	0.03	0.4	0.09
- Cadmium	-0.001	0.002	0.001	-0.001	0.002	0.001	-0.001	0.002	0.001	-0.001	0.01	0.001
- Calcium	25.6	220	62.73	32	190	61.1	37.6	250	61.5	20	68.5	54.5
- Chromium	-0.001	0.044	0.004	-0.001	0.039	0.004	-0.001	0.041	0.003	-0.001	0.04	0.003
- Copper	-0.001	0.27	0.027	-0.001	0.5	0.039	-0.001	1.14	0.055	-0.001	0.1	0.016
- Cyanide	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Hardness (Total)							173	324	234	173	318	229
- Hydroxide												
- Iron (Dissolved)	0.01	0.01	0.01	0.02	0.13	0.07	-0.01	0.68	0.16	-0.01	0.04	0.023
- Iron (Total)	0.023	25.5	3.9	0.21	25.8	3.8	0.09	30.5	2.9	0.01	25.3	2.73
- Lead	-0.001	0.099	0.011	-0.001	0.11	0.008	-0.001	0.06	0.005	-0.001	0.031	0.004
- Magnesium	2	57	38.47	10.56	47	25.53	2.36	57.8	25.6	4.8	384	35.4
- Manganese (Dissolved)							-0.005	0.02	0.009	-0.005	0.02	0.009
- Manganese (Total)	0.002	0.51	0.069	-0.001	1.2	0.18	0.016	1.3	0.15	0.006	1.22	0.145
- Mercury	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
- Molybdenum							-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Organic Carbon (Total)												
- Phenols	-0.001	0.035	0.005	-0.001	0.28	0.025	-0.001	0.31	0.034	-0.001	0.38	0.028
- Potassium	0.96	2.1	1.5	0.85	5.5	1.6	1	3.5	1.7	0.99	4.2	1.6
- Selenium	-0.001	0.004	0.001	-0.001	0.004	0.001	-0.001	0.003	0.001	-0.001	0.003	0.001
- Silica	5.4	33	19.2				5.1	11	8.1	5.4	16	8.9
- Silver	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Sodium	1.2	81	12.7	5.3	30	18.1	8	54	25.4	2.3	86.3	23.2
- Zinc	-0.001	0.2	0.045	-0.001	0.14	0.03	-0.01	0.19	0.032	-0.01	0.14	0.026

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Monitoring station is located in the western coal reserve area
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

WILLOW CREEK

	B-1 (B-151) (2)			B-2			B-3 (B-3N) (2)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record	6/78 - 3/95			6/78 - 3/95			2/80 - 3/95		
Field Measurements									
- Temperature	0	23	9.5	0	22	9.7	-1	35	14.6
- pH	6.8	9.4	8.1	7.5	9.2	8.2	7.1	807	37.8
- Specific Conductivity	365	1150	707	328	1350	667	315	1152	703
- Dissolved Oxygen	6.7	11.8	8.4	7	11.4	9.6	6.1	10.6	7.9
Laboratory Parameters (3,4)									
- Specific Conductance	792	976	879				790	1050	907
- Acidity	-0.01	28	4.3	-0.01	26	3.2	-0.01	20	2.7
- Chemical Oxygen Demand									
- Dissolved Oxygen									
- Total Dissolved Solids	365	1198	579	348	840	562	345	720	536
- Total Suspended Solids	1	2622	334	1	4310	436	-2	4105	465
- Total Settleable Solids	-1	-1	-1				-0.4	-0.4	-0.4
- Turbidity									
- Nitrogen (Ammonia)	0.07	0.09	0.08				-0.05	0.61	0.22
- Nitrate	-0.01	0.56	0.08	-0.01	1.02	0.09	-0.01	0.63	0.08
- Nitrite	-0.01	-0.01	-0.01				-0.01	-0.01	-0.01
- Oil and Grease	-0.1	7.6	1	-0.1	6.4	0.92	-0.1	10.6	1.6
- Alkalinity	180.9	423.8	289.2	202	354	278	186	398	271
- Bicarbonate	205	423	323	246	421	327	224	427	312
- Carbonate	10	12	11				20	24	22
- Chloride	4	42	22.8	2.7	40.5	22	6.4	66	26.4
- Fluoride	0.15	0.74	0.25	0.15	0.37	0.24	0.15	0.3	0.23
- Sulfate	75	720	195	74	415	190	70.5	255	175.6
- Phosphate (Ortho)	0.02	1.7	0.3	-0.01	10	0.72	0.04	1.2	0.32
- Aluminum	-0.05	-0.05	-0.05				-0.05	-0.05	-0.05
- Arsenic	-0.001	0.125	0.011	-0.01	0.05	0.009	-0.001	0.028	0.007
- Barium	0.05	0.35	0.11	0.02	0.75	0.19	0.045	0.79	0.187
- Boron	0.09	0.5	0.17	0.09	0.11	0.1	0.08	0.12	0.1
- Cadmium	-0.001	0.002	0.001	-0.001	0.002	0.001	-0.001	0.002	0.001
- Calcium	40.8	255	84.5	34.4	155	58.3	33	102	56
- Chromium	-0.001	0.082	0.006	-0.001	0.037	0.006	-0.001	0.04	0.006
- Copper	-0.001	0.23	0.03	-0.001	0.11	0.031	-0.01	0.11	0.031
- Cyanide	-0.001	-0.001	-0.001	-0.01	-0.01	-0.01	-0.001	-0.001	-0.001
- Hardness (Total)	279	338	309				256	379	318
- Hydroxide									
- Iron (Dissolved)	-0.01	0.04	0.016	0.02	0.02	0.02	-0.01	0.69	0.15
- Iron (Total)	0.04	1230	55.2	0.06	33.8	6.7	0.09	35.6	6.9
- Lead	-0.02	0.05	0.007	-0.001	0.013	0.001	-0.001	0.03	0.004
- Magnesium	28.8	55.7	45	25.9	57.6	46.4	23	65	44.4
- Manganese (Dissolved)	-0.01	1.7	0.21				-0.01	0.02	0.01
- Manganese (Total)	-0.01	0.085	0.033	0.002	1.7	0.25	-0.01	1.6	0.194
- Mercury	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
- Molybdenum	-0.01	-0.01	-0.01				-0.01	-0.01	-0.01
- Organic Carbon (Total)									
- Phenols	-0.001	0.086	0.012	-0.001	0.042	0.006	-0.001	0.096	0.015
- Potassium	1.5	11.9	2.8	1.4	5.8	2.6	1.5	6.2	2.6
- Selenium	-0.001	0.004	0.001	-0.001	0.004	0.001	-0.001	0.004	0.001
- Silica									
- Silver	-0.001	0.006	0.001	-0.001	-0.001	-0.001	-0.001	0.002	0.001
- Sodium	39.5	142	76.2	37.6	126	72.5	35	139	72.3
- Zinc	-0.01	0.285	0.045	0.003	0.175	0.036	-0.01	0.21	0.045

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Location designation was changed to the station identification in parentheses in 1994
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

	SULPHER CANYON			CRANDELL CANYON						BEAR CANYON	GENTLE WASH
	B-19 (BN-221) (2)			B-25			B-26			BEAR CANYON	GENTLE WASH
Period of Record	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	NS (5)	NS (5)
	6/78 - 3/95			4/81 - 10/83			4/81 - 10/83				
Field Measurements											
- Temperature	-4	32	13.3			23	2	11	6.4		
- pH	6.4	9.2	8			8.2	7.7	9.2	8.4		
- Specific Conductivity	84	1500	683				476	2040	981		
- Dissolved Oxygen	6.2	10.8	8.8								
Laboratory Parameters (3,4)											
- Specific Conductance	1484	1484	1484			514					
- Acidity	-0.01	38	7.1			-0.01	-0.01	8	2.6		
- Chemical Oxygen Demand											
- Dissolved Oxygen											
- Total Dissolved Solids	315	880	504			410	395	1480	774		
- Total Suspended Solids	-0.1	215	27.9			475	54	736	367		
- Total Settleable Solids	-0.4	-0.4	-0.4								
- Turbidity											
- Nitrogen (Ammonia)	-0.05	-0.05	-0.05								
- Nitrate	-0.01	0.51	0.05			0.06	0.04	14.4	4		
- Nitrite	-0.01	0.04	0.02								
- Oil and Grease	-0.01	24.2	2.27			0.8	-0.2	3.8	1.5		
- Alkalinity	162	496	296			294	56	329	192		
- Bicarbonate	44	496	341			358	68.3	401	235		
- Carbonate											
- Chloride	2.5	87	30.7			14	14	153	62.8		
- Fluoride	0.17	2.26	0.42			0.23	0.23	0.43	0.32		
- Sulfate	38	224	99.2			80	103	730	345		
- Phosphate (Ortho)	-0.001	0.72	0.165			0.4	0.04	0.93	0.38		
- Aluminum	-0.05	-0.05	-0.05								
- Arsenic	-0.001	0.025	0.002			0.006	-0.001	0.059	0.024		
- Barium	0.07	0.23	0.18			0.22	0.05	0.68	0.31		
- Boron	0.07	0.38	0.16								
- Cadmium	-0.005	-0.005	-0.005			-0.001	-0.001	0.005	0.002		
- Calcium	4.2	120	64.8			30.4	32	161	82.6		
- Chromium	-0.001	0.005	0.001			0.008	-0.001	0.051	0.014		
- Copper	-0.001	0.05	0.01			0.03	0.009	0.13	0.05		
- Cyanide	-0.001	-0.001	-0.001								
- Hardness (Total)	325	325	325								
- Hydroxide											
- Iron (Dissolved)	-0.02	1.04	0.38								
- Iron (Total)	0.015	4.25	0.55			4.16	0.36	42.5	17.7		
- Lead	-0.001	0.006	0.002			0.009	-0.001	0.042	0.021		
- Magnesium	5.3	56.4	40.1			7.52	10.1	104	62.6		
- Manganese (Dissolved)	-0.01	-0.01	-0.01								
- Manganese (Total)	0.004	0.16	0.04			0.16	0.005	0.78	0.26		
- Mercury	-0.0002	-0.0002	-0.0002								
- Molybdenum	-0.01	-0.01	-0.01								
- Organic Carbon (Total)											
- Phenols	-0.001	0.222	0.028			-0.001	-0.001	0.029	0.008		
- Potassium	0.17	4	1.9			3.6	2.4	21	9.7		
- Selenium	-0.001	0.005	0.001			-0.001	-0.001	-0.001	-0.001		
- Silica	4.6	27	12.1								
- Silver	-0.001	0.002	0.001				-0.001	-0.001	-0.001		
- Sodium	19.4	223	51.6			9.5	14	220	76.7		
- Zinc	-0.01	0.227	0.022			0.21	0.01	0.45	0.2		

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Location designation was changed to the station identification in parenthesis in 1994
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit
(5) No monitoring station exists

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

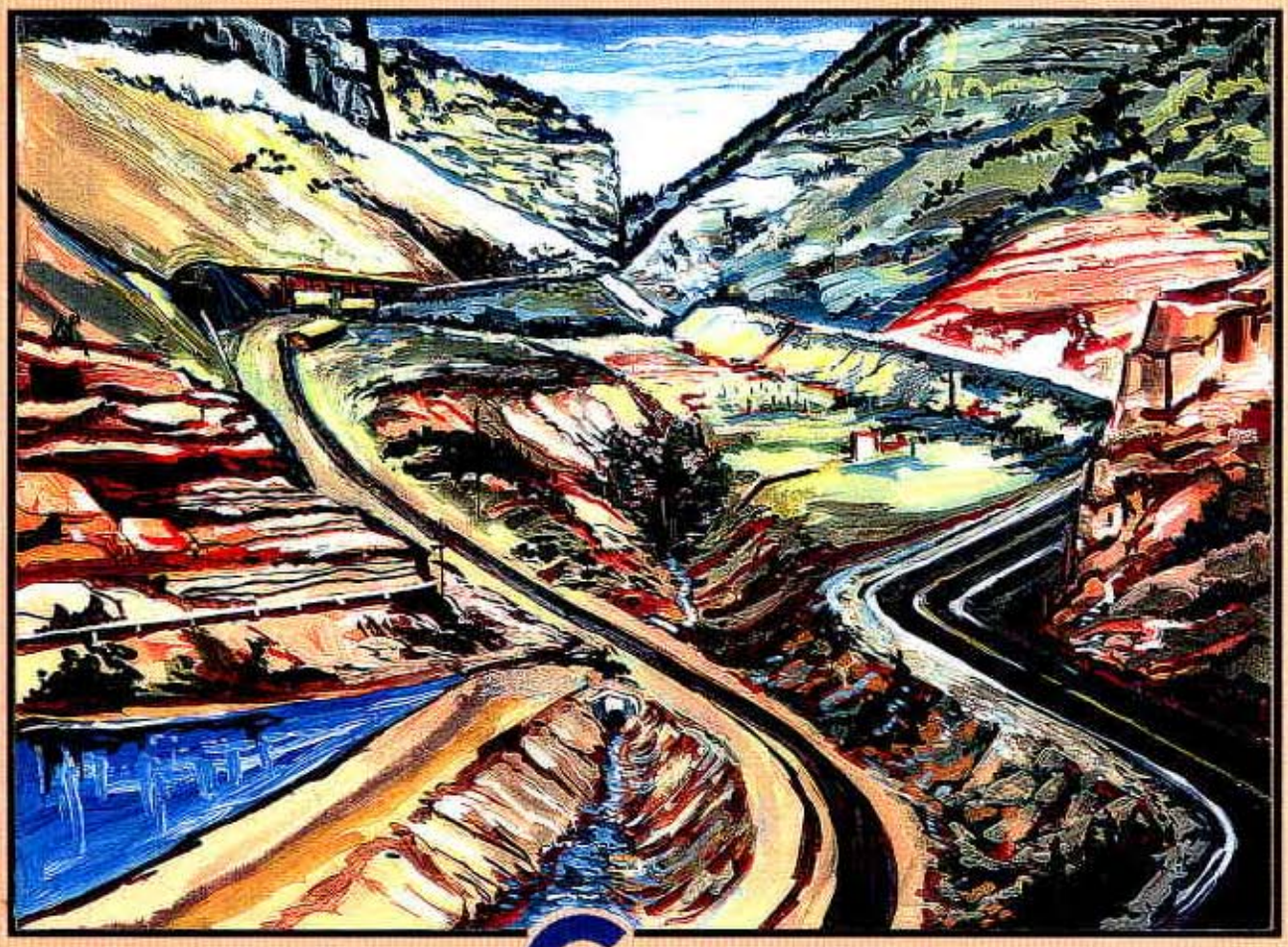
DRAINAGE MONITORING LOCATIONS (1)

	BARN CANYON	DRY CANYON	MATHIS CANYON						DEEP/BUCK CANYON		
	BARN CANYON NS (2)	DRY CANYON NS (2)	B-211			B-353			B-263		
Period of Record			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
			6/94 - 3/95			7/94 - 3/95			7/94 - 9/94		
Field Measurements											
- Temperature			1.5	25.1	13.8	9.3	21	14	1	21.1	11.05
- pH			7.9	8.6	8.4	8.3	9	8.6	8.27	8.44	8.36
- Specific Conductivity			704	910	760	501	573	527	513	548	530.5
- Dissolved Oxygen			5.9	9	7.2	7	7.4	7.2	5.8	6	5.9
Laboratory Parameters (3,4)											
- Specific Conductance			740	749	745	517	539	528			
- Acidity											
- Chemical Oxygen Demand											
- Dissolved Oxygen											
- Total Dissolved Solids			408	444	426	248	296	272			
- Total Suspended Solids			2	2	2	-2	-2	-2			
- Total Settleable Solids			-0.1	-0.1	-0.1	-0.1	-0.1	-0.1			
- Turbidity											
- Nitrogen (Ammonia)			-0.05	0.06	0.04	-0.05	-0.05	-0.05			
- Nitrate			0.02	0.06	0.04	-0.02	-0.02	-0.02			
- Nitrite			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			
- Oil and Grease			-1	-1	-1	2	2	2			
- Alkalinity			325	330	328	250	275	263			
- Bicarbonate			305	314	310	250	275	263			
- Carbonate			16	20	18						
- Chloride			9	13	11	4	5	4.5			
- Fluoride											
- Sulfate			86	99	93	29	31	30			
- Phosphate (Ortho)			-0.005	-0.005	-0.005	-0.005	-0.005	-0.005			
- Aluminum			-0.5	-0.5	-0.5	-0.05	-0.05	-0.05			
- Arsenic			-0.001	0.001	0.001	0.001	0.002	0.002			
- Barium											
- Boron			0.05	0.05	0.05	0.02	0.03	0.025			
- Cadmium			-0.005	-0.005	-0.005	-0.005	-0.005	-0.005			
- Calcium			44	51	47.5	62	66	64			
- Chromium											
- Copper			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			
- Cyanide											
- Hardness (Total)			361	372	366.5	290	304	297			
- Hydroxide											
- Iron (Dissolved)			-0.02	-0.02	-0.02	-0.02	0.02	0.015			
- Iron (Total)			0.03	0.08	0.055	0.08	0.29	0.185			
- Lead			-0.02	-0.02	-0.02	-0.02	-0.02	-0.02			
- Magnesium			57	64	61	33	34	33.5			
- Manganese (Dissolved)			-0.01	-0.01	-0.01	-0.01	0.01	0.008			
- Manganese (Total)			-0.01	-0.01	-0.01	-0.01	0.02	0.013			
- Mercury											
- Molybdenum			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			
- Organic Carbon (Total)											
- Phenols											
- Potassium			2	2	2	2	2	2			
- Selenium			0.001	0.001	0.001	-0.001	-0.001	-0.001			
- Silica											
- Silver											
- Sodium			26	36	31	11	11	11			
- Zinc			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) No monitoring station exists
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

ENVIRONMENTAL ASSESSMENT APPLICATION FOR LEASE WILLOW CREEK NORTH AREA

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management
Price River Resource Area



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Bureau of Land Management
Price River Resource Office

and

United States Department of the Interior
Office of Surface Mining Reclamation and Enforcement
(Cooperating Agency)

ENVIRONMENTAL ASSESSMENT

CYPRUS PLATEAU MINING COMPANY
APPLICATION FOR LEASE
WILLOW CREEK NORTH AREA

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1.0 PURPOSE AND NEED

1.1 BACKGROUND INFORMATION

Cyprus Plateau Mining Corporation (CPMC), a wholly owned subsidiary of Cyprus Western Coal Company (CWCC), currently operates the Star Point No. 2 underground coal mine complex located near Wattis, Utah approximately fifteen miles southwest of Price, Utah as shown by Figure 1.0-1, General Location Map. Cyprus-Amax Coal Company, the parent company of CWCC, also owns the inactive Castle Gate Mine, preparation plant, and loadout facilities located near the former town of Castle Gate, Utah approximately 10 miles north of Price, Utah and either owns or controls extensive underground coal reserves in the vicinity of the Castle Gate Mine.

Due to declining reserves within the existing Star Point Mine complex, the need to meet on-going coal contract commitments, and a desire to maintain stable on-going operations and related employment in the Price area, CPMC is proceeding with lease acquisition, planning, engineering, and environmental permitting for an underground coal mine, the Willow Creek Mine (Mine). The Mine is designed to replace the Star Point No. 2 complex as the existing coal reserves are depleted. For CPMC, as the project proponent, the purpose and need for the proposed action are directly related to the objectives of optimizing economic recovery of available coal reserves in the immediate vicinity of the planned Mine and establishing effective access to potential future coal reserves on the west side of the Price River.

In March 1995 CPMC, on behalf of CWCC, submitted a coal lease application to the Utah State Office of the Bureau of Land Management (BLM) for approximately 2,300 acres of land owned by the United States of America and managed by the BLM. CPMC also submitted a Mining and Reclamation Permit Application (May 3, 1995) to the Utah Division of Oil, Gas and Mining (UDOGM) addressing planned development, operation, and reclamation of the Willow Creek Mine and related facilities on existing fee lands and Federal, State, and County coal leases.

The proposed lease area is located approximately 10 miles north of the town of Price, Utah in Carbon County, with proposed new surface facilities for the Mine to be located adjacent to and north of Willow Creek and State Highway 191 in Willow Creek Canyon, approximately 1 mile northeast of the junction of Highway 191 with U.S. Highways 6 and 50. The Mine will utilize the existing preparation plant and loadout facilities currently permitted as part of the adjacent Castle Gate Mine. The Mine permit area covers an area of approximately 23 sections, extending north and south approximately 2.5 miles from the junction of the two highways and 6 miles to the east, as shown by Figure 1.0-2, Proposed Activities. The proposed lease area covers all or portions of five sections along the northern boundary of the proposed Mine permit area. This general area is part of the Book Cliffs of Central Utah and is characterized by high plateaus to the north; steep, narrow ridgelines cut by deep erosional drainages in the permit area and adjacent areas to the east, west, and south; and the relatively flat, dry, semi-desert areas of the Colorado Plateau to the south of the town of Price. Within the permit area, topographic relief ranges from 6,200 feet, near the confluence of Willow Creek with the Price River, to over 8,600 feet along the ridgelines to the southeast.

1.2 PURPOSE AND NEED FOR PROPOSED ACTION

1.2.1 Coal Leasing

The proposed action is approval and issuance of a coal lease for approximately 2,300 acres of Federal lands administered by the BLM pursuant to CPMC's March 1995 lease application. Subsequent development, operation, and reclamation of the Mine are considered in this environmental evaluation as reasonably foreseeable related future actions. The purpose and need for the proposed action are to make the associated mineral resources available for development, extraction, and beneficial use consistent with applicable provisions of the Mineral Leasing Act of 1920 as amended by Sections 2 and 3 of the Coal Leasing Amendments Act of 1976; the Federal Land Policy and Management Act of 1976 (FLPMA); BLM regulations; and the land use planning

and management determinations presented in the Price River Resource Area Management Framework Plan (MFP). CPMC applied for the subject coal lease to provide for efficient development of both the associated Federal coal reserves and existing adjacent leased Federal and fee coal reserves; provide access for future development of coal reserves to the west; and avoid bypass and possible sterilization of some of the marginal coal reserves contained within the proposed coal lease tract.

1.2.2 Required Agency Action

Under both FLPMA and the National Environmental Policy Act (NEPA), the BLM is required to evaluate proposed management actions relative to compliance with existing land management decisions and to determine whether or not the action would result in unnecessary or undue degradation of the potentially affected Federal lands. This EA provides the necessary information on issues, benefits, and concerns to allow the BLM as the responsible Federal land management agency to make the required determinations on both potential environmental impacts and lease issuance. As a cooperating agency, the Federal Office of Surface Mining Reclamation and Enforcement (OSMRE) will review and provide input on the environmental analysis.

1.3 AGENCY ROLES AND RESPONSIBILITIES

The proposed coal leasing and potential related future mining operations have been designed to effect full compliance with all applicable Federal, State, and local laws and regulations. Specifically, coal lease acquisition and management must comply with applicable land management regulations and guidelines of the BLM, and any mining plan application that may result from BLM's leasing decision must adhere to applicable regulations and guidelines set forth by OSMRE.

1.3.1 Bureau of Land Management

The BLM has the responsibility and authority to determine whether or not mineral leases, permits, and licenses are to be issued for Federal lands under the BLM's jurisdiction. Under applicable NEPA provisions, prior to granting leases, permits, or licenses, an evaluation of the potential effects of the proposed development on the environment of the affected area(s) must be completed. As the primary responsible Federal land management agency for those Federal lands which will be affected by the proposed Willow Creek Mine, the BLM will utilize this EA as a basis for the required determination on the lease application. The BLM will select a Preferred Alternative and determine whether or not the Preferred Alternative will result in unnecessary or undue degradation of potentially affected Federal lands consistent with applicable provisions of FLPMA. The BLM will also review the lease application and associated development plans in the context of the existing Management Framework Plan (MFP). Lease approvals may be conditioned on coordination with other resource values and land uses and appropriate rehabitation of disturbed lands.

1.3.2 Office of Surface Mining Reclamation and Enforcement

The OSMRE has jurisdiction over any mining plan application that may result from BLM's leasing decision. As a result, OSMRE is participating in the preparation of this EA as a formal cooperating agency.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) gives OSMRE primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations. In January 1981, pursuant to Section 503 of SMCRA, the UDOGM developed, and the Secretary of the Interior approved, a permanent program authorizing UDOGM to regulate surface coal mining operations and surface effects of underground coal mining on non-federal lands within the State of Utah. In March 1987, pursuant to Section 523 (c) of SMCRA, UDOGM entered into a cooperative agreement with the Secretary of the Interior authorizing UDOGM to regulate surface coal mining operations and 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 permit application packages to OSMRE and UDOGM for proposed mining and reclamation operations on federal lands in the state. UDOGM reviews the packages to ensure that the permit application complies with the permitting requirements and that the coal mining operation will meet the performance standards of the approved permanent program. If it does comply, UDOGM issues the applicant a permit to conduct coal mining operations. OSMRE, BLM and other federal agencies review the permit application package to ensure that it complies with the terms of the coal lease, the Mineral Leasing Act of 1920, the National Environmental Policy Act of 1969, and other federal laws and their attendant regulations. OSMRE recommends approval, approval with conditions, or disapproval of the mining plan to the Assistant Secretary, Land and Minerals Management. Before the mining plan can be approved, BLM and the surface management agency (if other than the BLM) must concur with this recommendation.

UDOGM enforces the performance standards and permit requirements during the mine's operation and has primary authority in environmental emergencies. OSMRE retains oversight responsibility for this enforcement. BLM has authority in those emergency situations where UDOGM or OSMRE inspectors cannot act before significant environmental harm or damage occurs.

1.3.3 Other Jurisdictional Agencies

For any related future mining operations, CPMC will also comply with applicable regulatory requirements relating to the following designated activities/structures under the authority of the noted jurisdictional agencies:

Federal Agencies

Office of Surface Mining Reclamation and Enforcement (OSMRE) - Compliance with the Surface Mining Control and Reclamation Act (SMCRA) under the Utah State Program as administered by UDOGM

Environmental Protection Agency (EPA) - Compliance with applicable air, water and hazardous materials requirements under programs administered by the Utah Division of Air Quality (UDAQ) and Utah Division of Water Quality (UDWQ)

U.S, Army Corps of Engineers (COE) - Compliance with Section 404 of the Clean Water Act as it relates to the planned construction and stream realignment activities in Willow Creek

U.S. Commerce Department, Bureau of Alcohol, Tobacco, and Firearms - Permits for procurement, transportation, storage, and use of explosives

Mine Safety and Health Administration (MSHA) - Compliance with applicable requirements relating to coal processing waste dams; impoundments and sedimentation ponds; plans for underground disposal of development waste, coal processing waste, or excess spoil; refuse piles; reclamation and closure of mine openings; any discharges into underground mines; mining within 500 feet of an active underground mine; and plans for extinguishing coal mine waste fires

U.S. Fish and Wildlife Service (USFWS) - Compliance under the Endangered Species Act, Bald Eagle Protection Act, and Migratory Bird Act

State Agencies

Utah Division of Oil, Gas, and Mining (UDOGM) - Compliance under the State of Utah Coal Mining Rules

Utah Division of Air Quality (UDAQ) - Compliance with applicable air quality permitting and operational requirements

Utah Division of Water Quality (UDWQ) - Compliance with applicable water discharge permitting, operational, monitoring, and reporting requirements

Utah State Engineer - Compliance with well and pond design and construction requirements and water rights requirements

Utah Department of Transportation (UDOT) - Highway modification and driveway permits

Utah Division of Wildlife Resources (UDWR) - Compliance with applicable wildlife protection measures

Utah State Historic Preservation Office (SHPO) - Compliance with applicable provisions of the National Historic Preservation Act

Local Agencies

Carbon County - Compliance with applicable requirements for special use, building, and water and sewer permits

CPMC either has applied or is in the process of applying for all required permits and approvals.

1.4 CONFORMANCE WITH LAND USE DESIGNATIONS AND PLANS

In accordance with applicable provisions of 43 CFR 1600, the BLM has developed and implemented a Management Framework Plan (MFP) for the Price River Resource Area which addresses both multiple use objectives and resource specific objectives for protection and management of those Federal lands under the BLM's jurisdiction and authority. The following program description summarizes the Minerals Management Decisions presented in the MFP:

> "The minerals program provides for the exploration and disposal of minerals by lease, license, or permit; coordination of minerals development with other land uses; and the assurance of rehabilitation of mined land ..."

The proposed action of coal leasing is consistent with both the general minerals management objectives as stated and specific multiple use objectives and decisions as outlined in the MFP.

The multiple use objectives and decisions for specific management categories (range, recreation, watershed, wildlife, and cultural) include limitations relative to the nature and extent of allowable disturbance. Relative to coal leasing, actual physical disturbance would be limited to that disturbance which would result from mine development, operation, and reclamation, as reasonably foreseeable related future actions. Specific control, reclamation, and monitoring provisions included in the mining and reclamation plans reviewed and approved by UDOGM with input from the BLM effectively address compliance with all applicable limitations imposed by the BLM's multiple use objectives and decisions as outlined in the MFP.

1.5 ISSUES AND CONCERNS

Issuance of the requested supplemental coal lease and related development and operation of the planned Willow Creek Mine offer a number of important benefits specifically including the following:

- Combines adjacent minable coal reserves with existing leased coal reserves as a logical mining unit assuring effective utilization and recovery of the available resource
- Assures continued availability of a valuable energy resource used to generate electricity and as an industrial heating fuel

- Provides for efficient development and consequent conservation of known coal reserves
- Facilitates effective reclamation, through a comprehensive reclamation program, of both new disturbance and previously disturbed areas
- Provides stable, high-paying jobs for approximately 250 to 300 employees with an annual payroll and benefits of $15 million or more
- Supports Federal, State, and local governments through payments of property, sales, excise, fuel, and other taxes estimated at $50 million or more annually
- Supports the National, State, and local economies through direct purchases of equipment, materials, supplies, and services (estimated at $25 million or more annually); royalty payment on fee and leased lands (estimated at $5 million annually); and indirect turn-over of these expenditures in the economy (multiplier of approximately $3.00 in total economic benefits for every dollar spent in wages, benefits, and purchases of goods and services)
- Supports local communities through charitable contributions

Since the Mine is designed to replace CPMC's existing Star Point Mine as the Star Point reserves are depleted, many of these are existing benefits which would be lost when the Star Point Mine closes and if the Mine were not developed. The new Mine will offer employment levels similar to the Star Point Mine although increased efficiency will result in production levels approximately 1.6 times current Star Point Mine production. The increase in production level is expected to result in corresponding increases in economic benefits. In addition, the adjacent unleased Federal coal is under significant cover depths and would probably be unminable using current mining technology if not recovered in conjunction with the planned Willow Creek Mine operations.

As well as the noted benefits, the planned mining and reclamation operations and related activities have the potential to result in possible environmental and socio-economic impacts. Based on available information on existing environmental resources and the planned mining and reclamation plans, potential impacts could occur in the following areas:

- Disturbance of existing soils, vegetation, and wildlife resources
- Impacts on existing land uses
- Air quality impacts
- Surface and ground water impacts
- Subsidence effects
- Socio-economic impacts

More detailed information on existing environmental resources and analysis of the planned mining and reclamation plans, potential mining related impacts, and planned control and mitigation measures is presented in the following sections of this EA.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO ACTION ALTERNATIVE

Under the No-Action Alternative the requested coal lease would not be issued. The proposed lease area and associated resources would remain in their current condition and configuration, subject however to any disturbance related to existing approved exploration and other activities. Potential adverse project related impacts would not occur, however, potential positive project related benefits would also be precluded. Since the No-Action Alternative would generally result in maintenance of existing conditions, it can be considered a reference for evaluation of all other potential alternatives.

It is important to note that development of the Willow Creek Mine, which is considered to be a reasonably foreseeable result of the Proposed Action, would likely still occur under the No Action Alternative, but would be limited to existing fee and leased Federal, State and County lands.

2.2 PROPOSED ACTION

2.2.1 Coal Leasing

The proposed action is approval and issuance of a coal lease for Federal lands administered by the BLM. The coal lease application covers approximately 2,300 acres of Federal lands located in the following areas as shown on Figure 1.0-2, Proposed Activities:

T12S, R9E, Section 25; Section 26-E½E½

T12S, R10E, Section 28 - S½, NE¼, S½NW¼, and NE¼NW¼; Section 29 - E½SE¼, NW¼, N½NE¼, and NW¼SW¼; Section 30 - N½, SW¼, W½E¼, and NE¼SE¼

Leasing would provide both surface access for necessary mining and related activities and the rights to extract economically recoverable coal reserves consistent with the terms of the lease agreement and under the provisions and requirements of an approved mining and reclamation permit from the UDOGM. The subject Federal coal reserves would be accessed from mine workings developed in fee and existing leased Federal coal reserves to the south and east. No direct mining related surface disturbance is planned within the proposed lease area and surface effects would be limited to potential mining related surface subsidence.

The Proposed Action of coal leasing involves the following sequence and timing of events:

- Submittal of Coal Leasing Application (CPMC, March 1995)
- Submittal of Resource Recovery and Protection Plan (CPMC, February 1996)
- Completion of Coal Leasing EA (BLM, ___)
- Preparation and Issuance of BLM Decision Document (BLM, ___)
- Public and Agency Review and Comment (BLM, ___)
- Issuance of BLM Final Decision (BLM, ___)
- Coal Lease Sale (BLM, ___)
- Issuance of Coal Lease (BLM, ___)

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The following alternatives to the Proposed Action of Coal Leasing have been identified, briefly evaluated, and eliminated from detailed analysis. Preliminary evaluation of these alternatives focused on consideration of the following general objectives:

- Effective conservation and/or utilization of available resources
- Protection, mitigation, and restoration of environmental resource values
- Protection of human health and safety

Reasons for elimination from detailed analysis are noted for each alternative.

Reduced Leasing Alternative - A reduction in the area and total reserves under the requested lease was considered as a possible alternative to the Proposed Action. This alternative was eliminated from detailed consideration and analysis because the requested lease block is based on a logical sequence of mine development and recovery of available coal reserves to the practical economic and operational mining limit. Reduction of the lease area would offer no advantage relative to reduction of potential mining related impacts and would result in potential loss and sterilization of reserves since mining would then bypass these reserves and potential future access could be lost.

Expanded Leasing Alternative - Additional coal reserves are known to exist to the north which could be included within the proposed lease area by expanding the lease boundary to the north. This alternative was eliminated from detailed analysis because the proposed coal lease block encompasses the anticipated northerly mining limit based on structural, operational, and economic considerations. Based on prior operating experience in the area, the practical mining limit is roughly defined by the 2,200 foot cover line. Above 2,200 feet of cover it is believed that ground pressures may result in adverse ground control and operating conditions which would render mining impractical.

Deferred Leasing Alternative - The alternative exists to break the proposed lease area into segments and lease each segment separately as needed. This alternative has been eliminated from detailed consideration and analysis because it is inconsistent with integrated planning objectives and development of logical mine development plans and the associated regulatory and economic commitments, and would result in considerable duplication of effort for both the BLM and CPMC.

2.4 REASONABLY FORESEEABLE RELATED FUTURE ACTIONS

Issuance of the proposed coal lease will result in the following reasonably foreseeable related future actions:

- Coal Mine Development, Production, and Reclamation
- Powerline Relocation

Because of their complexity and scope, these reasonably foreseeable related actions are described in the following sections and related potential environmental impacts are summarized in Section 4.0.

2.4.1 Coal Mine Development, Production, and Reclamation

2.4.1.1 General Project Scope and Schedule

Underground mining operations, which would be a reasonably foreseeable future action which would result from the proposed coal leasing, will target recovery of remaining recoverable coal reserves contained in the "A", "C", "D", and "K" coal seams. The proposed mining plans include mining of recoverable reserves in areas with less than approximately 2,200 feet of overburden cover as shown by Figure 1.0-2, Proposed Activities. There are extensive reserves under areas with greater than 2,200 feet of overburden, however, recovery of these

reserves is not considered feasible at this time using current mining technology. Most of the mine development work will involve underground methods using continuous miners and electric shuttle cars.

CPMC plans to utilize high productivity longwall mining systems for actual coal production, with coal haulage from the mine using a high speed main conveyor fed by several face conveyors from each of the active development areas, continuous miner sections, or longwall panels. The mine has been designed for a nominal annual production rate of 5.0 million tons of coal, based on an operating schedule of 250 days per year, 2 shifts per day, 8-hour shifts, with a base production rate of 1,000 tons per hour. The potential exists that, based on coal market conditions, the production rate could be increased by adding a third shift, resulting in a peak design production rate of 6.0 million tons of coal per year. The projected life of the Mine is approximately 15 to 20 years with the potential to extend the mine life significantly with development of additional coal reserves to the west.

2.4.1.2 Mine Construction and Development

Mine construction and development involves those activities necessary to complete the surface facilities and systems as shown on Figure 2.0-1, Mine Surface Facilities, and to develop mine portals, main entries, longwall panels, and the entire underground infra-structure which will be required to support the planned underground mining operations. From an environmental standpoint, the mine construction and development phase will be important due to the fact that essentially all direct mining related surface disturbance will occur during this phase. Mine construction and development activities have been designed and will be conducted in a manner that prevents or controls erosion and siltation, water pollution, and damage to public or private property; and to the extent possible using the best technology currently available, minimizes damage to fish, wildlife, and related environmental values, and minimizes additional contributions of suspended solids to streamflow or runoff outside the permit area.

In order to provide for a smooth transition of coal production from the existing Star Point Mine complex to the new Mine facility and continue to meet existing coal contract obligations, CPMC initiated certain pre-development activities during the 1995 construction season. These activities included re-excavation of the existing mine face-up area, placement of the coal refuse material previously placed in this area under the Utah AMR program in the existing permitted Schoolhouse Canyon coal refuse disposal area, and widening of a portion of State Highway 191 to accommodate required turn lanes. Re-excavation of the face-up area and relocation of the resulting coal refuse proceeded under a technical revision to the existing approved Castle Gate Mine Permit. Required highway modifications occurred entirely within the existing Highway 191 right-of-way and were conducted under approved plans developed in consultation with and under the jurisdiction of the UDOT.

All other planned construction and development activities will proceed, as soon as operationally feasible, following receipt of required permit approvals. It is anticipated that the necessary permits will be approved early in the second quarter of 1996, with construction and development activities proceeding immediately upon receipt of permit approvals and continuing over the next 18 to 24 months.

Required mine construction and development activities will proceed in a logical sequence to assure effective environmental protection and engineering control of these activities. The following general sequence of activities will be applicable for all planned mine construction and development activities:

- Establish preliminary access
- Construct required drainage and sediment control structures
- Recover and stockpile available soil or substitute materials
- Construct required roads
- Proceed with required site grading, excavation, and cut/fill operations
- Complete required foundation preparation work
- Construct required structures and facilities
- Complete required utility installations

- Develop mine portals, main entries, and longwall panels
- Complete infrastructure for underground operations (includes electrical systems, water distribution, communications, ventilation, mine drainage systems, and conveyors)
- Systems testing and commissioning

2.4.1.3 Mining and Related Operations

The mine plans and planned mining methods described in this section reflect CPMC's detailed review and evaluation of all existing available geologic and coal quality data, consideration of related environmental factors such as hydrologic and subsidence considerations, and the extensive operating experience of CPMC and other mine operators in this area. Overall project objectives include the following:

- Maximize recovery and utilization of the available coal resource
- Optimize coal production efficiency and economics
- Facilitate potential future development of nearby coal reserves
- Provide a safe, healthy, secure working environment
- Minimize potential adverse environmental impacts
- On completion of mining, provide for restoration of a productive, self-sustaining postmining land use

Based on CPMC's detailed review and evaluation of possible alternative mining scenarios, the plans presented in this section were selected as the best combination of mine layout, mining method, and mine sequencing in order to achieve the noted objectives and provide for organized sequential mining operations.

Previous mining experience in the general area and existing mining technology indicate that a maximum effective cover of approximately 2,200 feet represents a practical mining limit due to ground control considerations. This assumption would be tested by extending the D Seam main entries to the north beyond the 2,200 foot cover limit. If no significant ground control problems are encountered in the D north extension, CPMC would proceed progressively with longwall panel development and longwall extraction, monitoring ground conditions and response at each stage of the development process. Mining would remove coal reserves down to a minimum practical mining thickness of 5 feet which is the lower limit for the selected continuous mining equipment. The longwall equipment planned for use in the Mine can effectively recover coal seams down to a minimum seam thickness of 6.5 feet. Longwall mining methods, which inherently provide the highest potential recovery of any available underground mining method, will be used wherever operationally feasible to recover available coal resources. In any area where longwall operations are not feasible, room and pillar mining methods will be utilized, and CPMC will generally practice full retreat mining in room and pillar mining sections to recover as much of the remaining coal as reasonably possible.

Planned coal development and production is expected to begin with the D Seam (1996 through 2001), progress to the K Seam (1998 through 2012), continue with the A Seam (2001 through 2013), and then go back and pick up the C Seam (2006 through 2011). All mining prior to 1998 would occur in fee and existing Federal coal lease areas. Mining of the additional coal reserves contained in the supplemental lease tract would occur beginning in 1998 and continuing through 2006. It is estimated that the proposed coal lease tract contains approximately 16.0 to 25.0 million tons of high quality coal, although recovery of the in-place reserves in this area may be constrained by practical mining considerations related to the depth of the overburden cover. The supplemental lease area is important to the overall Willow Creek mine plan because it would provide direct access along the northern mining limit to extensive potential future coal reserves to the west of the Price River and serve as an effective access corridor for development of the eastern reserves included in the present mine plan.

Underground mining is a relatively complex process involving a number of inter-related activities which are designed to optimize coal production and handling, minimize environmental damage, and assure safe and healthy working conditions for the miners. The planned mining operations would involve the following activities:

Mining Activities

- Mine development
- Coal extraction
- Coal haulage
- Waste handling

Support Activities

- Ground control
- Mine ventilation
- Mine drainage
- Maintenance and miscellaneous support activities

The mining activities are discussed in the following sections. Ground control is an integral part of mining and is addressed both in the discussion of mining activities and under Subsidence Control and Monitoring. Other associated support activities are discussed separately.

Mine Development. Mine development involves excavation and construction of the underground openings, or entries, required to access the minable coal reserves, provide for efficient production of those reserves, facilitate haulage of both coal and mine waste, and provide for effective ventilation of the mine workings. Development activities would include development of mine portals, main entries, sub-mains, slopes and raises, and longwall panels.

The mine entries will be the primary mine access and supply routes for each minable coal seam, providing access and ventilation for all underground mine workings. Bleeder entries, which will be used to bleed off naturally occurring methane gas prior to mining and to route any continuing methane drainage to exhaust entries during and following mining, will be developed as mining progresses. Longwall panel development, will involve development of headgate and tailgate entries parallelling each longwall panel.

Development of slopes and raises may take advantage of modern raise boring technology which involves drilling a pilot hole using conventional surface or underground long-hole drilling equipment, connecting a rotary cutterhead on the lower level to a drive unit on the upper level, and progressively boring the required mine opening by advancing the rotating cutterhead toward the drive unit. All other mine development will involve the use of continuous miners to advance the development entries, electric shuttle cars to remove the excavated coal or waste rock, and electric roof bolters to provide required roof support.

Coal Extraction. CPMC plans to utilize the longwall mining method as the primary coal extraction and production technique. There are, however, certain areas where longwall mining will not be feasible due to limited seam thickness, the configuration of the remaining coal reserves (inadequate width or length to justify the costs associated with longwall development and set-up), geologic conditions, or potential subsidence concerns. In these areas, room and pillar mining methods will be utilized with continuous miners, shuttle cars, and roof bolters as the primary production equipment. Typical longwall recovery rates are 75 percent or greater since this mining method eliminates the need for temporary or permanent support pillars within the mining area. Longwall mining involves continuous recovery of coal from large blocks, or longwall panels, using semi-automated equipment systems. CPMC has used the longwall method successfully for the past 11 years at the Star Point Mine and feels that, based on site conditions, it represents the best method to insure maximum resource recovery and controlled subsidence. The longwall panels are expected to be approximately 500 to 800 feet wide and varying from 2,000 to 9,500 feet in length.

The following primary equipment is required to support longwall mining operations:

- Longwall shearer
- Armored face conveyor
- Stage loader
- Hydraulic support shields
- Panel conveyor
- Hydraulic and electrical support equipment and controls
- Shield transporters

Room and pillar mining, using continuous miners, is one of the primary underground coal mining method utilized in many mines and offers the benefits of low capital cost for the required mining equipment and considerable flexibility. Continuous miners can negotiate tectonically disturbed areas of the mine and adapt to seam variations and uneven reserve blocks. Continuous mining equipment is also relatively mobile and can easily be moved to different locations within the mine allowing relatively quick adjustments and continued production if ground control, water or other problems prevent further mining in an active mining area. Room and pillar mining involves development of underground mine openings (entries and cross-cuts) with intermediate pillars to support the mine roof during active mine advance. Each mining area developed using this method then becomes a "room" with a grid of supporting pillars. Once the mining advance reaches the mining limit for each area, retreat mining begins with partial extraction of the coal remaining in the support pillars. Because at least partial pillars must be retained during retreat mining to prevent total collapse of the mine roof coal recovery using room and pillar methods rarely exceeds 55 to 60 percent. Essentially all mine development work would be conducted using room and pillar mining methods except for completing slopes and raises, and would also be used to recover coal which is not recoverable using longwall methods.

The following primary equipment is required to support room and pillar mining operations:

- Continuous miner
- Shuttle cars
- Roof Bolter
- Feeder Breaker
- Section power center
- Mantrip vehicle
- LHD scoop
- Portable rock duster
- Section conveyor
- Miscellaneous support equipment

Coal Haulage. The mine coal haulage system will consist of several interconnected components to transport the coal to the surface. Coal haulage between the various mining levels will involve the use of main haulage belts on the intermediate access slopes which will transfer the coal from the lower level to the main haulage belt on the next level above. All coal transfer points are designed to minimize dust generation and dispersion using enclosures or water sprays, drop height will be limited to the extent operationally feasible, and impact beds and conveyor skirting will be utilized as appropriate to minimize coal breakage and dust generation, and contain both the coal stream and any associated coal dust. Consistent with safety considerations and applicable MSHA regulations, all underground coal haulage belts will be located in separate entries where they are isolated from both intake and return airways.

Waste Handling. Mining and related activities can result in production of mine waste materials including waste rock, carbonaceous shale, weathered coal, floor clay, and parting material. Where it is operationally feasible to separate these materials they will be removed and handled separately using the same equipment and haulage systems that will be utilized for room and pillar operations. Mine waste generated in conjunction with ongoing mining and related operations would be temporarily stockpiled until they can be recovered and transported to the surface during a scheduled waste handling shift.

Mine Ventilation. Effective ventilation of mine workings will involve the use of ventilation fans and control of airflow within the mine workings to provide adequate airflow volumes and flow rates in all active working areas. Airflow will be controlled, under mine ventilation plans submitted to and approved by MSHA, by maintaining a pressure differential which will force the air to follow a pre-determined path through the mine workings. The pressure differential and desired airflow will be maintained by isolating intake and return airways with air-tight stoppings and utilizing the network of mine entryways to effectively route both clean (intake) and used (return) air through the mine.

Dewatering and Mine Drainage Control. Ground water inflow to the active mine workings is expected to be limited given the relatively low overall permeability of the geologic sequence, limited recharge, and consequent lack of a significant ground water aquifer in the area to be mined. Water accumulations in abandoned underground workings in the area may result in localized increases in the amount and availability of ground water, particularly in down-dip areas to the north and east. Any ground water inflows to the active mine workings will be controlled by intercepting the water near the point of inflow with either shallow ditches or sumps and transferring the water to either abandoned mine areas or temporary holding areas. Minor ground water inflows will not be addressed unless they interfere with mine operations or pose a potential safety hazard.

Given the limited ground water inflow which is expected, mine water discharge to the surface is not anticipated. In the unlikely event that discharge does become necessary, however, mine drainage will be transferred within the mine and then to the surface utilizing a series of ditches in combination with intermediate sumps and submersible pumps and pipelines. On the surface, any mine drainage would either be routed to the mine water storage tank through the mine water system piping, or discharged to Sedimentation Pond 001, which has been designed to provide temporary storage for approximately 1.0 acre-feet of mine water discharge. Any mine water discharge routed through the sedimentation pond would be subject to sampling and applicable effluent discharge limitations.

Maintenance and Miscellaneous Support Activities. A number of support activities including rock dusting; extension of mine electrical, communications, and water systems; equipment maintenance and repair; and material and equipment supply and storage are necessary to maintain safe, efficient underground operations. Many of the necessary mining support functions including electrical distribution, mine ventilation, underground communications, and health and safety considerations are governed and monitored by MSHA under applicable provisions of the Coal Mine Health and Safety Act of 1969, and will be conducted under specific MSHA plan approvals.

2.4.1.4 Subsidence Control and Monitoring

Underground mining typically leaves a void where the coal has been removed, resulting in full or partial collapse of the immediate overlying units and potential deformation or settlement of the overlying ground surface, termed subsidence. The amount and nature of surface subsidence can be highly variable depending on coal extraction thickness, depth, mining method, mining sequence, geology, stratigraphy, and other factors. An evaluation of proposed mining plans and available geologic information determined the critical mining width above which maximum potential subsidence would occur is approximately 1.6 times the minimum overburden depth. At mining widths greater than or equal to this critical width, the maximum potential surface subsidence is projected at 0.7 times the coal extraction thickness. The angle of draw, which defines the horizontal limit of potential subsidence effects and is measured from a vertical projection of the actual mine disturbance limit, is predicted to be 22.5 degrees (Agapito, 1994).

All of the planned mining and related operations, including those activities within the proposed lease tract, have been designed to provide for safe operating conditions and to control or minimize subsidence to the extent reasonably practicable within the constraints of effective resource conservation and recovery. Design ground control measures include CPMC's layout and orientation of planned mining areas; mine development sequencing; sizing of development entries, pillars, and longwall panels; and selection of appropriate mining method(s) for specific mining areas. Operational ground control measures will include the following:

- Control and sequencing of development and mining operations consistent with design plans
- Use of roof bolts, trusses, cribs, timber props, and other artificial roof support measures consistent with an approved MSHA Roof Control Plan
- The temporary roof control provided by shield supports on longwall panels as well as the controlled stress relief inherent in the longwall mining method
- Use of yielding chain pillars in longwall areas to provide for gradual controlled caving and stress relief
- Controlled pillar recovery during retreat in room and pillar mining sections and the accompanying controlled caving and stress relief
- Retention of barrier pillars or avoidance of full extraction mining adjacent to main and sub-main haulageways and in other areas where necessary to prevent or minimize surface subsidence and protect surface features or structures
- Implementation of a comprehensive subsidence monitoring program with evaluation of the resulting data and modification of mining plans and methods if appropriate

2.4.1.5 Mine Structures and Facilities

The planned underground mining and related activities will require limited surface support facilities. The facilities to be utilized in conjunction with the planned operations will include both existing facilities located in the Castle Gate, Gravel Canyon, and Crandall Canyon areas and new facilities to be constructed in the planned Willow Creek Mine surface facilities area. None of the planned surface facilities will be located within the proposed coal lease area. The planned facilities will provide the necessary infrastructure for effective management and handling of personnel, equipment, materials and supplies, and both coal and mine waste materials, and will include a number of structures specifically designed to control or mitigate potential mining related impacts.

The surface structures and facilities will be operated, maintained, and ultimately reclaimed in a manner that prevents or controls erosion and siltation, water pollution, and damage to public or private property. In addition, to the extent possible using the best technology currently available, proposed structures, facilities, and operations will minimize damage to fish, wildlife, and related environmental values, and additional contributions of suspended solids to streamflow or runoff outside the permit area.

2.4.1.6 Reclamation of Mining Disturbance

Reclamation of surface disturbance areas would generally occur following the cessation of mining operations, although CPMC would implement temporary stabilization measures in certain areas following initial construction or during ongoing operations, including progressive reclamation of the Schoolhouse Canyon refuse stockpile.

Objectives of the planned reclamation activities will be twofold; 1) For construction disturbance and ongoing surface disturbance such as that associated with expansion of the coal refuse stockpile, temporary stabilization and contemporaneous reclamation will serve to stabilize disturbance areas, minimize erosion, and limit potential surface water impacts; 2) For long-term use areas, final reclamation is designed to restore disturbed areas to a safe, stable condition and to reestablish the productivity of the land consistent with the postmining land use(s). The Mine reclamation plan has been designed to successfully meet these objectives and will result in effective temporary stabilization, and a postmining configuration which blends with the surrounding terrain and provides environmental values consistent with or superior to those which existed prior to mining.

Reclamation will involve a logical sequence of activities designed to achieve the overall reclamation objectives in an organized progressive manner. The following represent the general steps for reclamation of any mine or mine related surface disturbance areas:

- Facility Demolition and Removal
- Stabilization and Sealing of Mine Openings
- Disposal of Coal Refuse, Non-Coal Wastes, and Mine Waste Materials
- Backfilling and Grading to Establish the Final Design Configuration
- Drainage Reestablishment
- Road Removal
- Soil/Substitute Replacement
- Revegetation
- Post-Reclamation Management, Maintenance, and Monitoring
- Removal and Reclamation of Sedimentation Ponds and Associated Structures

Since there will be no surface disturbance other than potential mining related subsidence within the proposed coal lease area, the noted reclamation considerations are not directly applicable.

2.4.2 Powerline Relocation

The only existing structure which will potentially be impacted by subsidence resulting from the proposed mining operations is a power transmission line extending up Barn Canyon. Relocation of the powerline to an area which would not be impacted by the proposed mining activities or related subsidence is currently under consideration. In addition to the No-Action Option, where the existing powerline would remain in its current location with the potential for subsidence related damage and interruption of service, to potential line relocation options were identified and are briefly outlined below:

- **Power Line Relocation Option A** - This routing option follows an existing electric distribution line along the railroad and the Price River to the entrance to Sulphur Canyon. It follows Sulphur Canyon to Emma Park where it meets the existing line from Barn Canyon. This routing option would require the construction of approximately 5 miles of transmission line at an estimated cost of $2,529,000 and would result in maximum surface disturbance of approximately 12.1 acres (assumes a 20 foot disturbance corridor). Actual surface disturbance would probably be significantly less since poles could be set in many locations with only localized disturbance and both the section along the Price River and the upper half of Sulfur Canyon would be accessible from existing roads. Construction along this alignment could follow an abandoned communications line and utilize the existing associated access. Option A is the preferred option since construction and maintenance access requirements would be minimized; this alignment would generally avoid conflicts with mining activities and existing powerlines, the risk of land subsidence and associated rock slides would be precluded, and total length and construction cost would be reduced.

- **Powerline Relocation Option B** - This powerline routing option follows the existing Carbon-Spanish Fork #1 138 kV line. It proceeds up Willow Creek Canyon approximately 3 miles from the Carbon Power Plant to Hells Canyon, up Hells Canyon about 1 1/4 miles to Emma Park and then about 2 1/2 miles to a point where it meets the existing Carbon-Spanish Fork #2 line. This routing option is approximately 7 miles in length. Construction costs are estimated at $3,643,000 and maximum surface disturbance would be approximately 17.0 acres (assumes a 20 foot disturbance corridor). Actual surface disturbance would probably be reduced due to pole placement considerations, but this option would require construction of a new access. Concerns associated with this option include the potential for three major transmission lines along the sides of Willow Creek Canyon; conflicts between mine facilities and transmission lines; the need for extensive side hill construction and access roads in Hells Canyon; and difficult construction and maintenance within Hells Canyon.

3.0 AFFECTED ENVIRONMENT

Commercial and industrial development in the general area of both the proposed coal lease area and the associated Mine includes extensive historical underground mining activities, the nearby PacifiCorp Carbon Generating Station, and transportation facilities, as represented by U.S. Highways 6 and 50, State Highway 191, and the Denver and Rio Grande Western (D&RGW) Railroad line running up the Price River Canyon. Most of the proposed lease area and the remainder of the planned Mine permit area generally consists of undeveloped lands utilized for low-intensity grazing, wildlife habitat, limited dispersed recreation, and very limited timber production.

Active underground mines operated continuously from the 1870's through the 1940's, when coal demand and production began to decline due to reduced post-war industrial production and the shift to diesel railroad engines. The Castle Gate Mines No's. 1, 2, and 4, which were within the area encompassed by the mine permit boundary, were developed and operated from 1888 through 1972, when the last of the mines closed. Although extensive underground mine development and production occurred throughout the proposed permit area, associated surface disturbance was generally limited to mine portal and surface facility areas in the valley bottoms and on natural bench areas adjacent to existing drainages.

This section presents a discussion of the affected environment and the major resource areas of concern including:

- Geology
- Hydrology
- Soil Resources
- Vegetation
- Fish and Wildlife
- Land Use
- Cultural Resources/Native American Religious Values
- Air Quality
- Socioeconomics
- Transportation
- Recreation and Aesthetic Resources

The following resource categories or sensitive areas are not addressed within this EA for the specific reasons noted:

- Areas of Critical Environmental Concern (Includes Wildlife Refuges) - No areas of critical environmental concern have been identified within the project impact area

- Hazardous Waste - Hazardous wastes are not currently present within the project impact area and would not be used, generated or stored in conjunction with the reasonably foreseeable related mining activities

- Prime and Unique Farmlands - Prime and unique farmlands would not be affected because there are no designated prime and unique farmlands within the project impact area

- Wild and Scenic Rivers - Wild and Scenic Rivers would not be affected since there are no designated wild and scenic rivers within the project impact area

- Public Parks and Components of the National Parks System - There would not be impacts on public parks on National Park Service lands since no park lands fall within the project impact area

- Wilderness - Wilderness would not be affected because there are no designated Wilderness Areas or Wilderness Study Areas within the project impact area

- Designated Trail Systems - Designated trail systems would not be affected because no components of any designated trail system fall within the project impact area

- Wetlands - Wetlands would not be affected since no jurisdictional wetlands have been identified within the project impact area (riparian and stream community values are discussed under the vegetation (3.4) and fish and wildlife (3.5) sections)

- Floodplains - There are no perennial streams within the proposed lease area and the ephemeral drainages within the project impact area including Dry Canyon, Hell Canyon, Skinny Canyon, Dinosaur Canyon, and Barn Canyon, do not have defined floodplains. Floodplains, therefore, will not be affected

3.1 GEOLOGY

The proposed lease and associated Mine permit area are characterized as deeply incised "plateau topography". This topography consists of flat-topped ridges rising above, and bordering adjacent Colorado Plateau high desert lands. Major canyons include the Willow Creek Canyon draining from the north-west. Elevations in the general permit area range from over 8,000 feet above sea level on the tops of the flat-topped ridges to about 6,000 feet above sea-level along the Price River south of the permit area. Strata in the area is composed of moderately weak fine-grained units interfingered with thick, resistant sandstone units. Erosionally, these units create moderate to steep weathered slopes interspersed with vertically exposed resistant ledges and cliffs. The characteristic high relief is the result of extensive erosion along zones of weakness creating steep-walled canyons which intersect the proposed permit area.

The geology of the general area is dominated by relatively flat-lying, interbedded sedimentary units. Typical surface topographic features to the area, including elevated plateaus, near-vertical rocky cliffs, and steep weathered slopes, are reflections of the main lithologic units consisting primarily of resistant sandstones, and interbedded shales, siltstones, and mudstones. With the exception of minor localized jointing and cleating, there are no known major structural features in the permit and immediately adjacent areas.

The Cretaceous Blackhawk Formation is the principal coal-bearing formation. Mineable coal seams include, in ascending order, the Sub -1, 2, and 3 Seams, the A/B Seam, C Seam, Kenilworth (K) Seam, and the D Seam as shown by Figure 3.0-1, General Stratigraphic Column. Mineable coal seams range from 3.5 to 25 feet in thickness and are bituminous in character. The Aberdeen Sandstone is the first stratigraphic unit below the lowermost coal seam to be mined. Ground water occurrences have been documented in the Aberdeen Sandstone as well as in several other sandstone members in the stratigraphic sequence. These units appear to have sufficient permeability to store and transmit ground water and, dependent on lateral extent and recharge conditions, may function as localized perched or regional aquifers.

Based on chemical analysis of coal, roof, and floor samples, overall sulfur content is low with organic sulfur as the dominant sulfur form in the coat and pyritic sulfur as the dominant form in the overburden materials. Acid producing potential is consequently low and buffering capacity is relatively high due to the presence of significant quantities of calcium resulting in very low acid-forming potential. Similarly, chemical analysis generally indicate low concentrations for most potentially toxic components and low alkalinity producing potential. The chemical analysis results and subsequent conclusions are generally consistent with chemical analysis of coal refuse materials from previous mining operations involving production from the same coal seams. Exceedences indicate some potential for elevated SAR and localized increased in boron and selenium concentrations. Elevated SAR values for drillhole samples are, however, inconsistent with analysis results for mine waste and coal refuse samples from the same geologic units. Where mine waste rock or coal refuse materials are placed in surface stockpiles, suitability testing for these specific components may be appropriate as part of the overall reclamation program.

3.2 HYDROLOGY

Within the proposed lease and associated permit and adjacent areas both surface and ground water hydrologic features and regimes are reflective of and strongly influenced by geologic structure, stratigraphy, lithology, and localized topography and climatic conditions.

Generally, the topography in the area is very rugged. High plateaus are present to the north, west and northeast of the proposed lease and surrounding areas, with narrow ridgelines cut by deep drainages to the east, west, and south. The rugged, very steep terrain, and deep drainages effectively limit the recharge and lateral continuity of any potential aquifers as evidenced by the few, small flow seeps and springs in the area. Semi-arid climatic conditions and precipitation patterns result in a high loss of moisture to runoff, evaporation, and sublimation reducing the amount of water available for recharge or streamflow. Recharge to underlying units is also limited by the small outcrop areas of the flat lying units. Downward movement of recharge through the stratigraphic sequence to underlying units is limited by low vertical permeabilities of the units (which are often fine-grained, well cemented, or massive), the presence of relatively impermeability shale unites acting as confining layers, and the lack of faulting or fracturing.

As a result of these controls, ground water occurrence is limited to shallow ground water contained in the alluvial/colluvial deposits associated with local drainages; isolated zones containing perched ground water; limited ground water storage in abandoned mine workings which extend throughout the area; and a regional aquifer occurring in the deeper portions of the Blackhawk Formation and extending into the underlying Star Point and Mancos Formations.

3.2.1 Ground Water

3.2.1.1 Ground Water Resources

Ground water resources in the proposed lease, permit, and adjacent areas are limited in both extent and quantity. Ground water occurrence has been quantified by drilling, aquifer testing, hydrogeologic analysis of water-bearing strata, mapping of ground water storage in underground mines, a spring and seep survey, and analysis of water quality and quantity characteristics.

Ground water occurrences are limited: shallow alluvial/colluvial valley-fill deposits in local drainages; perched ground water in thin, laterally discontinuous units associated with the Price River, North Horn, and Flagstaff Formations; ground water accumulated over time in extensive underground workings; and, the regional aquifer consisting of deeper units in the Blackhawk Formation extending into the underlying Star Point and Mancos Formations.

Ground water movement is limited by low transmissivities, the lack of significant secondary permeabilities, and limited recharge in outcrop zones. Ground water has gradually accumulated over time in the down-dip workings of mines, resulting in potentially significant volumes of water. Mine inflows are minimal.

3.2.1.2 Ground Water Quality

Water quality is variable as a result of the different lithological compositions of the area bedrock and the variable residence time of ground water, which affects the amount and types of dissolved constituents. Ground water quality is highly variable dependent on the recharge source, flow path, strata with which the water comes in contact, and discharge mechanism. Generally, water quality for alluvial/colluvial ground water sources is very similar to surface water quality for the associated drainages reflecting close interaction between the two systems. Water quality for perched ground water sources, stored mine water, and the regional ground water aquifer system reflect some degradation relative to surface water sources due to contact with and dissolution of soluble minerals and salts in the geologic sequence.

A relatively short flow path between the recharge area and discharge point for most perched ground water results in limited water quality degradation. The total dissolved solids (TDS) concentrations of springs issuing from the Flagstaff or North Horn Formations are generally less than 500 mg/L. Springs issuing from the Price River Formation generally contain TDS concentrations of 800 to 100 mg/L. Generally, for both stored mine water and the regional ground water aquifer, water quality degradation is greater the deeper in the geologic sequence the water is found. For example, TDS concentrations is deeper portions of the regional aquifer such as the Mancos Shale frequently exceed 3,000 mg/L. This observation is consistent with the assumption that within the regional ground water aquifer, ground water gradually percolates downward through the geologic sequence with resultant dissolution of soluble metals from all units and salts from the shale members. Available data indicate that TDS values for the regional ground water aquifer and stored mine water in the western coal reserve area are within the same range with no indication that mine inflow, water accumulation, and long-term ground water storage in abandoned mine workings results in any significant ground water quality degradation (Castle Gate, 1994). Ground water in the Willow Creek Mine area is typically a weak calcium sulfate or sodium sulfate chemical type. In the western coal reserve area, ground water is also typically a weak calcium sulfate chemical type or, in one well, a sodium bicarbonate chemical type. Mine discharge/inflow in the western coal reserve area is typically a weak calcium sulfate chemical type, similar to that of ground water in the western coal reserve area. There is some potential that interception of ground water by the abandoned mine workings may reduce further downward percolation and resulting degradation of water within the regional ground water aquifer.

Available water quality information is summarized in Appendix A, Ground Water Quality Summary. The following discussions summarize important information relative to existing ground water conditions in the permit area.

pH - Field measured pH values range from 7.6 to 9.3, indicating neutral to moderately alkaline conditions. High pH values are relatively common in the arid western United States and are reflective of the geochemistry of the dominant stratigraphic unit

Electrical Conductivity (EC) - Ground water EC values vary widely, with field measured values ranging from approximately 1200 to 3,350 μmhos/cm. Generally, lower EC values are associated with near-surface ground water sources including alluvial/colluvial and perched ground water occurrences while high EC values are associated with either relatively deep regional ground water sources or moderate to highly permeable marine sediments

Total Dissolved Solids - Measured ground water TDS values range from 1,270 to 2,450 mg/l. Observed high EC values as described above are directly correlated to elevated TDS values. The observed variability in TDS values is a reflection of the highly variable lithologic composition of area bedrock. The more permeable sandstones with limited cementation have few soluble components and any ground water associated with these units will typically have very low TDS content. The more highly consolidated marine shales and fine-grained siltstones have low permeability and greater concentrations of salts and other soluble components resulting in longer residence times and greater potential for dissolution and salt loading

Iron - Concentrations of dissolved and total iron range from <0.01 to 0.39 and 0.17 to 15.7 mg/L, respectively. Given that many of the lithologic units in the area show visible evidence of iron cementation, it is reasonable to assume that the observed iron concentrations are related to natural sources and processes of weathering and oxidation

Magnesium - Concentrations of magnesium range from 19 to 140 mg/L, which are consistent with natural concentrations in sedimentary sequences in the southwest

Oil and Grease - Oil and grease concentrations for the four wells range from 1 to 6 mg/L. These values are at or slightly above the detection limit and may be a reflection of naturally occurring petroleum in the sedimentary sequence or constituents used during the construction and installation of the monitoring wells

3.2.2 Surface Water

Both surface and ground water hydrologic features and regimes within the proposed lease and associates permit and adjacent areas are reflective of and strongly influenced by geologic structure, stratigraphy, lithology, and localized topography and climatic conditions.

The climate in the proposed lease and adjacent areas is arid to semi-arid. The area is in a mean annual precipitation belt of 13 to 25 inches (USGS, 1978). The mean annual precipitation for the area is approximately 14.84 inches. Average monthly precipitation ranges from 0.65 inches in June to 1.86 inches in September (Utah State University, 1994). Most of the precipitation falling as snowfall occurs during December, January, February, and March. Precipitation falling as rainfall, commonly high-intensity short-duration storms of limited aerial extent (Butler and Marsell, 1972), occurs during spring, summer and fall, with August, September, and October receiving the maximum moisture. Temperatures in the proposed lease area are seasonal, with the high mean monthly temperature occurring in July and the low mean monthly temperature occurring in January (NCC, 1975). Evaporation and infiltration rates in the proposed lease and adjacent areas vary with vegetation, soil type, and time of year. The average annual potential evaporation in central Utah is 40 inches per year (Geraghty, et al., 1973). Net infiltration rates for unfrozen soils under similar conditions to those found in the region are around 0.50 inches per day (Gray, 1973).

Generally, the topography in the area is very rugged, with high plateaus to the north and steep and narrow ridgelines cut by deep drainages in the permit area and surrounding areas to the east, west, and south. The rugged terrain, the characteristics of dominant soils and formations which outcrop in this area, combined with the climate influence the surface drainage configuration and flow characteristics. Most drainage channels contain no flowing water except during snowmelt or precipitation events. The steep slopes and numerous deep, narrow drainages result in rapid runoff rates. This rapid runoff from snowmelt and thunderstorm precipitation causes relatively brief, high velocity flows in the smaller drainages, and significant flow variation in the larger drainages. Velocities in natural stream channels during 100-year floods were calculated for various representative stream channels in the area were found to range from 15 to 25 ft/sec (Earthfax Engineering, 1994). Measured stream flows in the area range from 1.0 to 450 cfs in the Price River, 0 to 11.4 cfs in Sulphur Canyon, and 0 to 335 cfs in Willow Creek (USGS, 1993). During 1994, flow in Willow Creek at monitoring site B3N changed from 0 cfs to large unmeasurable flow in early August (Ben Grimes, personal communication). Runoff from storm events typically carries heavy sediment loads. During 1994, during ongoing surface water monitoring by CPMC, total suspended sediment concentration ranges of 1,150 to 3,790 mg/L were measured in area surface waters following large storm events. These intermittent high-velocity flows limit the deposition of alluvial material in area flow channels while the steep, rocky cliffs, which form a dominant topographic feature of the area, contribute to significant deposits of large, blocky colluvial material on the lower slopes and in the steep-sided drainage valleys.

Willow Creek drains an area of approximately 49,540 acres. The headwaters are east and north of the proposed lease area draining the southern flanks of Reservation Ridge. Elevations range form approximately 9,100 feet to 6,100 feet at its confluence with the Price River. Willow Creek is one of the primary tributaries of the upper Price River drainage. Total drainage length is approximately 9.3 miles. The average annual basin discharge for Willow Creek at its mouth is approximately 6,500 acre-feet (Earthfax, 1994).

3.2.2.1 Surface Water Resources

Other than the Price River, surface water resources in the permit area are limited. The principal perennial streams located within or adjacent to the permit area boundary include: 1) Price River, the dominant drainage; 2) Sulphur Canyon, which is tributary to the Price River upstream of the permit boundary; 3) Willow Creek, which is tributary to the Price River, and drains the majority of the permit area; 4) Mathis and Deep/Buck Canyons (certain reaches) and Antone Creek which are all tributary to Willow Creek within the permit area; and 5) Summit Creek, which is tributary to Willow Creek upstream of the permit area, but drains portions of eastern extremes of the permit area. Numerous intermittent and ephemeral channels drain the area, many of which normally exhibit continuous flow only in response to spring snowmelt and/or high intensity thunderstorms.

Presently, beneficial surface water use in the area includes domestic water supply, industrial uses, and agriculture. Streams are classified as either 1C, "protected for domestic purposes with prior treatment by complete treatment processes", 3A, "protected for cold water species of fish and other cold water aquatic life", 3C, "protected for non-game fish, and other aquatic life".

3.2.2.2 Surface Water Quality

Water quality varies as a result of the different lithologic compositions of the area bedrock, the composition of contributing ground water, and the flow regime. Surface water conditions are typical of arid regions of the western United Sates. Seasonal or storm-event peak flows tend to dilute geochemical constituent concentrations. However, during low-flow periods, constituent concentrations tend to increase. For those constituents that appear to show elevated levels, it is reasonable to assume the elevated levels are a result of natural sources and the processes of weathering, oxidation, erosion, evaporative concentration and sediment transport.

Surface waters exhibit some variability, but in general, display a calcium-bicarbonate chemical type. Surface water in the Price River is a calcium-bicarbonate chemical type whereas surface water in Willow Creek is a mixed chemical type with, occasionally, a weak calcium signature. Ephemeral/intermittent tributaries also have water exhibiting a calcium-bicarbonate chemical type. Springs/seeps are typically a calcium-bicarbonate type. However, some springs/seeps display calcium-sulfate or sodium-bicarbonate chemical signature.

Surface water quality also varies temporally and appears to be generally flow dependent. Typically, constituent concentrations decrease during high flow periods and increase during low flow periods. Specific conductivity, total dissolved solids (TDS), and sulfate concentrations all appear to decrease during high-flow conditions and increase during low-flow conditions. Observed iron concentrations, however, do not show flow dependency. Concentrations tend to increase with higher flows and decrease under low flow conditions.

The Price River exhibits slightly different water quality than that of Willow Creek and the intermittent/ephemeral tributaries. Generally, mean constituent concentrations are lower in the Price River than in other area surface water. Most chemical constituents exhibit a flow dilution relationship, and with increased flows the concentrations tend to decrease. This process controls constituent concentration in most surface waters and this relationship potentially skews the data to suggest that the Price River water is of better quality than that of other area surface waters.

Surface water quality is summarized in Appendix B, Surface Drainages - Water Quality Summary. The following discussions summarize important information relative to existing surface water conditions in the proposed permit area.

pH - Measured pH values range from 6.9 to 9.6, indicating neutral to moderately alkaline conditions. High pH values are relatively common in the arid western United States and are reflective of the geochemistry of the dominant stratigraphic units. When pH values for stations above and below existing mine disturbance areas are compared, available monitoring data indicates no significant variance and thus no significant impact from these activities.

Phenols - Elevated phenol levels in several samples cannot be traced to any known disturbance activities. Since phenols are one of the common reaction products resulting form natural oxidation and in-situ combustion of coal, it is believed that the observed elevated phenol levels may be due to natural processes.

Sulfate - Natural sulfur springs have been identified in Sulphur Canyon, Willow Creek, and a number of other area drainages and the presence of hydrogen sulfide gas (H_2S) has been documented in area wells. In essentially all cases, elevated sulfate values can be tied to natural upstream sources.

Total Dissolved Solids - Observed high TDS values appear to reflect two basic characteristics of area surface and ground water systems. The first contributing characteristic is the direct discharge of

shallow perched ground water systems to surface drainages. As a component of the areas rugged terrain, many of the upper stratigraphic units outcrop in the deep natural drainages which divide the area. If these units have sufficient permeability to store and transfer ground water, they act as localized perched aquifers and commonly discharge to surface drainages within a relatively short distance from their recharge area. This mechanism results in direct transport of soluble minerals to the surface water system. The second contributing characteristic is the effect of extended dry periods which may significantly reduce stream flows, minimizing dilution of high TDS from ground water contributions and concentrating existing dissolved solids in remaining flows.

Total Suspended Solids - Given the topography and climate of the area, high TSS values may normally be expected during spring runoff and following major thunderstorms. Extremely steep natural slopes and channel gradients combined with short duration, high-intensity flows resulting from snowmelt and major thunderstorms result in significant surface erosion and sediment transport. Weathering and mass wasting of the exposed rock outcrops also results in significant colluvial deposition on the lower slopes and in drainages with the smaller fractions of the colluvium being mobilized and transported by storm runoff and resulting drainage flows.

Iron - Elevated iron values have been observed in surface water quality samples from several area drainages. Given that many of the lithologic units in the area show visible evidence of iron cementation and the direct correlation between elevated iron levels and high levels of suspended solids, it is reasonable to assume that in most cases the observed elevated iron levels can be correlated to natural sources and the processes of weathering, oxidation, erosion, and sediment transport.

3.3 SOIL RESOURCES

The USDA-SCS General Soils Map - Carbon County Area, Utah, shows the following three general soils types as occurring within the boundaries of the proposed lease area and the associated mine permit area:

- Type 7 - Strych-Gerst-Travessilla: Shallow to very deep, well drained, nearly level to moderately steep soils, on outwash plains, benches and mesas
- Type 10 - Travessilla-Rock Outcrop-Midfork Family: Shallow to very deep, well drained, steep and very steep, soils; and rock outcrop, on mountain slopes and canyon sides
- Type 14 - Beje-Trag-Senchert: Shallow to very deep, well drained, gently sloping to moderately steep soils, on plateaus and mountain valley floors

Type 10 is found over approximately 85 percent of the planned permit area and is found in nearly all areas except a portion of the extreme northeast corner of the permit area and a narrow tier along the southern edge of the permit area. Type 10 soils are also the dominant soil type on the proposed coal lease area.

Mapping for all soils within the project area is presented in the USDA-SCS report, "Soil Survey of Carbon Area, Utah" (SCS, 1988). A detailed soil survey was conducted for the planned mine surface facilities area by Mr. Kent Crofts of Intermountain Environmental (IME) in 1994. The site-specific surveys involved identification of individual soil series as well as all existing disturbance at a mapping scale of 1- inch equals 200 feet. The most significant aspect of this mapping relative to accurate characterization of existing site soil conditions is the resulting documentation of the location and extent of previously disturbed soils.

3.4 VEGETATION

There is considerable variation in vegetation resources over the mine permit area, with vegetation types ranging from low elevation salt desert shrub to montane coniferous stands. Changes in elevation, with associated moisture and temperature gradients have a major influence on vegetation types in the area. Topography, aspect, soil type, past and present land uses, historical grazing management practices,and historical range fires are also

significant factors affecting plan community distribution. Vegetation in the proposed lease area is dominated by vegetation communities characteristic of steep, dry slopes and upland areas although limited occurrences of all other vegetation types except disturbed communities are present.

Dominant vegetation types for the Book Cliffs area in the vicinity of the proposed lease area and the associated mine permit area include Sagebrush-Grass, Mountain Brush, Pinyon-Juniper, Aspen, Conifer, Ponderosa Pine, and Riparian community types. The Riparian Community, typified by cottonwoods and willows, is generally found only along perennial and intermittent streams. The Mountain Brush Community is often interspersed with other vegetation types. The Pinyon-Juniper Community is most commonly found on lower elevation south-facing slopes. Conifer stands, dominated by Douglas Fir, Subalpine Fir and White Fir are found on protected north-facing slopes. Extensive areas of ledges, talus slopes and rock outcrops which typify the Book Cliffs result in many areas which lack any significant vegetation.

3.4.1 Vegetation Communities

A total of five major undisturbed vegetation types and a disturbed area classification have been identified as occurring within the area corresponding to the mine permit area. The identified as occurring within the area corresponding to the mine permit area. The identified vegetation types include:

- Grass-Sage
- Mixed Brush
- Conifer
- Pinyon-Juniper
- Riparian Bottom
- Disturbed

The identified vegetation types are described in the following sections.

Grass-Sage Vegetation Type

The Grass-Sage vegetation type occurs on a steep dry slopes and in the lower reaches of several of the small intermittent and ephemeral drainages in this area. Depending on site conditions, either Basin big sagebrush (*Artemisia tridentate spp. tridentate*) or Salina wildrye (*Elymus salinus*) are the dominant species. Along the banks of Willow Creek in the vicinity of the mine facilities area, Basin big sagebrush dominates. Along the eastern banks of the Price River and on most of the exposed knolls and ridges in this area, however, Salina wildrye is the dominant plan species. Other frequently occurring plants in this vegetation type are Western wheatgrass (*Agropyron smithii*), Cheatgrass brome (*Bromus tectorum*) and Fourwing saltbrush (*Atriplex canescens*).

Mixed Brush Vegetation Type

The Mixed Brush Vegetation Type generally occurs on relatively moist sites such as the bottoms of canyons, gulches and depressions and is typically found on moderate to well developed soils at the lower elevations near Willow Creek and along the Price River. At higher elevations however, such as in the eastern portion of the proposed permit area, it occurs over a wide range of lope and aspect combinations. The visually dominant plant species for this type is Gambel's oak (*Quercus gambelli*), but Utah serviceberry (*amelanchier utahensis*) is often a co-dominant. Basin big sagebrush, Utah juniper (*Juniperus osteosperma*) and Pinyon pine (*Pinus edulis*) are often found on more xeric sites, while more xeric sites frequently support Wolfberry, (*Symphoricarpos occidentals*), Bigtooth maple (*Acer grandidentatum*) and quaking aspen (*Populus tremuloides*). Common understory plant associated with this vegetation type include Salina wildrye, cheatgrass brome, and Oregon grape (*Mahonia repens*).

Pinyon-Juniper Vegetation Type

The Pinyon-Juniper Vegetation Type is not typically found on steep, rocky, dry south-facing slopes between the Price River and Willow Creek and near the base of the Book Cliffs in the south portions of the proposed permit area. Below the base of the Book Cliffs, such as in the area to the east of Kenilworth, this type also occurs on more level or gently sloping but equally dry sites. The Pinyon-Juniper type may be characterized as open, pygmy forested type dominated by Pinyon pine and Utah juniper as the principle overstory species. Common understory shrubby species include Basin big sagebrush, Gambel's oak, Curleaf mountain mahogany (*Cerocarpos ledifolius*) and various species of Rabbitbrush (*Chrysothamnus spp.*). The most common grasses are Salina wildrye and various wheatgrasses.

Riparian Bottom Vegetation Type

The Riparian Bottom Vegetation Type is limited to the streambanks immediately adjacent to the Price River, a few small sites in the bottom of Crandall Canyon, and a very narrow bank along portions of Willow Creek in the vicinity of the proposed mine facilities area. Additional, very limited occurrences may exist in portions of other small area drainages although they have never been delineated or mapped.

The visually dominant tree species for this type include Narrowleaf cottonwood (*Populus angustifolia*) in the upper portions of the proposed facilities area and Fremont cottonwood (*Populus fremontii*) in the lower portions of this site. Coyote willow (*Salix exigua*) is the most common understory shrub, Redtop, (*Agrostis stolonifera*) is the most common grass species, and Yellow sweetclover (*Melilotus officinalis*) is the most common forb associated with this vegetation type.

Conifer Vegetation Type

In the general permit area, the Conifer Vegetation Type is typically found at higher elevations, on north facing slopes, and in some drainage bottom areas. The most common tree species associated with this type is Douglas fir (*Pseudotsuga mezieii*), although Subalpine fir (*Abies lasiocarpa*) and White fir (*Abies concolor*) can be locally dominant depending on site conditions. The density of tree canopy cover is the primary influence on the site-specific composition for this vegetation type. Relatively dense conifer stands typically have a very sparse understory with understory species typically being limited to Wolfberry, Oregon grape and Salina wildrye. Open conifer stands generally have relatively more shrubs and grasses in the understory and often resemble the Mixed Brush Vegetation Type in appearance.

Disturbed Vegetation Type

Mining and related activities have been conducted for over a century in the proposed surface facilities and nearby areas, resulting in a long sequence of development activities and significant related surface disturbance. Active mining operations in this area occurred more or less continuously from 1890 through 1972 when the final active mine closed.

Three basic categories of disturbance exist in this area; 1) Mining related disturbance which occurred prior to August 3, 1977 and which has not been further effected by subsequent mining or reclamation activities; 2) Areas disturbed or utilized for mining related activities after August 3, 1977; and 3) Non-mining related disturbances associated with highway, railroad, powerlines, utility, or other non-mine related development and activities. The 1981 Mariah Associates field investigations did not include sampling and characterization of the disturbed sites but the resulting report did include the following statement regarding these areas:

> "... most disturbed sites are in such condition that vegetation growth is limited, if it is allowed at all. Although isolated patches of species usually associated with the various natural vegetation types occur within and on the edges of adjacent disturbed areas, most species growing in these sites are primary successional species and are considered weeds: *Salsola kali, Kochina scoparia, and Convolvulus arvense. Chrysothamnus nauseous,* a shrub species that invades disturbed sties, commonly grows on the edges of disturbed areas..."

3.4.2 Vegetation Types

Breaking the Disturbed Vegetation Community classification into the three disturbance categories noted in the preceding section, a total of seven vegetation types have been identified as occurring within the permit area. Occurrences of all of these types have been previously disturbed in connection with mining and related activities conducted by Price River Coal Company, Castle Gate Coal Company, and Blackhawk Coal Company, and the AMR project in the facilities area. Four of these vegetation types (Grass-Sage, Mountain Brush, Pinyon-Juniper, and Conifer) were sampled in conjunction with the 1981 Mariah Associates vegetation studies and three more (Pre 8/3/77 Mining Disturbance, Post 8/3/77 Mining Disturbance, and AMR Reclaimed Sites) have been sampled as part of the supplemental 1994 field work.

A total of 282 different plant species have either been encountered in the previous vegetation sampling or have been reported in site specific vegetation literature as occurring in association with the vegetation plan community types occurring with the Willow Creek Mine permit area. Of these 282 species, 239 (85 percent) are considered to be naturally occurring or native plants to this area. Forty three species (15 percent) of the flora of this site can be considered as introduced species which are not native to this area. Of the 43 introduced species, 10 are grasses, 28 are forbs, 4 are shrubs and one is a tree.

3.5 FISH AND WILDLIFE

Because it is primarily an upland area, the proposed coal lease area does not offer any significant fish habitat other than that associated with the Price River along the western boundary of the area. The associated mine permit area, however, does provide a variety of fish and wildlife habitat values as described in the following sections.

3.5.1 Aquatic Resources

Site-specific aquatic studies were conducted on October 10 through 12, 1994, June 28 through 29, 1995, and October 10, 1995, to provide habitat, benthic macroinvertebrate, and fisheries information for Willow Creek. Six sampling locations were used to characterize aquatic biota, while seven locations were examined for aquatic habitat.

Fish

Willow Creek is considered to be a Class 4 fishery by UDWR, which is defined as a stream with low recreational fishing potential. Game fish species expected to occur in Willow Creek include rainbow trout (*Oncorhynchus mykiss*), Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), and brown trout (*Salmo trutta*). Two of these species, rainbow trout and Yellowstone cutthroat trout, were collected in at least one of the 1994 and 1995 site-specific surveys. Based on the electroshocking survey conducted at six locations on October 12, 1994, only one rainbow trout (total length = 8.5 inches) was collected. Subsequent fish population surveys on June 28 and 29, 1995, resulted in collection of four rainbow trout. Although numbers remained low, trout were collected at five of the six sampling locations on October 9 and 10, 1995. The total number of trout per 100 feet of stream ranged from 0 to 3 in the 1995 surveys. When expressing the numbers in terms of area, trout standing crops ranged from 0 to 76 pounds/acre. Additional qualitative sampling for trout was conducted in the lower portion of Willow Creek during October, 1995. A total of six rainbow trout and one cutthroat trout were collected in a 500-ft section of the stream. Discussions with UDWR indicated that trout species likely occur in relatively low numbers in Willow Creek (Christopherson 1994; Phippen 1994). Since spawning conditions are poor in this section of Willow Creek, the primary use by trout species is considered to be as a migration route (Phippen 1994). The sporadic occurrence of trout in lower Willow Creek is primarily related to the seasonal spawning migrations and habitat limitations. Rainbow and Yellowstone cutthroat trout are suspected to move from the Price River into Willow Creek and other tributaries during their spring spawning periods (usually early May through June for Yellowstone cutthroat and mid-March through June for rainbow). Brown trout move into tributary streams in October. After spawning, adult fish migrate back to the Price River. Trout in Willow Creek also may originate from upstream sources. Prior to 1994, fingerling rainbow trout were

stocked in the upper portions of Willow Creek. UDWR may continue future stocking of rainbow trout in Willow Creek; however, no formal plan exists at this time (Christopherson 1994). During high flow periods, trout may be washed downstream into the lower portions of Willow Creek.

The Price River is also considered a Class 4 fishery. Game fish populations in the Price River downstream of the Willow Creek confluence are comprised of both warmwater and coldwater species. Game fish species include brown trout, Yellowstone cutthroat trout, rainbow trout, and channel catfish (*Ictalurus punctatus*). The section of the Price River from Helper to Price is characterized by relatively low flows due to irrigation diversions. UDWR surveys have shown that trout numbers are relatively low in this stretch. Based on an electroshocking survey conducted near Helper in 1987, 7 and 28 trout were collected at two sampling locations (Janssen and Donaldson 1987). The highest catch was dominated by rainbow trout. The numbers of Yellowstone cutthroat and brown trout ranged from 1 to 4. Population studies were completed for a section of the Price River upstream of the Willow Creek confluence, which resulted in a trout density of 64 ± 6 for the sampled reaches (UDWR 1981). This population estimate would also be representative of the Price River from the Willow Creek confluence downstream to Helper. As a result of return flows, a more diverse fish community exists downstream of Wellington. Trout and channel catfish numbers are higher in this section of the Price River, compared to the section from Helper to Price (Christopherson 1994). Fingerling rainbow trout and brown trout are stocked in the Price River by UDWR. Yellowstone cutthroat trout, an introduced species, occurs in the small tributaries to the Price River. This species is no longer stocked in the Price River drainage.

Non-game fish species in Willow Creek consist of speckled dace (*Rhinicthys osculus*) redside shiner (Richardsonius balteatus) mountain sucker (*Catostomus platyrhynchus*), and bluehead sucker (*Catostomus discobolus*). The results of the October 1994 and June 1995 surveys indicated that species abundance varied from 5 to 30 individuals/300-ft section at the six sampling locations. Based on the fish population studies conducted in Willow Creek, the total number of fish ranged from 29 to 78 in June, 1995, and 32 to 52 per 100 feet of stream in October, 1995. Mountain sucker and speckled dace were the most widely distributed and abundant species during all surveys. Non-game fish species in the Price River downstream of the Willow Creek confluence are similar to regional lists. UDWR surveys have collected flannelmouth sucker, mountain sucker, bluehead sucker, mottled sculpin, carp, Utah chub, longnose dace, speckled dace, and redside shiner (UDWR 1981; Janssen and Donaldson 1987).

Macroinvertebrates

The results of the October 1994 macroinvertebrate sampling in Willow Creek revealed relatively low macroinvertebrate densities and number of taxa at all locations. Total densities ranged from 12.5 individuals/ft^2 to 53 individuals/ft^2. These densities are similar to the results of a macroinvertebrate survey that was conducted near Helper (25 individuals/ft^2) (Janssen and Donaldson 1987). Using the rating criteria developed for fish food (i.e., macroinvertebrate) abundance by Binns (1982), total densities represented a rating of 0 (<25 individuals/ft^2) and a rating of 1 (25 to 99 individuals/ft^2). The lowest number of macroinvertebrate taxa was found at two of the downstream locations. The other four locations supported 13 to 20 taxa, which is still considered a low number of taxa in a Surber sample. The number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa (referred to as the EPT Index) and the EPT abundances also were low at all locations. Since relatively low densities and few taxa were shown for these indicator groups, water quality and habitat conditions were considered low quality. The drought conditions in 1994 also likely contributed to the low macroinvertebrate productivity.

Sampling was repeated in October, 1995 to characterize the macroinvertebrate community during a year when persistent flow was present in Willow Creek. In comparison to 1994, macroinvertebrate abundance increased slightly at all locations in 1995, with mean densities ranging from 54 individuals/ft^2 to 138 individuals/ft^2. In spite of these increases, the Binns (1982) rating for macroinvertebrate abundance remained low (1). The number of taxa ranged from 14 to 19, which is similar to the range shown in 1994. The increased macroinvertebrate abundance in 1995 was mainly the result of higher number of Ephemeroptra, Plecoptera, and Trichoptera. The number of taxa for these three groups also increased, as indicated by an EPT Index ranging from 8 to 14.

Shannon species diversity indices were calculated for each sampling location, which provided an indication of the density distribution among the various taxa. Diversity values less than 2 generally indicate a possible stressed biological community, as shown by the dominance of relatively few taxa. In October, 1994, the upstream locations showed mean diversities ranging from 1.78 to 2.31. In contrast, diversity indices at the downstream locations were lower, with values from 1.15 to 1.66. Species diversities also were relatively low in October, 1995, when indices ranged from 1.61 to 2.14.

3.5.2 Aquatic Habitat

Aquatic habitat in the lower portion of Willow Creek is limited due to the presence of a silt/clay layer on the rock surfaces, small size of the steam, relatively low flows during most months, and limited amounts of cover provided by substrates, instream debris, and overhanging riparian vegetation. The abundance and diversity of fish and macroinvertebrate communities in Willow Creek are a reflection of the limiting habitat conditions. The presence of the thick silt/clay layer on the stream substrates limited the development of a productive and diverse macroinvertebrate community. Drought conditions in 1994 also likely contributed to the low fish and macroinvertebrate numbers and diversity although survey numbers were not significantly different during 1995, which was a much wetter year. Increased surface flows in average and wet years would provide some additional cover and habitat for fish and macroinvertebrate communities, although cover is still expected to be limited.

3.5.3 Wildlife

The proposed lease area, associated mine permit area, and adjacent areas encompass a portion of the far western reach of the Tavaputs Plateau and drain to the Price River which is tributary to the Green River which in turn flows to the Colorado River. Potential vegetation communities and habitats in this area include the Douglas-fir forest (*Pseudotsuga*) at the higher elevations, piñon juniper woodland (*Juniperus-Pinus*) and Great Basin sagebrush (*Artemesia*) at mid-elevations, and saltbush-greasewood (*Atriplex-Sarcobatus*) and sagebrush steppe (*Artemesia-Agropyron*) at the lower elevations. In descending order these communities are encompassed by the montane (Canadian and Hudsonian life zones), sub-montane (Transition life zone), and cold desert (Upper Sonoran life zone) ecological associations. For each of these communities, wildlife occurrence and relative utility as habitat varies dependent on which wildlife species are being considered, however, riparian bottom areas generally offer the highest level and greatest diversity of habitat values. In addition to the identified vegetation communities and ecological associations two physical attributes common in this area; 1) Disturbed areas; and 2) Areas of exposed rock; either provide or limit distinct requisite habitat values.

Designated habitat values which exist in the vicinity of the project area include bald eagle wintering areas, sage grouse year-long range, elk winter range, crucial mule deer winter range, and high priority mule deer winter range. Bald eagle wintering areas are located several miles to the south of the proposed mine permit area and the UDWR has indicated that no historic nesting activity has occurred in this part of Utah and that foraging requisites for successful bald eagle nesting are not available in the immediate area. Sage grouse are year-round residents of the high plateau areas in the vicinity of the proposed lease and permit areas, however, the closest known sage grouse use areas are several miles north of the proposed permit boundary. Elk are occasional inhabitants of the West Tavaputs Plateau with substantial use areas being concentrated in the sub-montane and montane zones. While almost the entire proposed permit area falls within designated elk winter range, the UDWR has indicated that substantial elk use of areas other than the high plateaus (Douglas-fir forest), and high ridgelines (Piñon juniper and Great Basin sagebrush) would normally occur only on an occasional basis, typically as a result of unusually severe winter weather conditions. Mule deer are common year-round residents of this area and some vertical migration occurs in response to seasonal changes. The northeast portion of the proposed mine permit area is designated a crucial mule deer winter range and much of both the proposed lease and permit areas are designated as high priority mule deer winter range.

The proposed project and adjacent areas provide suitable habitat for a wide range of terrestrial wildlife. Based on a listing of potential inhabitants of the West Tavaputs Plateau, which encompassed both the proposed lease and mine permit areas, 5 species of amphibians, 11 reptile species, 104 bird species, and 50 species of mammals are potential inhabitants of this area. Common inhabitants of this area include but are not limited to the great

blue heron, golden eagle, blue grouse, ruffed grouse, skunk, porcupine, ground squirrel, cottontail rabbit, woodchuck, and mule deer.

It is important to note that, with the exception of mining related subsidence, no mining related surface disturbance will occur within the proposed lease area and surface disturbance within the proposed mine permit area will be limited to an area of approximately 70 acres near Willow Creek, much of which has been previously disturbed. The previously disturbed areas provide substantially reduced life-requisite values for most indigenous wildlife. Native vegetation, micro-habitat and relief features, watering sources, and breeding requisites have, for most disturbed areas, been destroyed or significantly altered. In the area where the proposed mine surface disturbance will occur, habitat value and wildlife use are effectively constrained by the adjacent steep cliffs which may limit wildlife movements, previous disturbance, and proximity to Highways 191, 6 and 50, and the UP&L Carbon Generating Station.

3.5.4 Threatened, Endangered, and Sensitive Species

In 1989, the UDOGM Abandoned Mine Reclamation Program (AMR) group initiated informal consultation with the USFWS regarding any listed threatened, endangered, or candidate species potentially occurring within AMR's Willow Creek reclamation project area which occurs within the primary facilities area of CPMC's proposed action. In response, a listing of Federal threatened, endangered, and candidate species potentially occurring in the vicinity of the AMR project area was provided by the U.S. Fish and Wildlife Service. Those species formally listed as threatened or endangered (or candidates) and potentially subject to project impacts, were identified as follows:

Listed Species

Bald Eagle	*Haliaeetus leucocephalus*
Humpback Chub	*Gila cypha*
Bonytail Chub	*Gila elegans*
Colorado Squawfish	*Ptychocheilus lucius*
Razorback Sucker	*Zyrauchen texanus*
Uinta Basin Hookless Cactus	*Sclerocactus glaucus*

Candidate Species

Creutzfeldt Catseye	*Cryptantha creutzfeldtii*
Yellow Blanketflower	*Guilardia flava*
Canyon Sweetvetch	*Hedysarum occidentale* var. *conone*

Terrestrial

Potential habitat for 13 Federal candidate (Category 2) species and 5 listed threatened or endangered species exists within the permit area according to UDWR records and based on current listings. The five listed species include:

1) Bald eagle
2) Peregrine falcon
3) Gray wolf
4) Grizzly bear, and
5) Black-footed ferret

The black-footed ferret's habitat (prairie dog colonies) does not exist within the proposed permit area, therefore, there is no potential for existence of this species in this area. The grizzly bear has been eliminated from this part of Utah for many years, despite the existence of potential habitat. Therefore, the potential for this species to exist within the proposed permit area is also non-existent. The gray wolf was an historic resident of the West Tavaputs Plateau, however, at present its numbers are so low that occurrence within the proposed permit area would be incidental at best, and given the animal's mobility, the proposed mining and related activities would

have little or no effect if a transient animal happened to take up residence in the region. The American peregrine falcon could potentially exist in the mine plan area, and the steep escarpments of the Bookcliffs offer nesting habitat, however, the UDWR has indicated that no nests or resident falcons are known to exist in the vicinity of the proposed permit area.

With regard to the northern bald eagle, critical wintering areas exist a few miles to the southwest of the permit area. At present, there are no known high-priority concentration areas or critical roost trees within proposed permit area boundaries, however, the proposed permit area has been classified as substantial value use area to wintering eagles due to foraging opportunities presented. No historical nesting by bald eagles is known to have occurred in this part of Utah, and foraging requisites for nesting activity are not available in the immediate area.

Aquatic

Potential habitat for two Federal candidate (Category 2) fish species, roundtail chub *(Gila robusta)* and leatherside chub *(G. copei)* exists in Willow Creek. Although these species historically occurred in the Price River and its tributaries, neither species has been recently identified or observed in Willow Creek (Christopherson, 1994). Sightings of leatherside chub have been reported recently in the Price River upstream of the Willow Creek confluence.

Seven Federally listed or candidate fish species occur or could potentially occur in the Price River below the Willow Creek confluence. Potential habitat exists for three Federal candidate Category 2 species: roundtail chub, leatherside chub, and flannelmouth sucker *(Catostomus latipinnis)*. The lower portions of the Price River near the Green River confluence contain potential habitat for four Federally listed endangered species: humpback chub *Gila cypha)*, bonytail chub *(G. elegans)*, Colorado squawfish *(Ptychocheilus lucius)*, and the razorback sucker *(Xyrauchen texanus)*. Critical habitat also has been designated in the Green River downstream of the Price River confluence for the bonytail chub (Gray Canyon), humpback chub (Gray Canyon), Colorado squawfish (entire section between the Yampa and Colorado River confluences), and razorback sucker (entire section between the Yampa and Colorado River confluences) (USFWS, 1994). Additional critical habitat reaches also have been designated in the Colorado River downstream of the Green River confluence.

3.6 LAND USE

Land uses in the proposed lease and associated permit and adjacent areas are presently and have historically been constrained by location, topography, climate, and availability of important resource values. Rugged terrain, limited soil resources, low precipitation and seasonally harsh weather conditions, limited water resources, and existence of significant high quality coal reserves are the primary factors which determine land use capabilities in this area. Generally, these factors limit land use options to mining, scattered oil and gas production, low-intensity grazing, wildlife habitat, limited timber production at the higher elevations, and dispersed recreational uses including hunting, fishing, hiking and similar activities. The PacifiCorp Carbon Generating Station, located adjacent to and on the west side of the permit area, represents a unique land use which is indirectly tied to the surface water and the coal resources available in the area. With the exceptions of the Carbon Station, historic and current mining activities, and limited grazing, there are no significant residential, commercial, or agricultural land uses in the permit area and adjacent areas.

The permit and adjacent areas are zoned by the Carbon County Planning department as mining and grazing, or "critical environmental". The critical environmental designation incorporates livestock grazing, wildlife habitat and certain recreational activities as the dominant uses but incorporates and does not preclude mining development.

3.7 CULTURAL RESOURCES/NATIVE AMERICAN RELIGIOUS VALUES

3.7.1 Cultural Resources

Because no surface disturbance is planned in the proposed lease area, this area was not inventoried for cultural resources, however, surface disturbance areas in the associated mine permit area were evaluated. Generally, both pre-historic and historic use in this area have been limited to valley bottoms and the lower hillslopes by environmental factors including the arid climate, the resulting lack of significant vegetation on exposed upper slopes, and the rugged terrain. Given these factors the potential for occurrence of any significant cultural resource values in the proposed lease area is low. Site specific field inventories of surface disturbance areas associated with the planned mine surface facilities were conducted during the months of June and August 1994. Field inventory work followed extensive research and review of previous studies of the area, historical accounts, and conversations with individuals familiar with the area. Field surveys involved coverage of an area of approximately 120 acres by a qualified archaeologist and a paleontologist using parallel pedestrian transects spaced at intervals of up to 15 meters to search for any evidence of cultural, historic, or paleontological values. In addition, accessible rock outcrop exposures around the perimeter of the survey area were examined by the paleontologist for any evidence of paleontological values.

Cultural, historical, and paleontological investigations for the planned permit area resulted in identification of three previously recorded historic sites, one new cultural resource site, one new historic resource site consisting of several elements, and four new paleontological resource sites.

Research and review of previous site investigations indicated the existence of three previously recorded historic resource sites;

> **Site 42Cb580** - Located in willow Creek Canyon on the north side of State Highway 191. a series of scattered coal waste piles and associated debris covering a total of approximately 5 acres and containing approximately 150,000 cubic yards of coal, coal refuse, and miscellaneous debris.
>
> **Site 42Cb581** - Located in Willow Creek Canyon on the north side of State Highway 191. Two large coal refuse piles mixed with fill material which have been graded and surfaced with gravel. The flat top surfaces of these piles are presently used as turn-outs along Highway 191.
>
> **Site 42Cb582** - Located in Willow Creek Canyon on the north side of State Highway 191. Four small coal piles adjacent to State Highway 191 which are presently used as vehicle pull-outs.

These sites were reclaimed in conjunction with the 1990 AMR program. These sites were not significant and therefore were not recommended for listing on the National Register of Historic Places (NRHP).

One new cultural resource site, a series of pictograph panels, was identified during the site specific field investigations. This site is described as follows;

> **Site 42Cb1001** - Located on the north side of State Highway 191. Three pictograph panels were found on a near vertical sandstone face under a slight overhanging ledge. The three panels consist of a total of 27 human and geometric figures painted onto the sandstone surface with a reddish-brown pigment. The figures are not of the San Rafael Fremont style which is the most common rock art style found in this area, although they are similar in style to figures found at a site in short Canyon, south of Price, Utah (Castleton, 1984 and Schaafsma, 1971).

Site 42Cb1001 contains certain distinctive characteristics and has the potential to yield important information on prehistoric of historic people and events and has been recommended as potentially eligible for NRHP listing.

One new historic resource site, including numerous elements related to the Castle Gate Mines and associated activities, was identified through site specific field investigations. Additional features associated with both the Castle Gate Mines and Castle Gate townsite are located in Price Canyon within the existing approved Castle Gate Mine permit area but are not included under this site designation. This site and the component elements are described as follows:

> **Site 42Cb1000** - Located in Willow Creek Canyon on the north side of State Highway 191. This site consists of 42 separate features associated with historic mining activities at the Castle Gate Mines. All features or elements were included under a single site because they are temporally related. In certain cases spatial relationships also exist and the elements occur in a relatively undisturbed context, however, due to a long history of successive disturbance and more recent and extensive site reclamation efforts, most elements exist in a disturbed state and spatial relationships have been altered or destroyed.

Most of the features which make up Site 42Cb1000 retain integrity of location, materials, workmanship, and association. Although many of these features and adjacent areas have been significantly disturbed by a long sequence of mining, reclamation, and other activities, they are associated with significant historical events (i.e., the Castle Gate Mine disaster) and certain individual features exhibit distinctive characteristics and have the potential to yield important information on historic people and events. The entire site has been recommended as potentially eligible for NRHP listing although it should be recognized that many areas of the site and even certain of the identified features have no historical importance and do not contribute to its cultural significance.

Four new paleontological localities, consisting of one or more trace fossils, were identified during site specific field investigations. These localities are described as follows:

> **Locality 42Cb127T** - Located in a sandstone exposure within a small drainage valley on the north side of State Highway 191. An unidentified three-toed dinosaur track measuring approximately 23.5 inches long by 22.5 inches wide.
>
> **Locality 42Cb128T** - Located on the north side of State Highway 191 in a sandstone outcrop above a thin coal seam overlooking Willow Creek. Several three-toed dinosaur tracks eroding out of the bottom of the sandstone exposure.
>
> **Locality 42Cb129T** - Located in a large sandstone boulder at the bottom of a small natural drainage north of State Highway 191 and east of the existing face-up area. The boulder appears to have been "dino-turbated" and contains several unidentified three-toed dinosaur tracks.
>
> **Locality 42Cb130T** - Located in the top of a minor coal seam outcrop which overlooks Willow creek on the north side of State Highway 191. Several unidentified dinosaur tracks eroding form the top of the coal seam.

The individual paleontological localities do not contain unusual or unique fossil resources and so have not been recommended as eligible for NRHP listing. Since most fossils found in the Blackhawk Formation are associated with the coal seams, any unusual fossil remains (especially any fossil bone materials) encountered during mining may be important and should be evaluated if possible.

3.7.2 Native American Religious Values

Native American utilization of the project and other areas in the general vicinity covered an extended period beginning in approximately 4,000 B.C. and extending through the late 1800's. In the mid to late 1800's the Utes, who are descended from the Numic/Shoshonean peoples, were displaced from this area by the arrival and settlement of the area by early Morman settlers. With settlement of the Utes on a reservation in the Uintah Basin, the general project area is no longer inhabited or utilized on any regular basis by Native American groups and no Native American religious sites are known to exist in the immediate area.

3.8 AIR QUALITY

The permit and adjacent areas lie within the central area of the Upper Colorado River Air Basin (Environmental Research and Technology, 1976). The central area has been divided into smaller sub-basins, each of which is characterized by meteorological conditions and related dispersion characteristics which are relatively homogeneous. The sub-basin concept, which assumes contained air flow within the basin, is generally applicable for normal air flow conditions but breaks down under storm conditions or other situations where strong regional air movements result in greater air turbulence and mixing between sub-basins and even major air basins.

Air movements in this area are strongly affected by natural drainage patterns and daily temperature variations. As local air masses cool at night, the denser, cool air flows down valleys and other natural drainage channels. Generally, the winds associated with downslope movements are low to moderate, however, if the drainage alignment parallels the prevailing wind direction or if topographic features concentrate natural air flows, moderate to strong downslope winds and high intensity gusts may result. As natural warming occurs during the morning and early afternoon, warm air masses begin to move up-valley. Differential heating and upper level winds tend to have a greater impact on the upward air movements resulting in greater mixing and instability with resultant variable winds and greater potential for gusty conditions. Normally, prevailing winds in the area are from the west and northwest, however, during the winter persistent high pressure cells which settle above the Wasatch Mountains to the north can shift the prevailing winds to the northeast for extended periods.

Carbon County, which encompasses most of the proposed permit area and adjacent areas, has been designated as an attainment area for all NAAQA primary pollutant levels indicating no significant existing air pollution problems in this area. Available monitoring data does indicate spot exceedences of secondary standards for total suspended particulates (TSP) for the areas of Price, Huntington, and Cedar Mountain, however, these exceedences are generally due to natural conditions of blowing dust and are not related to any specific development for operating activities.

3.9 SOCIOECONOMICS

Carbon County's estimated 1994 population was 21,100, which is about 2 percent more than the 1993 population and about 9 percent less than the county average in the 1980's. The State Population Estimates Committee indicates that Carbon's population peaked in 1982 at 24,300. The decline since 1982 has been a significant 3,200 or 13 percent. The county experienced out migration annually between 1982 and 1990. Since then, population has stabilized and begun a slow increasing trend. Population projections for the county by the Utah Office of Planning and Budget show a very modest population increase of less than 5 percent by year 2000.

The economy of Carbon County is dominated by mining (primarily coal mining), agriculture and tourism, while public sector employment, including government services and education, make up a smaller yet important segment of the economy. Mining is the dominant contributor to the economy of Carbon county, making up approximately 30 percent of the county's total earnings. Recent trends in the Utah coal mining industry, however, have significantly affected employment rates in this sector. While coal production in the state of Utah increased by approximately 84 percent from 11.8 million tons/year to 21.7 million tons/year between 1983 and 1993, coal mining employment decreased by approximately 50 percent during the same period (from 4,296 to 2,162 employees) due to improvements in coal mining technology that have decreased the amount of direct labor that is required to mine efficiently. Annual coal production in the state of Utah was approximately 25 million tons in 1995, but estimates for coal mining employment rates are not available.

3.10 TRANSPORTATION

The rugged terrain of the area limits routing options for major roads and utility transmission lines, consequently roads and utility lines typically follow the existing natural drainage valleys. Within the permit area, State Highway 191 follows the Willow Creek Valley from Castle Gate Junction northeast to the summit of Greyhead Peak. Similarly, U.S. Highway 6 and 50 follows the Price River Valley on the western side of the proposed

permit area. A major north-south rail line and several water distribution pipelines parallel Highway 6 and 50, and several electrical power transmission lines parallel the alignments of both Highways 191, and 6 and 50. An existing power transmission line extending up Barn Canyon crosses the proposed lease area. Due to access considerations and practical construction constraints, transportation and utility related development is also concentrated in valley bottom and adjacent lower valley slope areas. The narrow configuration of area drainage valleys and existing developed transportation and utility infrastructures generally precludes any significant additional development or use for this land use category.

3.11 RECREATION AND AESTHETICS

Although not a significant use, portions of the proposed lease and associated permit and adjacent areas are utilized on a limited basis for hunting, fishing, hiking, scenic driving and other dispersed recreational uses. Generally, these activities occur on a seasonal basis primarily on public lands in the area. Similar to many of the other potential uses, rugged terrain and limited access tend to minimize recreational use in this area. Availability of and proximity to much more desirable recreational areas along the Wasatch Front and in Canyonlands National Park to the south are also limiting factors. Given existing low use levels and the various limiting factors, the potential for expanded recreational use of this area is small.

The closest recreational facilities are Scofield Reservoir, located approximately 25 miles northwest of the mine area, and the Price Canyon Recreation Area, located across both the Price River and U.S. Highway 6 and 50 approximately 1 mile west of the proposed permit boundary. In addition, State Highway 191, which passes by the mine surface facilities area and intersects the permit area on a northeast-southwest diagonal, is designated as a Scenic Byway.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

It is important to recognize that approval of the pending coal lease application will not, in itself, result in any direct environmental consequences. The purpose of the coal leasing application, however, is to provide access to the subject Federally owned coal reserves for mine development and coal recovery which will have potential direct, indirect, and cumulative environmental consequences. The discussions of both mine development, operations, and reclamation in Chapter 2.0 and environmental resource values in Chapter 3.0 provide the basis for evaluation of the effects of coal leasing and the reasonably foreseeable related mining operations and powerline relocation which would occur as the indirect but logical consequence of coal lease application approval.

The following sections summarize potential direct, indirect, and cumulative impacts of the No-Action Alternative and coal leasing as the Proposed Action. The evaluation of potential impacts takes into consideration the nature and duration of the Proposed Action and reasonably foreseeable related actions, the current condition and distribution of potentially affected environmental resources, and the nature and effectiveness of planned control and mitigation measures associated with the Proposed Action and reasonably foreseeable related actions.

4.2 NO-ACTION

The No-Action Alternative precludes issuance of the coal lease but would not limit planned development, operation, and reclamation of the Mine on existing fee and leased Federal, State, and County lands. With the planned development, essentially all of the indirect and cumulative impacts under the Proposed Action would still occur. The only significant difference between the Proposed Action and No-Action Alternatives would be that the area of concern for geologic and ground water hydrologic impacts would be reduced under the No-Action Alternative. It is important to note that bypassing the proposed lease tract at this time would probably result in effective sterilization of the associated reserves since the lease tract does not contain sufficient reserves to support development of a separate mine and effective mine development would probably be precluded by the significant depth of the coal seams in this area and the lack of readily accessible outcrop exposures from which mining development could occur.

4.3 PROPOSED ACTION

The Proposed Action, as described in Chapter 2.0, is approval of the pending coal lease application covering an area of approximately 2,300 acres of land owned by the United States of America and managed by the Price Resource Office of the BLM. Inherent in the proposed action are the indirect and cumulative effects of the underground coal mining and related operations and powerline relocation which represent reasonably foreseeable foreseeable related future actions.

4.3.1 Geology

Potential indirect and cumulative effects of the proposed action relative to geologic resources will include extraction of the economically recoverable coal resource and consequent disturbance of the overlying rock strata due to the effects of mining induced subsidence. Coal extraction is not considered to be an adverse environmental effect and is consistent with both applicable Federal land management regulations and policies and the existing BLM Resource Management Plan for this area.

Subsidence is an unavoidable consequence of underground coal mining operations and, as described in Section 2.1.2.5, Subsidence Control and Monitoring, the planned mining operations have been designed and will be implemented and monitored to both minimize and provide for controlled ground subsidence. Coal extraction thickness will range from approximately 5 to 13 feet resulting in potential maximum subsidence of 3.5 to 9.1 feet assuming the projected maximum subsidence rate of 0.7 times extraction thickness. It is important to note

that this is the maximum potential subsidence with full extraction. In reality, practical operational limitations on coal extraction, increased mining depth, and the massive sandstones previously discussed will probably result in actual subsidence which is considerably less than this maximum value.

Surface evidence of mining related subsidence is expected to be minimal since most of the planned mining will occur at depths of 700 to over 2,000 feet, averaging approximately 1,800 feet and the occurrence of several relatively massive high-strength sandstone units in the overlying stratigraphic sequence which will probably limit vertical deformation. Use of the planned longwall mining method inherently provides the greatest amount of control over the area and rate of subsidence. Associated subsidence is typically uniform consistent with a relatively uniform coal recovery thickness and occurs progressively with panel extraction minimizing potential differential settlement. Experience indicates that approximately 90 percent of longwall related subsidence occurs within 2 to 3 years following completion of mining.

No significant material damage or diminution of use of either existing structures or renewable resource lands due to mining related subsidence is anticipated. The only structure which will potentially be impacted by mining subsidence is an existing power transmission line extending up Barn Canyon. This line will be relocated to an adjacent canyon which will not be affected by mining activities. In the unlikely event that any other significant damage or diminution of use does occur, CPMC will repair or mitigate the damage or diminution of use to the extent technologically and economically feasible within reasonable limits. This may involve repairing, replacing, or providing reasonable compensation for any damaged structure and restoring the land or providing alternate lands or compensation consistent with the value and reasonably foreseeable use of the affected lands.

In the proposed coal lease area the potential for any significant surface effects due to mining related subsidence is expected to be minimal due to the relatively high overburden cover depths in this area and normal subsidence mechanisms. Any minor surface subsidence which does occur should not adversely effect environmental resources since the proposed lease area is an relatively rugged upland area utilized primary as wildlife habitat and no critical resource values are known to exist in this area.

Potential cumulative impacts relative to geologic resources would be limited to the gradual depletion of area coal resources due to ongoing coal mine development and extraction. This is however not a significant concern given an estimated reserve base of approximately 737 million tons of in-place reserves in the immediate area and 1.907 billion tons of coal reserves for the Uintah - Southwestern Utah Coal Region (Uintah - Southwestern Utah Coal Region Draft Environmental Impact Statement, BLM, 1983).

4.3.2 Hydrology

Given the nature and extent of the associated planned mining and related operations there is a potential for both indirect and cumulative impacts on surface and ground water resources relative to coal leasing approval and related actions. Potential hydrologic impacts include the following:

Ground Water

- Alteration of ground water flow patterns
- Drainage of seeps and springs
- Alteration of recharge/storage/discharge relationships
- Increases in the concentrations of TDS and certain individual chemical constituents

Surface Water

- Temporary increases in runoff from surface disturbance areas
- Minor reductions in surface flows and alteration of flow patterns due to operation of sedimentation structures and flow reductions due to water supply withdrawals
- Changes in surface water chemistry
- Increases in the levels of TDS, TSS, and certain individual chemical constituents

These impacts and related mitigation measures are discussed in the following sections.

4.3.2.1 Ground Water

Potential mining related hydrologic consequences for ground water resources in the Mine permit area (including the proposed lease area) will be limited by the lack of significant ground water recharge in the area, the existence of a thick sequence of low permeability bedrock layers between the coal seams to be mined and the ground surface, the general lack of significant regional ground water movement due the absence of well defined regional aquifers, and very limited beneficial ground water use in the permit and adjacent areas.

Alteration of Ground Water Flow Patterns - Alteration of ground water flow patterns will occur as a result of underground mining excavation and consequent mine drainage. These activities will reduce the potentiometric surface in the immediate vicinity of the mine workings, which will induce ground water flow into the underground workings as the hydrologic system adjusts to reestablish a balanced potentiometric surface. Natural ground water flows in the immediate vicinity of the underground mine workings will tend to be deflected toward the mine workings under the influence of the cone of depression. This deflection of flow will provide some natural mitigation of flow alteration as flow lines converge beyond the active mining area to reestablish downgradient flow continuity at some point downdip from the mine workings.

In general, reduction of the potentiometric surface near the mine workings is expected to be both minor and localized due to the relatively low permeability of the associated stratigraphic units. Additionally, ground water flow patterns in the overlying perched aquifer system may also be affected by downward leakage through subsidence fractures. This may result in partial or full drainage of the perched aquifers and may affect the discharge of springs and seeps. Impacts on perched aquifers and associated springs and seeps due to secondary subsidence effects are not expected to be significant since the perched aquifers are very limited in areal extent, potential subsidence areas represent a relative small portion of the total permit area, and beneficial use from this system is limited to a single spring (B41) located in Section 26, T12S, R10E, in the eastern portion of the permit area and well outside the propose lease area.

Upon completion of operations and final mine reclamation and closure, the underground workings will gradually fill with water resulting in reestablishment of a potentiometric surface at approximately the same level which existed prior to mining. Any minor changes in the potentiometric surface which may occur are not expected to be significant since the overall hydrologic balance within the ground water basin will not be effected.

Reductions in the quantity and availability of ground water as a result of alterations to the ground water flow patterns are expected to represent a minor percentage of total ground water flows within the basin, will be limited in areal extent, and should be temporary in nature. In addition, reductions in ground water flows are not expected to adversely impact ground water users since primary beneficial ground water use within the permit area is limited to a single spring and general ground water use within the regional ground water basin involves stratigraphic units which are well above and are effectively hydraulically isolated from the sequence which may be impacted by a significant thickness of low permeability bedrock.

Drainage of Seeps and Springs - The planned Willow Creek mining activities may result in some drainage and dewatering of overlying perched ground water aquifers as a result of vertical seepage through subsidence fractures. Consequently, springs and seeps discharging from those stratigraphic units containing perched ground water may be effected. Effects, however, are expected to be minimal since a detailed spring and seep survey of the entire 14,670 acre permit area identified only 3 seeps and 12 minor springs. These potential effects are not expected to extend to the proposed coal lease area since no springs or seeps are known to exist within this area.

Alterations to recharge/storage/discharge relationships - The planned mining, processing, and related activities are not expected to have any significant effect on recharge, storage, or discharge relationships. Recharge within the ground water basin occurs primarily along the outcrop of the various stratigraphic units as a result of direct precipitation and infiltration in outcrop areas. CPMC's operations are both limited in areal

extent and are not located within any major recharge area. Mining will result in some drainage of existing stored mine water and dewatering of any saturated units encountered during mining operations potentially affecting ground water storage relationships. However, this effect will be localized and temporary, as discussed above. Upon completion of operations and abandonment of the mine, ground water will once again accumulate in both the old and new mine workings and equilibrium ground water storage relationships will be reestablished. Discharge relationships will also be minimally affected with some temporary reduction in downgradient ground water flows as a result of filling of the underground mine workings as well as localized alterations in ground water flow patterns. The quantity of ground water discharge which will be effected is a relatively small percentage of the total volume within the ground water basin.

Increases in Chemical Constituents - As ground water encounters freshly exposed subsurface materials in the mine, oxidation and weathering will cause changes in ground water chemistry including increases in TDS and the concentrations of individual chemical constituents. Over time these increases will stabilize and start to decrease as available soluble chemical constituents are depleted and chemical concentrations in the mine water and the exposed rock reach equilibrium. Gradual filling of the mine workings will also have a beneficial water quality effect, displacing oxygen and reducing the oxidation potential as flooding of the abandoned workings occurs.

As described in Section 3.2.1, Ground Water, ground water in both the Willow Creek permit and adjacent areas is a weak calcium-sulfate or sodium-sulfate chemical type. Increases in both sodium and sulfate constituents will not change ground water chemistry although they could result in a shift toward a more dominant sodium-sulfate ground water type. While various chemical constituents of the ground water may increase as a result of mine drainage, these increases will not affect ground water use. Due to the limited volume of ground water drainage relative to total flows within the ground water basin, minor changes in ground water chemistry and levels of certain constituents are not expected to significantly effect overall ground water quality. Use of ground water from the permit area is limited to a single surface spring and ground water use in adjacent areas is very limited due to the availability of more accessible and higher quality surface water sources. There are no known springs, seeps, or water supply wells in the immediate project vicinity which are used as domestic water supplies, therefore, no mining related impacts on water supplies or users are anticipated. As noted in section 2.4.1.3, Mining and Related Operations, CPMC does not anticipate the need to discharge mine water inflows to the surface since water recycling and underground storage should be adequate to address anticipated inflow volumes.

4.3.2.2 Surface Water

In general, potential hydrologic consequences for surface water resources resulting from coal leasing will be negligible since no direct surface disturbance within the coal lease area is proposed. Indirect impacts due to the related mining operations and associated minor surface disturbance will be limited by the generally arid climate, specific control and mitigation measures, and compliance with applicable regulatory effluent standards as administered under the UPDES program.

Temporary Increases in Runoff From Surface Disturbance Areas - Surface disturbance will result in removal of existing vegetation and consequent increases in surface runoff potential. Increased disturbed area runoff will be addressed by minimizing the area of surface disturbance, diverting upgradient runoff around mine disturbance areas, intercepting disturbed area runoff as close to its source as reasonably practicable and routing it through designed collection ditches to sedimentation ponds, and reclaiming disturbed areas as soon as operationally feasible following completion of mining. Given the relatively limited proposed surface disturbance area, potential increases in runoff will be negligible when compared with total runoff volume for the contributing drainage basin and disturbed area runoff contributions will be buffered by detention and controlled release from the designed sedimentation ponds.

Minor Reductions in Surface Flows and Alteration of Flow Patterns - Surface flow contributions from mine surface disturbance areas may be temporarily reduced or deferred due to operation of the mine sedimentation control system which will include designed collection ditches and sedimentation ponds. Any reduction or

deferral of flow, however, will be minor since total long-term storage capacity for all ponds is limited to 0.73 acre-feet and the maximum discharge interval for the ponds is 3.4 days.

Surface flows in the Price River may be slightly reduced due to withdrawal of water under existing active water rights to meet mine water supply requirements. Maximum mine water supply requirements are estimated at 730 acre-feet per year (1.0 cubic feet per second) which is well within the limits of existing water appropriations and represents a negligible reduction in total flow even under low flow conditions for the Price River.

Changes in Surface Water Chemistry - Surface waters in the project area are generally a calcium-bicarbonate water type. Exposure of surficial materials by mining related surface disturbance and subsequent leaching may result in minor changes in the chemistry of disturbed area runoff. The most probable potential change in surface water chemistry would be a shift in water chemistry from a strong calcium-bicarbonate type toward a sodium-sulfate type. It should, however, be noted that this change would occur only for runoff from the relatively limited mine surface disturbance area and that dilution effects due to mixing with other surface runoff and natural streamflows would render any minor localized chemical changes negligible with no overall impact on the chemical character of area streams anticipated.

Increases in Chemical Constituents - Similar to the general water chemistry impacts discussed in the previous section, contact between disturbed area runoff and exposed surficial materials may result in increases in TDS, TSS, and other chemical constituents in the disturbed area runoff. Potential increases in TSS will be addressed during construction and operations through implementation and operation of appropriate drainage and sediment control measures and following active operations through reclamation of all mine surface disturbance areas. Increases in TDS and other chemical constituents should be negligible due to the limited disturbance area, the temporary nature of the proposed mining operations, and the buffering effects of natural mixing and dilution. TSS, TDS, and certain other chemical parameters will be monitored for any mine discharges and must meet applicable effluent limitations under the terms of the Mine's UPDES Permit. Since all mine discharges must pass through designed sedimentation ponds, any elevated constituents can be addressed, if necessary, using appropriate treatment measures prior to discharge to the natural drainages. As previously noted, CPMC does not anticipate the need to discharge mine water inflows to the surface system. In the unlikely event however, that such discharge would become necessary, the discharge would be passed through the mine drainage and sediment control system and would be sampled for compliance with applicable effluent standards prior to discharge to receiving waters. Given concerns relative to potential hazards to aquatic biota associated with emulsified longwall fluids, any mine water discharge would also be sampled for the presence of this material.

4.3.2.3 Cumulative Hydrologic Impacts

Ground water impacts resulting from the proposed coal leasing and associated planned mining and related activities will be minimal due to limited ground water occurrence, low overall permeabilities and consequent limitations on the effective area of influence, and the lack of beneficial ground water use in the area. Similarly, there will be no surface disturbance in the coal lease area and surface disturbance associated with the Willow Creek mining and related operations will involve such a small area that potential mining related surface water impacts will be negligible. Any potential surface water impacts will be effectively mitigated through effective control of mine water supply withdrawals, operation of a comprehensive drainage and sediment control system, compliance with applicable monitoring requirements and discharge effluent standards under the required UPDES permits, and reclamation of surface disturbance areas and restoration of surface drainage characteristics.

The cumulative impact area for evaluation of potential cumulative ground water impacts include the permit area along with any upgradient areas which could be impacted by mining related drawdown and downgradient areas which could be impacted by any mining related changes in ground water flow or quality. Given the characteristic low permeability of the geologic sequence, the limited volume and flow of ground water, and the consistent flat dip of the geologic units to the northeast, the ground water cumulative impact area can be defined by the Price River on the west and a boundary extending one mile beyond the northern, eastern, and southern permit boundary. Other activities which could result in possible contributing ground water impacts within this area are limited to contributions from the existing abandoned underground mine working in the area; the

Andalex Resources Pinnacle Mine located near the southeast corner of the permit area; and the Cockrell Oil Company coalbed methane project located to the northeast of the permit area.

A cumulative impact area for evaluation of potential cumulative surface water impacts includes the permit and adjacent areas and downstream waters which could be impacted by mining related changes in surface water flows or quality. Given these constraints and the nature of general surface drainage patterns in the area, the surface water cumulative impact area can be defined as a boundary extending one mile beyond the northern, eastern, and southern permit boundaries and the Price River to the west from the point where the northern cumulative impact boundary intersects the river to the confluence of Hardscrabble Canyon with the Price River near Martin, approximately 2 miles downstream from any mining related surface disturbance associated with the Mine. There are a number of activities within the cumulative impact area which could result in potential contributing surface water impacts including; operation of the Price City/Price River Water Improvement District water supply and treatment plant on the Price River near Royal; the PacifiCorp Carbon Generating Station; railroad operations in the Price River Canyon; surface runoff contributions from U.S. Highways 6 an 50 and State Highway 191; the Cockerell Oil Company coalbed methane project, and mine discharge and surface runoff from the numerous historical mining operations in the area.

Within the defined surface and ground water cumulative impact areas the minor impact contributions associated with the planned mining and related operations are not significant as described under the discussions of individual impacts presented above on either an indirect or cumulative level.

4.3.3 Soil Resources

Potential indirect and cumulative effects of the proposed action on soils resources will be limited to disturbance, loss, and alteration of the physical and chemical characteristics of soils in any areas subject to new surface disturbance. Since no surface disturbance is planned in the proposed coal lease area there will be no direct, indirect, or cumulative soils impacts for this area. Potential indirect soils impacts for the associated Mine permit area will generally be limited to the planned mine surface facilities area of approximately 70 acres which will be the only area where direct new surface disturbance will occur. Potential soils impacts in the mine facilities area will be minimized by the fact that most of the area has been extensively disturbed by previous historic mining activities and by recovery, stockpiling, and replacement during reclamation of all available soils material and adequate near-surface overburden materials which have been determined to be suitable for use as a soil substitute. Relative to potential cumulative soils impacts, the area and volume of affected soils is so small as to negligible.

4.3.4 Vegetation, Wildlife, and Wildlife Habitat (Includes Sensitive Species and Associated Habitat Values)

Since no direct surface disturbance is planned in the proposed coal lease area, there will be no direct, indirect, or cumulative vegetation or wildlife impacts in this area. Potential indirect and cumulative impacts on vegetation, fish, wildlife, and related habitat values resulting from the foreseeable related mining operations and powerline relocation may include:

<u>Vegetation and Terrestrial Wildlife</u>

- Redisturbance of approximately 48.9 acres of disturbed vegetation and habitat occurring on previously disturbed areas
- Temporary loss of approximately 6.9 acres of previously undisturbed vegetation and habitat
- Displacement of mobile resident wildlife to nearby areas providing similar habitat and adequate carrying capacity
- Direct mortality of non-mobile wildlife
- Increases in indirect wildlife disturbance due to increased human activity in the area
- Increased potential for accidental wildlife losses through electrocution or traffic related mortality

- Localized reduction or elimination of certain vegetation types and altered wildlife behavioral and use patterns if existing watering sources such as springs are lost due to subsidence related interruption of ground water flow

Fish and Aquatic Habitat

- Limited sedimentation from construction activities
- Temporary loss of low quality habitat and limited riparian vegetation as a result of realignment of portions of the Willow Creek channel and construction disturbance replacement of an existing culvert crossing
- Any significant changes in stream water quality or flow rates
- Risks associated with any petroleum spills or leaks from equipment used near the stream during construction

4.3.4.1 Vegetation and Terrestrial Wildlife Resources

In general, potential mining related impacts to vegetation and terrestrial wildlife resources will be minimized by practical limitations on wildlife use of the proposed mine facilities area, the relatively small area which will be affected by mining related surface disturbance, the limited period of actual mining use, and effective restoration and enhancement of mine disturbance areas through site reclamation. Proposed disturbance will be limited to approximately 133 acres, of which 127 acres have been previously disturbed and only approximately 6 acres will represent new disturbance. The total surface disturbance, and particularly the new disturbance, are so small as to be considered negligible. In addition, extensive areas of undeveloped lands exist in the vicinity of the Proposed Action. These undeveloped areas generally provide comparable or better potential wildlife habitat than the proposed lease and mine permit disturbance areas. Following completion of mining (approximately 20 years), all surface disturbance areas will be reclaimed to conditions and values comparable to or better than the existing conditions. Vegetative cover and production within the proposed lease and mine permit area is low, and no known threatened, endangered, or sensitive vegetation or wildlife species exist within, or utilize proposed surface disturbance areas for their basic life requisites. Some of the proposed lease and mine permit areas have, however, been designated as critical habitat (winter/summer range) for mule deer.

Displacement of mobile wildlife due to mining related surface disturbance will largely affect only those species and individuals animals which utilize the limited area encompassed by the mine surface facilities area. At this time, terrestrial wildlife use of this area appears to be limited to a few rodent species, lagomorphs, mule deer, and a limited number of bird and bat species. Most other terrestrial wildlife have already been displaced by prior disturbance and do not appear to have reestablished in the area due to limiting habitat values and existing levels of human activity. Given that the numbers of potentially displaced wildlife will be extremely small due to limited populations and the small total surface disturbance area, the ability of the surrounding habitats to absorb these immigrants should be more than adequate. Increased levels of human activity may result in indirect wildlife impacts including some alteration of diurnal and seasonal animal movements. The impacts of increased human activity will be minimized by limiting both the total area of surface disturbance and by limiting essentially all surface activities to this area.

During the period of active operations, CPMC will work closely with UDWR biologists from the local Price Office to develop and maintain a program for reporting any significant wildlife observations in the proposed permit area. As part of an ongoing employee training and communication program, CPMC employees will be instructed to report any incidents of accidental wildlife mortality or eagle sightings to the Willow Creek Environmental coordinator. CPMC will also coordinate with UDWR and private sector biologists to perform periodic raptor monitoring surveys if it is determined that mining and related activities have significant potential to adversely affect raptor breeding in the area. In addition, CPMC will design and construct any mine related power transmission lines in accordance with the guidelines set forth in "Environmental Criteria for Electric Transmission Systems" (USDI, USDA, 1970) and/or REA Bulletin 61-10 "Powerline Contacts by Eagles and Other Large Birds". These guidelines specify pole and transmission line configurations which isolate the ground

wire minimizing the potential for simultaneous contact with a live and ground wire by a raptor or other bird approaching or landing on the support poles or cross beams.

A portion of the potentially disturbed area falls within critical or important winter range for mule deer. While all disturbed areas would be on fee land, wildlife mitigation would be performed by CPMC to reduce impacts. A number of mitigation options have been identified and are being evaluated by CPMC in conjunction with the UDWR. These options include the following:

- Retreatment of an old chained area in critical winter range east of the town of Kenilworth: This area is on BLM land and was chained many years ago. Shrubs, pinion, and juniper are reinvading the area and reducing its usefulness for wildlife. Treatment would include roller chopping the shrubs and trees and reseeding the area. An EA, which could involve one to two years of analysis, would be required for these activities. This option would not meet the mitigation schedule for the Willow Creek Mine.

- Reseeding one or two areas of land in critical winter range in the Gordon Creek area: This area is on UDWR land. Enhancement of the vegetation is desirable to provide winter feed for deer and elk in the area. Treatment would consist of seeding the areas with native and wildlife desirable plant species to enhance the range. Treatment could be accomplished during the spring and fall of 1996.

- Placement of water harvesting devices in summer range on the ridge south of the mine site: This area is on CPMC land south of Highway 191 in summer range for deer and elk. There is minimal water in the area and use by deer and elk is limited. Treatment would include placing several water harvesting devices (such as guzzlers) in areas that would extend the range for wildlife. This project could be completed during 1996.

- Willow Creek stream enhancements: This area includes Willow Creek in the vicinity of the mine site or upstream of the mine site. Treatment could include removing barriers to fish migration or other habitat enhancements to the stream. Specific elements of this option are still being considered by UDWR.

CPMC will continue to discuss mitigation options with the UDWR with the commitment to conduct mitigation activities during the summer/fall of 1996. This time period corresponds with the planned construction period for the Willow Creek Mine facilities.

The potential also exists for reduction or elimination of certain vegetation types and alteration of patterns of wildlife behavior, use, and movement in certain areas if historic watering sources such as springs dry up due to subsidence related changes in ground water flow. The potential for adverse effect would be very site specific and would depend on the flow volume, normal flow period, and the existence of other potential water sources in the immediate area for given vegetation types and herds, groups, or species of wildlife. The potential for such effects as evaluated through baseline studies, ongoing hydrologic monitoring, and mine planning and associated subsidence predictions are negligible for the proposed lease area since no springs or seeps have been identified in this area and are minor for the associated mine permit area as discussed in Section 4.3.2.1, Ground Water.

4.3.4.2 Aquatic and Riparian Resources

With the exception of a short segment of the Price River which forms the western boundary of the proposed coal lease area and which will not be disturbed, there are no aquatic or riparian resources in the coal lease area and, consequently, there is little or no potential for direct, indirect, or cumulative impacts on resources in these categories due to coal leasing. Realignment of two short segments of Willow Creek, and the construction activities associated with replacement of the existing culvert crossing would result in localized surface disturbance, increased runoff, and possible increased sedimentation to Willow Creek and the Price River for a

short period. Scheduling of required construction activities during the seasonal low flow period to the extent operationally feasible and the use of alternative sediment controls should effectively minimize potential sediment contributions. The construction of other mine surface facilities may result in minor temporary increases in runoff and erosion. Sediment contributions, however, will be controlled by a combination of designed drainage and sediment control structures established prior to construction disturbance and temporary control measures.

Construction of the realigned stream segments will result in the temporary loss of low quality habitat and limited riparian vegetation in the two existing stream segments which will be effected. The existing segments of the Willow Creek channel which will be replaced represent habitat for benthic macroinvertebrates, resident fish (mountain sucker and speckled dace), and migratory routes for several trout species (brown trout, Yellowstone cutthroat trout, and rainbow trout) and support very limited riparian vegetation in a thin zone bordering the channel margins. The loss of existing marginal stream habitat values and limited riparian vegetation due to stream realignment will be effectively mitigated by construction of designed channel segments and revegetation with riparian and other suitable vegetation species. The designed channel segments will have similar hydrologic and geomorphic characteristics as the existing stream segments which they will replace but they will incorporate specific design considerations and construction practices which will result in significant overall enhancement of long-term channel stability, aquatic habitat values, fish resting and feeding habitat, and increases in the extent of valuable riparian vegetation.

Construction activities for replacement of the existing culvert crossing will result in relatively limited, temporary disturbances to aquatic and riparian habitat values. Since construction would occur during low flow, if feasible, fish movements, which are normally limited by low flow conditions, would not be significantly impacted. If construction must occur at some time other than low flow, provisions will be made to minimize any barriers to fish movement. Following completion of construction activities, disturbed areas would be returned to their approximate pre-disturbance condition and configuration.

The use of construction equipment near the Willow Creek stream channel represents a minor potential risk since a petroleum spill or leak could result in steam contamination and potential toxic effects on fish and macroinvertebrates. The magnitude and duration of the impact would depend on the location and amount of the spill, the type of material spilled, and flow conditions at the time of the spill. Potential impacts due to the use of equipment in the vicinity of the stream will be mitigated by establishment of a stream buffer zone up to 100 feet wide where feasible, prohibition of equipment lubrication or fueling within this zone, utilization of localized drainage control measures for all disturbance areas within the Willow Creek floodplain, and development and implementation of a Spill Prevention, Control, and Countermeasures Plan consistent with applicable requirements under the Clean Water Act.

Prior to reclamation, stormwater runoff from disturbed areas would be a potential source of additional sediment contributions to Willow Creek. Sediment contributions will, however, be effectively controlled by construction, operation, and maintenance of a integrated drainage and sediment control system including diversion and collection ditches, sedimentation ponds, and alternative sediment control measures.

Mine water supply requirements for sanitary use, surface dust control, fire fighting reserve, and operational mine water will be addressed through a combination of direct withdrawals from the Price River under existing active water rights, culinary supply from the existing culinary water line, and collection and recycling of both mine water and mine inflows. Any use of surface water from the Price River may result in potential temporary minor reductions in stream flow, however, any reductions will be on the order of the historic reductions associated with the Castle Gate Mine and previous mine operations. Maximum anticipated withdrawals from the Price River will be limited to approximately 730 acre-feet annually (1.0 cubic feet per second) which is well within the limits of designated appropriations for the existing active water rights and represents a negligible change in overall flow rate. For this reason, it is anticipated that the incremental mining related withdrawals will have no measurable effect relative to potential downstream surface water depletion in the Price or Green River drainages.

4.3.4.3 Cumulative Vegetation, Fish, and Wildlife Impacts

Potential vegetation and wildlife impacts are directly related to surface disturbance and aquatic and fisheries impacts are directly related to surface water impacts. Since no surface disturbance is planned in the proposed coal lease area and no significant direct surface water impacts are anticipated for this area, coal leasing is not expected to directly result in any cumulative vegetation, fish, or wildlife impacts. Potential cumulative impacts for the associated mining and related operations will be limited by the relatively small surface disturbance area and specific operational control and mitigation measures. Given the extensive areas of undeveloped land in this general area, minor localized changes in wildlife population or habitat such as those potentially resulting from the planned operations will not have any significant adverse effect.

4.3.5 Land Use

Approval of the pending coal lease application will result in a change in land use designation for lands which are the subject of the lease application from undeveloped grazing and wildlife habitat to coal mining. This change is compatible with the BLM's applicable Resource Management Plan and, in reality, may result in little or no change in surface land uses for the area. Potential indirect and cumulative effects of the associated planned mining and related operations relative to land use will involve restoration of the historical mining use for the areas to be disturbed and utilized for the planned mine surface facilities area and a change in land use designation from wildlife/grazing to mining for other areas within the mine permit boundaries. While the land use designation for these areas will change, actual physical land use for all areas except the mine surface facilities area is expected to remain essentially the same.

4.3.6 Cultural Resources

Since the Proposed Action, approval of the pending coal lease application will not involve any direct surface disturbance in the coal lease area, no direct cultural resource impacts are anticipated. Indirect and cumulative cultural resource impacts resulting from the associated planned mining and related operations will be limited to potential disturbance of existing cultural, historic, and paleontological resources within the mine surface facilities area. Impacts on the one known cultural resource site and the single historic resource site will be mitigated through either avoidance or documentation, resource recovery, and recordation in consultation with the State Historic Preservation Office.

4.3.7 Air Quality

Obviously, since no surface disturbance is planned within the proposed coal lease area there will be no direct related air quality impacts. Indirect and cumulative air quality impacts resulting from the associated mining and related operations are expected to be minor. Given that the Willow Creek Mine will be an underground mining operation, potential air emissions resulting from the mining and related operations will be limited to fugitive dust and minor combustion and vehicular emissions. Potential fugitive dust sources will include construction activities in the mine surface facilities area; unpaved mine roads and surface operations areas; coal, refuse, and topsoil stockpiles; conveyors and associated coal handling systems; coal processing equipment; coal loadout operations; mine ventilation fans; wind erosion on disturbed and exposed surface areas; and site reclamation activities.

The only source of potential combustion emissions will be a small used oil boiler which will be used to heat the maintenance shop facility. Potential mine related vehicular emissions will be limited to construction equipment during the initial construction phase, employee and supplier traffic to and from the mine, operation of a small fleet of surface maintenance and support vehicles, and reclamation equipment during the final reclamation and closure phase. All mining and related operations will be conducted in compliance with applicable provisions of both the Federal Clean Air Act and Utah air emission laws and regulations. The Willow Creek permit area falls within an area presently classified as an attainment area under the primary pollutant standards as defined by the National Ambient Air Quality Standards (NAAQS). Given this classification, Federal air emission

requirements are not applicable except to the extent that they provide for State responsibility for protection of air quality and application of Best Available Control Technology (BACT) for potential emission sources.

4.3.8 Socioeconomics, Transportation, Recreation, and Aesthetics

The proposed coal leasing action will not have any direct socioeconomic, transportation, recreation, or aesthetic impacts. In conjunction with the associated planned mining and related activities, however, the following indirect and cumulative impacts are anticipated:

- Temporary increases in the demand for rental housing and medical and social services associated with the temporary work force required for Mine construction
- Continued long-term demand for housing, utilities, and educational, medical, and social services in conjunction with the long-term Mine work force
- Increases in traffic levels on U.S. Highways 6 and 50 and State Highway 191 between Price and Helper and the Mine, and between Duchesne and the Mine
- Minor decreases in dispersed recreational use in the vicinity of the Mine
- Temporary minor adverse visual impacts associated with the mine surface facilities

With the exception of traffic impacts, all of the noted indirect and cumulative effects are minor, and in most cases, temporary in nature. U.S. Highway 6 and 50 are adequate to handle the increased traffic loads without any significant modification. State Highway 191 is generally adequate to meet projected traffic requirements except in the immediate mine facilities area. In this area, increased traffic levels and turning requirements to enter and exit the mine facilities dictate specific highway modifications as a traffic flow and safety consideration. In order to mitigate traffic concerns in this area, Highway 191 has been widened to provide three lanes, one lane for through traffic in each direction and a middle turn lane, adequate shoulders and more effective sight lines in the vicinity of the Mine facilities area. Visual impacts will be mitigated in part by the surface facilities design which consolidates the required facilities into the smallest possible area, configures the facilities so that they are compatible and blend with the natural terrain, and utilizes colors which are consistent with natural hues.

4.4 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS AND RESIDUAL ADVERSE EFFECTS

The only irreversible and irretrievable resource commitment associated with the Proposed Action is the depletion of existing coal reserves which will result from the associated mining operations. Residual adverse effects resulting from coal lease approval and issuance would include indirect and cumulative geologic and hydrologic effects for those areas within the coal lease tract affected by mining. Residual adverse effects could include minor surface subsidence, localized alteration of ground water flow patterns, and increases in ground water TDS and concentrations of other individual chemical constituents as previously described in this section. None of the potential residual adverse effects are expected to result in any significant long-term environmental hazards nor are they expected to adversely affect human health or safety.

4.5 MONITORING

Detailed mining and reclamation plans submitted the UDOGM, as the primary responsible jurisdictional agency for coal mining operations in the State of Utah include specific plans for monitoring of surface and ground water and mining related subsidence. These plans and associated evaluation and reporting requirements are designed to identify, quantify, and document any significant changes in the monitored systems as a basis for review and modification, if indicated, of the approved mining, reclamation, and associated activities to effectively control and mitigate any significant adverse impacts. Hydrologic monitoring has been initiated and will continue through the reclamation liability period. Subsidence monitoring will be initiated prior to initial underground

mining disturbance and will continue for a reasonable period following completion of mining operations in any given area.

5.0 CONSULTATION AND COORDINATION

5.1 LIST OF PREPARERS

Bureau of Land Management - Price Resource Office

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david Mills, Wildlife Biologilst
Kerry Flood, Hydrologist

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5.2 PERSONS, GROUPS, OR AGENCIES CONSULTED

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Hydro-Bios

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McVehil and Monnett

George McVehil, Air Scientist

6.0 REFERENCES

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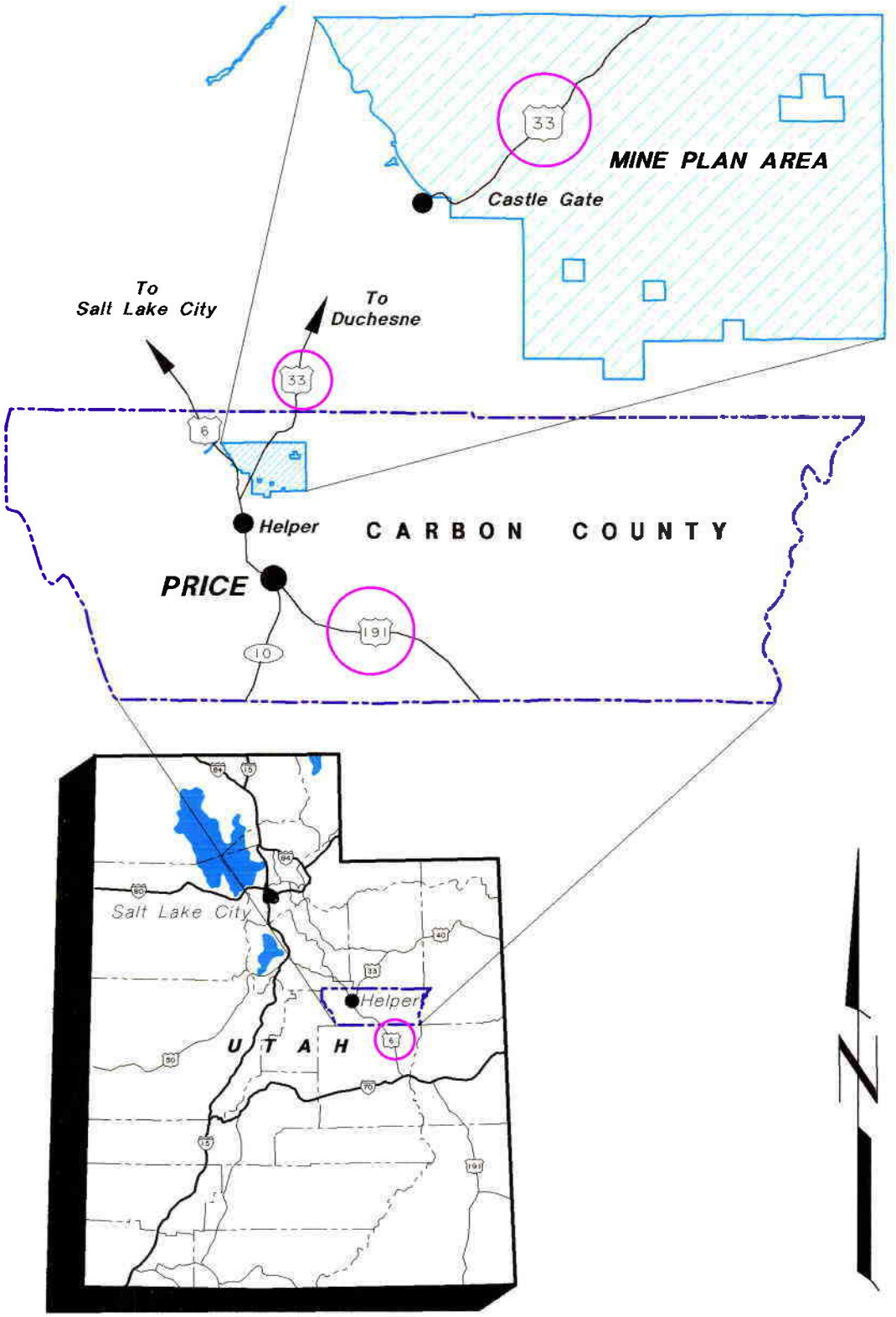
Merritt, R. W. and K. W. Cummins. 1984. An Introduction to the Aquatic Insects of North America. Second Edition. Wiley/Hunt, Dubuque, Iowa, 772 pp.

Phippen, K. 1994. Fish Biologist, Utah Division of Wildlife Resources, Price, Utah. Personal communication to Rollin Daggett, HydroBios Consultants, Fort Collins, Colorado, September 22, 1994.

FIGURES



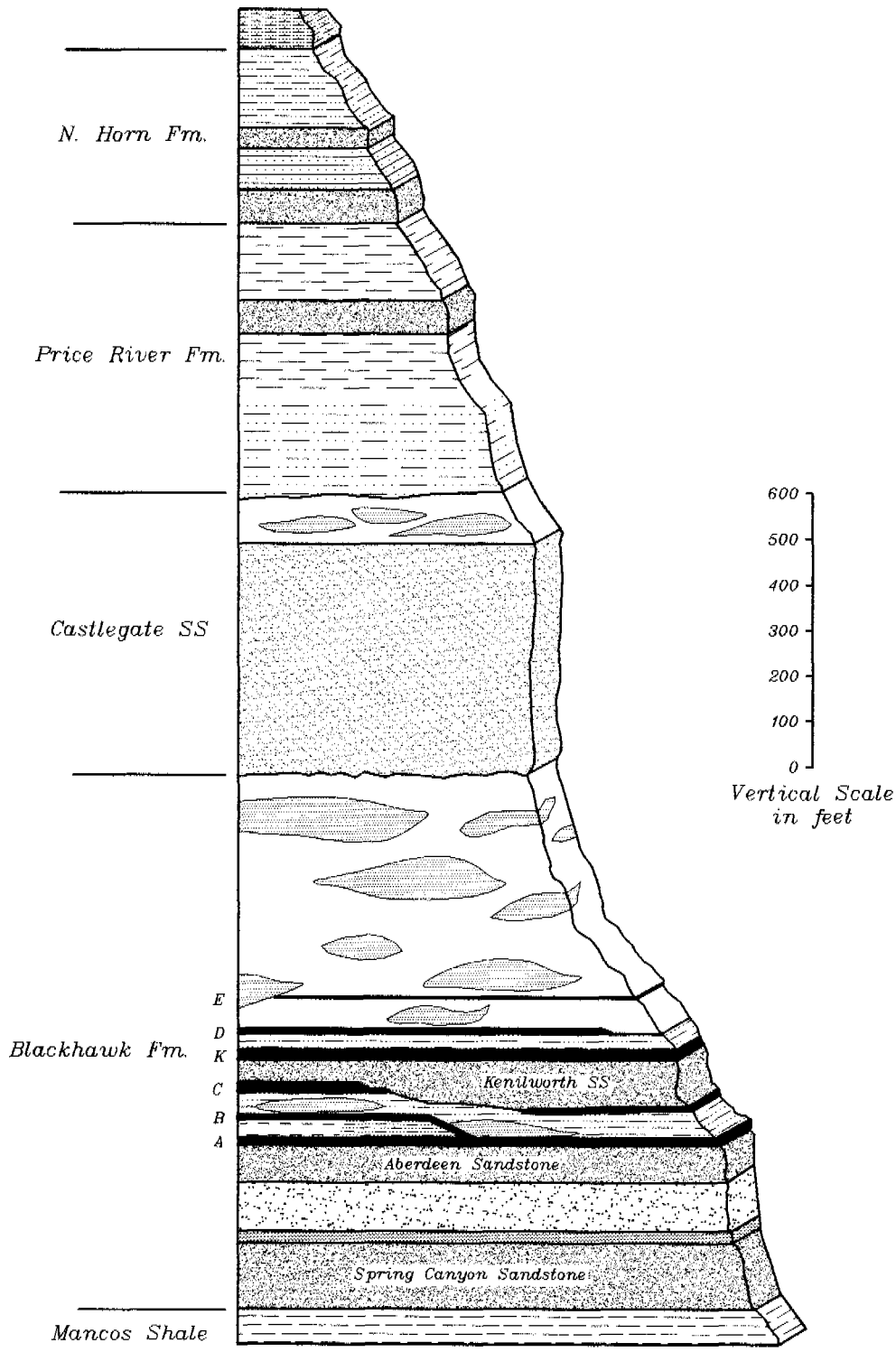
Project No.: 500-5000	Design By: J.NETTLETON	Scale: NOT TO SCALE
File: NEWPGLOC.DWG	Drawn By: K.CONRATH	Date: MARCH 1994

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

FIGURE 1.0-1

CYPRUS Plateau Mining

GENERAL LOCATION MAP



Project No.: 866-2200	Design By: J.NETTLETON	Scale: AS SHOWN	CYPRUS Plateau Mining
File: STRAT2.DWG	Drawn By: K.CONRATH	Date: JANUARY, 1995	GENERAL STRATIGRAPHIC COLUMN
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	FIGURE 3.0-1		

APPENDICES

APPENDIX A

GROUND WATER QUALITY SUMMARY

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

MONITORING WELLS
WILLOW CREEK

MONITORING STATION (1)	B-51			B-121			B-331 (2)			B-331A (3)		
LOCATION	PANTHER CANYON WELL			ALRAD CANYON WELL			DRY CANYON WELL			DRY CANYON WELL		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (4)	10/94 - 3/95			10/94 - 3/95			10/94 - 3/95			10/94 - 3/95		
Field Measurements												
- Water Level Elevation (ft)	6709.2	6722.5	6712.7	6997.8	6997.8	6997.8	6274.3	6333.8	6312.77	6806.9	6811.9	6312.77
- Temperature (degrees C)			15.5			14.3			14.33			10
- pH (s.u.)			7.58			9.3			8.61			8.19
- Specific Conductivity (umhos/cm)			3020			1226			3350			1815
Laboratory Parameters (5,6)												
- Specific Conductance			3250			1570			3700			1728
- Total Dissolved Solids			2450			1270			2070			1300
- Nitrogen (Ammonia)			2			1.1			2.01			0.33
- Nitrate (NO3 - N)			0.04			0.04			0.14			-0.02
- Nitrate-Nitrite (NO3/NO2)			0.04						0.15			-0.02
- Nitrite (NO2 - N)			-0.01			-0.01			0.01			0.01
- Oil and Grease			2			3			6			1
- Alkalinity (as CaCO3)			420			52			760			392
- Bicarbonate (as HCO3)			420			28			760			392
- Carbonate (as CO3)			0			24			0			0
- Chloride (Dissolved)			164			28			720			50
- Sulfate			1240			820			64			611
- Phosphate (Ortho)			-0.005			-0.005			-0.005			0.013
- Aluminum (Dissolved)			-0.05			-0.03			-0.05			-0.05
- Arsenic (Dissolved)			-0.001			-0.001			0.011			0.004
- Boron (Dissolved)			2.22			0.08			0.33			0.1
- Cadmium (Dissolved)			-0.005			-0.005			-0.005			-0.005
- Calcium (Dissolved)			131			222			63			177
- Copper (Dissolved)			-0.01			-0.01			-0.01			-0.01
- Hardness (as CACO3)			902			633			469			930
- Iron (Dissolved)			0.39			-0.01			0.02			-0.02
- Iron (Total)			15.7			9.9			6.49			0.17
- Lead (Dissolved)			-0.02			-0.02			-0.02			-0.02
- Magnesium (Dissolved)			140			19			76			119
- Manganese (Dissolved)			0.86			-0.005			0.23			0.44
- Manganese (Total)			0.89			0.16			0.28			1.08
- Molybdenum (Dissolved)			0.04			0.07			-0.01			-0.01
- Potassium (Dissolved)			27			18			17			13
- Selenium (Dissolved)			-0.001			-0.001			-0.001			0.001
- Sodium (Dissolved)			449			100			677			68
- Zinc (Dissolved)			-0.01			-0.01			-0.01			NA

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Dry Canyon well installed to monitor the Aberdeen Sandstone aquifer
(3) Dry Canyon well installed to monitor the Upper Blackhawk Formation
(4) Monitoring wells B-51, B-121, B-331 and B-331A have been sampled for groundwater quality on a single event
(5) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(6) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

SPRINGS AND SEEPS

MONITORING STATION (1) LOCATION	B-41 DRY CANYON			B-71 PANTHER CANYON			B-161 SPRING NEAR KENILWORTH ADIT			B-241 POSSIBLY HISTORIC ROSB SPRING		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (2)	6/94 - 3/95			6/94 - 3/95			6/94 - 3/95			6/94 - 3/95		
Field Measurements												
- Flow (cfs)	0.001	0.002	0.002	0.001	0.005	0.002	0.004	0.018	0.01			0.001
- Temperature (degrees C)	3.6	10.2	6.9	7.5	16.7	11.4	9.5	15.5	12			8.5
- pH (s.u.)	7.1	8.6	7.9	7	7.3	7.2	7.1	8.3	7.71			7.6
- Specific Conductivity (umhos/cm	469	469	469	416	4230	2855	410	4090	2833			688
Laboratory Parameters (3,4)												
- Specific Conductance (Lab)	567	588	587.5	3700	4200	4033	4040	4230	4146			606
- Total Dissolved Solids	328	338	333	3430	4104	3827	2732	2890	2824			340
- Ammonia - (NH3-N)	-0.05	0.07	0.05	0.16	0.44	0.33	0.05	0.07	0.06			-0.05
- Nitrate (NO3 - N)	0.77	1.1	0.92	5.8	7.7	6.6	0.03	0.13	0.073			0.04
- Nitrate-Nitrite (NO3/NO2)	0.77	1.1	0.92	5.8	7.7	6.6	0.03	0.12	0.07			0.04
- Nitrite (NO2 - N)	-0.01	0.01	0.008	-0.01	0.01	0.007	-0.01	-0.01	-0.01			-0.01
- Oil and Grease	-1	-1	-1	-1	4	1.67	-1	17	6			-1
- Alkalinity (as CaCO3)	210	212	211	520	577	543	1054	1200	1142			300
- Bicarbonate (as HCO3)	210	212	211	508	577	540	914	1100	1013			300
- Carbonate (as CO3)				-2	12	6.5	110	148	133			0
- Chloride (Dissolved)	9	10	9.5	70	97	81	151	180	165			12
- Sulfate	84	97	91	2000	2531	2322	1100	1152	1129			29
- Phosphate (Ortho)	-0.005	0.018	0.01	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005			0.147
- Aluminum (Dissolved)	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05			-0.05
- Arsenic (Dissolved)	-0.001	-0.001	-0.001	-0.01	-0.01	-0.01	-0.001	0.003	0.001			-0.001
- Boron (Dissolved)	0.02	0.04	0.03	2.9	3.4	3.2	6.1	6.8	6.4			0.04
- Cadmium (Dissolved)	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005			-0.005
- Calcium (Dissolved)	61	72	66.5	240	302	275	21	27	24.6			64
- Copper (Dissolved)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01
- Hardness (as CACO3)	276	319	298	2246	2871	2616	561	654	619			279
- Iron (Dissolved)	-0.02	-0.02	-0.02	-0.01	0.16	0.11	-0.01	0.06	0.04			-0.02
- Iron (Total)	0.1	0.32	0.21	0.04	0.14	0.07	0.07	0.3	0.21			0.73
- Lead (Dissolved)	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02			-0.02
- Magnesium (Dissolved)	30	34	32	400	516	469	124	143	135			29
- Manganese (Dissolved)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01
- Manganese (Total)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01
- Molybdenum (Dissolved)	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01
- Potassium (Dissolved)	2	2	2	43	45	44	37	40	38			2
- Selenium (Dissolved)	-0.001	-0.001	-0.001	0.007	0.012	-0.01	-0.001	-0.001	-0.001			0.003
- Sodium (Dissolved)	12	12	12	100	133	121	730	783	750			30
- Zinc (Dissolved)	-0.01	0.01	0.008	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Station B-241 sampled a single time.
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

SEEPS AND SPRINGS

MONITORING STATION (1)	B-261			B-262			B-341			B-342		
LOCATION	PACE SPRING			BUCK/DEEP CANYON			MATHIS CANYON SPRING			MATHIS CANYON SPRING		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (2)	6/94 - 3/95			7/94 - 3/95			6/94 - 3/95			6/94 - 3/95		
Field Measurements												
- Flow (cfs)		0.002		0.002	0.009	0.006	0.001	0.002	0.001	0.002	0.005	0.004
- Temperature (degrees C)		8.8		10	10.9	10.3	3	8.2	5.3	7	13.1	10.1
- pH (s.u.)		7.39		7.02	7.78	7.47	7.5	8	7.7	7.5	8.3	7.9
- Specific Conductivity (umhos/cm)		630		645	845	7.14	748	848	802	750	842	796
Laboratory Parameters (3,4)												
- Specific Conductance (Lab)		556		637	759	679	722	752	738	630	639	635
- Total Dissolved Solids		290		320	418	358	398	422	409	352	360	356
- Ammonia - (NH3-N)		0.06		-0.05	0.07	0.04	-0.05	-0.05	-0.05	-0.05	0.05	0.038
- Nitrate (NO3 - N)		0.35		0.05	0.16	0.1	0.13	0.23	0.18	0.08	0.1	0.09
- Nitrate-Nitrite (NO3/NO2)		0.34		0.05	0.16	0.1	0.13	0.22	0.18	0.08	0.09	0.09
- Nitrite (NO2 - N)		-0.01		-0.01	0.01	0.007	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Oil and Grease		-1		-1	15	5.3	-1	23	8	-1	-1	-1
- Alkalinity (as CaCO3)		300		330	412	358	322	368	345	300	320	310
- Bicarbonate (as HCO3)		300		330	412	358	322	368	341	280	312	296
- Carbonate (as CO3)		0							12	8	20	14
- Chloride (Dissolved)		3		7	10	8	4	5	4.33	4	5	4.5
- Sulfate		6		12	47	26	64	74	68	35	47	41
- Phosphate (Ortho)		-0.005		-0.005	0.011	0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
- Aluminum (Dissolved)		-0.05		-0.05	0.06	0.037	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
- Arsenic (Dissolved)		-0.001		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.01	-0.01	-0.001
- Boron (Dissolved)		0.02		0.03	0.04	0.04	0.04	0.05	0.05	0.03	0.04	0.035
- Cadmium (Dissolved)		-0.005		-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
- Calcium (Dissolved)		81		77	85	81	68	75	71	80	82	81
- Copper (Dissolved)		-0.01		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Hardness (as CACO3)		309		320	393	347	285	311	294	327	336	332
- Iron (Dissolved)		-0.02		-0.02	0.03	0.17	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
- Iron (Total)		0.07		-0.02	1.14	0.41	-0.02	-0.02	-0.02	0.07	0.11	0.09
- Lead (Dissolved)		-0.02		-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
- Magnesium (Dissolved)		26		31	44	35	28	30	29	31	32	31.5
- Manganese (Dissolved)		0.19		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Manganese (Total)		0.22		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.02	0.013
- Molybdenum (Dissolved)		-0.01		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Potassium (Dissolved)		1		1	2	1	-1	-1	-1	-1	1	0.75
- Selenium (Dissolved)		-0.001		-0.001	0.002	0.001	0.003	0.005	0.004	0.002	0.003	0.003
- Sodium (Dissolved)		8		17	25	19	54	63	59	14	16	15
- Zinc (Dissolved)		-0.01		-0.01	0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Station B-261 sampled a single time
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

SEEPS AND SPRINGS

MONITORING STATION (1)	B-351			B-321			B-32			B-33		
LOCATION	MATHIS CANYON SPRING			WILLOW CREEK SPRING			MATHIS CANYON SPRING			MATHIS CANYON SPRING		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record (2)	6/94 - 3/95			9/94 - 3/95			6/80 - 10/83			5/78 - 6/79		
Field Measurements												
- Flow (cfs)		0.001			0.009		0.004	0.04	0.02	0	0.06	0.02
- Temperature (degrees C)		9			10		6	25	15.6	3	7.5	5.4
- pH (s.u.)		7.34			7.14		7.5	8.5	7.9	7.4	8.3	7.8
- Specific Conductivity (umhos/cm)		643			1563		270	529	453			
Laboratory Parameters (3,4)												
- Acidity							-0.01	20	8.6	-0.1	20	4
- Specific Conductivity (Lab)		567			1567							
- Total Dissolved Solids		294			1090		288	352	313	255	396	338
- Nitrogen (Ammonia)		0.06			0.24							
- Nitrate (NO3 - N)		0.94			-0.02		-0.01	1.4	0.63	-0.01	1.1	0.39
- Nitrate-Nitrite (NO3/NO2 - N)		0.93			-0.02							
- Nitrite (NO2 - N)		-0.01			-0.01					-0.01	-0.01	-0.01
- Oil and Grease		-1			-1		-0.1	3.2	1.4	-1	4.6	1.6
- Alkalinity (as CaCO3)		284			350		196	276	224	204	348	265
- Bicarbonate (as HCO3)		284			350		239	322	270	236	476	300
- Carbonate (as CO3)		0			0							
- Chloride (Dissolved)		3			45		1.4	13.1	7.3	2.7	17.4	9.9
- Fluoride							0.2	0.36	0.25	0.17	0.26	0.23
- Sulfate		29			463		43	81	64	24	136	66
- Phosphate (Ortho)		-0.005			-0.005		0.04	0.5	0.16	0.02	0.024	0.022
- Aluminum (Dissolved)		-0.05			-0.05							
- Arsenic (Dissolved)		-0.001			0.001		-0.001	0.01	0.002	-0.001	-0.001	-0.001
- Barium (Dissolved)							0.03	0.08	0.05	0.04	0.16	0.075
- Boron (Dissolved)		0.02			0.08							0.077
- Cadmium (Dissolved)		-0.005			-0.005		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Calcium (Dissolved)		72			156		40	62	53	40	63	52
- Copper (Dissolved)		-0.01			-0.01		-0.001	0.04	0.02	-0.001	0.04	0.011
- Hardness (Total)		291			821							
- Iron (Dissolved)		-0.02			0.02							0.02
- Iron (Total)		0.63			0.08		0.04	1.2	0.57	0.008	1.2	0.3
- Lead (Dissolved)		-0.02			-0.02		-0.001	0.002	0.001	-0.001	0.002	0.001
- Magnesium (Dissolved)		27			105		25.92	38.4	30.9	24.5	52.8	37.5
- Manganese (Dissolved)		-0.01			0.81					-0.001	0.01	0.006
- Manganese (Total)		0.03			0.78		-0.01	0.03	0.02			
- Mercury (Dissolved)										-0.0002	-0.0002	-0.0002
- Molybdenum (Dissolved)		-0.01			-0.01							
- Phenols (Dissolved)							-0.001	0.1	0.03	-0.001	0.03	0.008
- Potassium (Dissolved)		1			9		1	1.5	1.3	1.1	2.3	1.5
- Selenium (Dissolved)		-0.001			-0.001		-0.001	0.004	0.001	-0.001	-0.001	-0.001
- Silver (Dissolved)							-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Sodium (Dissolved)		8			59		8.5	38	18.5	3.5	33.5	17.8
- Zinc (Dissolved)		-0.01			-0.01		0.007	0.035	0.022	0.002	0.049	0.02

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Sampling sies B-351 and B-352 sampled a single time
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.2
GROUNDWATER QUALITY SUMMARY

MONITORING WELLS
WILLOW CREEK

MONITORING STATION (1)	BM-25			BM-26			BM-27			BM-28		
LOCATION (2)	BOTTOM OF ROYAL MINE			ROYAL MINE (3)			ROYAL MINE (4)			ROYAL MINE (5)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record	6/77 to 4/78			6/77 to 4/78			6/77 to 4/78			6/77 to 4/78		
Field Measurements												
- Mine Inflow (cfs)				0.01	0.01	0.01	0	0.002	0.001			0.005
- Temperature (degrees C)	12	13	12.5	8	9	8.25	9	9	9	4	7	5.75
- pH (s.u.)	6.9	8.16	7.48	7.33	8.2	7.78	7.63	8	7.8	7.2	7.9	7.61
- Specific Conductivity (umhos/cm	1390	2050	1646.3	1050	1990	1312.8	1200	1790	1509.5	1380	1850	1538.6
Laboratory Parameters (6,7)												
- Acidity												
- Total Dissolved Solids	906	1350	1080.8	700	1300	861	964	1200	1082.5	898	1240	1007.2
- Total Suspended Solids	32	1900	354.4	100	1228	633.67	4	14	10.25	7	31	14.6
- Nitrogen (Ammonia)	0.15	8	1.44	0.1	8	7.38	-0.01	0.36	0.23	0.05	0.35	0.154
- Nitrate (NO3 - N)	0.02	9	1.479	0.05	0.84	0.14	0.06	0.7	0.3	0.03	0.6	0.224
- Nitrite (NO2 - N)	1.02	1.05	1.035	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.01
- Oil and Grease	3.4	4070	599.26	1.7	13.6	6.9	-1	5.2	2.75	-1	7.4	3.18
- Alkalinity (as CaCO3)	2.54	490	366.29	168	277	187	164	358	219	374	400	383.2
- Bicarbonate (as HCO3)	268.4	558.76	427.57	204.96	270.8	228.12	200	436.7	267.4	456.28	488	467.5
- Carbonate (as CO3)	-0.001	19.2	2.75	-0.001	-0.001	-0.001	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Chloride (Dissolved)	46	150	99.14	24	32	24.33	28	34	31	20	32	26.8
- Fluoride	0.5	0.66	0.57	0.36	0.51	0.43	0.38	0.5	0.435	0.33	0.44	0.384
- Sulfate	400	580	362	360	640	430	560	560	590	360	460	404
- Phosphate (Total)	0.09	2.8	0.645	0.15	2.3	0.91	0.08	2.3	0.664	0.04	0.74	0.18
- Phosphate (Ortho)	0.02	0.54	0.205	0.04	0.15	0.09	0.015	0.04	0.024	-0.01	0.03	0.018
- Aluminum (Dissolved)	-0.001	0.036	0.019	-0.001	-0.001	-0.001						
- Arsenic (Dissolved)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.014	0.004
- Barium (Dissolved)	0.005	0.11	0.053	0.012	0.055	0.03	0.05	0.07	0.055	0.025	0.057	0.04
- Boron (Dissolved)	-0.001	0.3	0.149	-0.001	0.3	0.18	0.13	0.25	0.19	0.075	0.2	0.14
- Cadmium (Dissolved)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Calcium (Dissolved)	80	123.2	7	88	112	100.67	152	170.4	162.14	180	316	207.04
- Chromium (Dissolved)	-0.001	0.013	0.003	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Copper (Dissolved)	0.004	0.005	0.0043	-0.001	0.005	0.003						0.004
- Hardness (Total)	530	800	565.43	470	522	498.67	740	810	762.5	660	830	776
- Iron (Dissolved)												
- Iron (Total)	0.072	3.42	1.076	0.051	16.43	6	0.149	0.409	0.32	0.438	4.39	2.92
- Lead (Dissolved)	-0.001	0.004	0.002	-0.001	0.003	0.001	-0.001	0.005	0.003	-0.001	0.004	0.002
- Magnesium (Dissolved)	60.94	79.2	71.59	55.2	62.4	59.28	84	92.16	87.24	-0.01	96.48	62.02
- Manganese (Total)	0.023	0.218	0.073	0.021	0.227	0.13	0.004	0.156	0.05	0.395	0.039	0.28
- Mercury (Dissolved)	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
- Molybdenum (Dissolved)	-0.001	0.029	0.015	0.002	0.002	0.002						
- Nickel (Dissolved)	-0.001	0.169	0.085	-0.001	-0.001	-0.001						
- Phenols (Dissolved)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001						
- Potassium (Dissolved)	6.52	17.8	10.33	6	15.51	6.85	5.82	9.11	7.79	4.76	7.03	6.11
- Selenium (Dissolved)	-0.001	-0.001	-0.001	-0.001	0.005	0.003	-0.001	-0.001	-0.001	-0.001	0.004	0.002
- Silver (Dissolved)	-0.001	0.051	0.008	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Sodium (Dissolved)	6.5	185	137.14	18.5	65	42.84	23	102	51.48	15	56	28
- Zinc (Dissolved)	0.011	0.408	0.091	0.093	0.408	135.72	0.02	0.082	0.056	0.012	0.074	0.037

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Mine discharge/inflow stations BM25, BM26, BM27, and BM 28 are located in the western coal reserve area.
(3) Royal Mine 20 feet above bottom
(4) Royal Mine at Crosscut # 3
(5) Royal Mine 40 feet below ground surface
(6) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(7) "-" indicates result below laboratory detection limit

APPENDIX B

SURFACE DRAINAGES WATER QUALITY SUMMARY

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

PRICE RIVER

	B-21 (2)			B-20 (2)			B-5			B-6		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record	6/78 - 10/83			2/80 - 10/83			6/78 - 3/95			6/78 - 3/95		
Field Measurements												
- Temperature	0	18	9.3	0	20	7.8	0.2	20.4	8.7	1	20	9
- pH	6.8	9.1	7.9	6.7	9.5	8.1	7	9.6	8.2	7.1	9.5	8.1
- Specific Conductivity	250	809	477.8	235	575	380	253	795	447	250	710	435
- Dissolved Oxygen	7.2	10.2	8.8	7.2	12	10	4.9	12	8.9	5.7	12	8.9
Laboratory Parameters (3,4)												
- Specific Conductance							367	631	505	361	634	511
- Acidity	-0.01	16	2.6	-0.01	24	4.4	-0.01	30	6	-0.01	34	6.9
- Chemical Oxygen Demand												
- Dissolved Oxygen												
- Total Dissolved Solids	252	945	356	189	880	314	198	1080	329	190	910	319
- Total Suspended Solids	1	1945	192.9	1	1278	205.9	-1	1604	188.6	0.5	1633	200
- Total Settleable Solids							-0.4	-0.4	-0.4	-0.1	-0.1	-0.1
- Turbidity												
- Nitrogen (Ammonia)							-0.05	0.17	0.073	-0.05	0.3	0.117
- Nitrate	-0.01	0.23	0.06	-0.01	0.58	0.118	-0.01	0.84	0.158	-0.01	0.63	0.14
- Nitrite	-0.01	-0.01	-0.01				-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Oil and Grease	-0.1	18.8	1.8	-0.1	57	4.4	-1	40	3.02	-0.1	28.4	2.5
- Alkalinity	7	320	214.4	10	266	199	150	298	222	142	334	219
- Bicarbonate	203.5	390.4	298.7	12	322	241	150	363	261	150	407	259
- Carbonate	-0.01	-0.01	-0.01				8	8	8	4	4	4
- Chloride	3.5	107.9	13.9	4	45.3	13.1	3	45.3	14	4	26	12.2
- Fluoride	0.13	0.24	0.18	0.1	0.36	0.17	0.1	0.28	0.16	0.1	0.28	0.167
- Sulfate	4	500	69.03	10	455	71.9	13	590	62.9	2.6	460	59.8
- Phosphate (Ortho)	-0.01	1.52	0.33	0.005	0.9	0.28	0.03	1.7	0.28	0.02	1.08	0.25
- Aluminum							-0.03	-0.05	0.02	-0.03	-0.03	-0.03
- Arsenic	-0.001	0.027	0.005	-0.001	0.029	0.004	-0.001	0.038	0.003	-0.001	0.03	0.003
- Barium	0.05	0.36	0.148	0.06	0.35	0.14	0.03	0.4	0.127	0.01	0.95	0.14
- Boron				0.03	0.35	0.13	0.03	0.45	0.11	0.03	0.4	0.09
- Cadmium	-0.001	0.002	0.001	-0.001	0.002	0.001	-0.001	0.002	0.001	-0.001	0.01	0.001
- Calcium	25.6	220	62.73	32	190	61.1	37.6	250	61.5	20	68.5	54.5
- Chromium	-0.001	0.044	0.004	-0.001	0.039	0.004	-0.001	0.041	0.003	-0.001	0.04	0.003
- Copper	-0.001	0.27	0.027	-0.001	0.5	0.039	-0.001	1.14	0.055	-0.001	0.1	0.016
- Cyanide	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Hardness (Total)							173	324	234	173	318	229
- Hydroxide												
- Iron (Dissolved)	0.01	0.01	0.01	0.02	0.13	0.07	-0.01	0.68	0.16	-0.01	0.04	0.023
- Iron (Total)	0.023	25.5	3.9	0.21	25.8	3.8	0.09	30.5	2.9	0.01	25.3	2.73
- Lead	-0.001	0.099	0.011	-0.001	0.11	0.008	-0.001	0.06	0.005	-0.001	0.031	0.004
- Magnesium	2	57	38.47	10.56	47	25.53	2.36	57.8	25.6	4.8	384	35.4
- Manganese (Dissolved)							-0.005	0.02	0.009	-0.005	0.02	0.009
- Manganese (Total)	0.002	0.51	0.069	-0.001	1.2	0.18	0.016	1.3	0.15	0.006	1.22	0.145
- Mercury	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
- Molybdenum							-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
- Organic Carbon (Total)												
- Phenols	-0.001	0.035	0.005	-0.001	0.28	0.025	-0.001	0.31	0.034	-0.001	0.38	0.028
- Potassium	0.96	2.1	1.5	0.85	5.5	1.6	1	3.5	1.7	0.99	4.2	1.6
- Selenium	-0.001	0.004	0.001	-0.001	0.004	0.001	-0.001	0.003	0.001	-0.001	0.003	0.001
- Silica	5.4	33	19.2				5.1	11	8.1	5.4	16	8.9
- Silver	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
- Sodium	1.2	81	12.7	5.3	30	18.1	8	54	25.4	2.3	86.3	23.2
- Zinc	-0.001	0.2	0.045	-0.001	0.14	0.03	-0.01	0.19	0.032	-0.01	0.14	0.026

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Monitoring station is located in the western coal reserve area
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

WILLOW CREEK

	B-1 (B-151) (2)			B-2			B-3 (B-3N) (2)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Period of Record	6/78 - 3/95			6/78 - 3/95			2/80 - 3/95		
Field Measurements									
- Temperature	0	23	9.5	0	22	8.7	-1	35	14.6
- pH	6.8	9.4	8.1	7.5	9.2	8.2	7.1	807	37.8
- Specific Conductivity	365	1150	707	328	1350	667	315	1152	703
- Dissolved Oxygen	6.7	11.8	8.4	7	11.4	9.6	6.1	10.6	7.9
Laboratory Parameters (3,4)									
- Specific Conductance	782	976	879				790	1050	907
- Acidity	-0.01	28	4.3	-0.01	26	3.2	-0.01	20	2.7
- Chemical Oxygen Demand									
- Dissolved Oxygen									
- Total Dissolved Solids	365	1198	579	348	840	562	345	720	536
- Total Suspended Solids	1	2622	334	1	4310	436	-2	4105	465
- Total Settleable Solids	-1	-1	-1				-0.4	-0.4	-0.4
- Turbidity									
- Nitrogen (Ammonia)	0.07	0.09	0.08				-0.05	0.61	0.22
- Nitrate	-0.01	0.58	0.08	-0.01	1.02	0.09	-0.01	0.63	0.08
- Nitrite	-0.01	-0.01	-0.01				-0.01	-0.01	-0.01
- Oil and Grease	-0.1	7.6	1	-0.1	6.4	0.92	-0.1	10.6	1.6
- Alkalinity	180.9	423.8	289.2	202	354	278	186	398	271
- Bicarbonate	205	423	323	246	421	327	224	427	312
- Carbonate	10	12	11				20	24	22
- Chloride	4	42	22.8	2.7	40.5	22	6.4	66	26.4
- Fluoride	0.15	0.74	0.25	0.15	0.37	0.24	0.15	0.3	0.23
- Sulfate	75	720	195	74	415	190	70.5	255	175.6
- Phosphate (Ortho)	0.02	1.7	0.3	-0.01	10	0.72	0.04	1.2	0.32
- Aluminum	-0.05	-0.05	-0.05				-0.05	-0.05	-0.05
- Arsenic	-0.001	0.125	0.011	-0.01	0.05	0.009	-0.001	0.028	0.007
- Barium	0.05	0.35	0.11	0.02	0.75	0.19	0.045	0.79	0.187
- Boron	0.09	0.5	0.17	0.09	0.11	0.1	0.08	0.12	0.1
- Cadmium	-0.001	0.002	0.001	-0.001	0.002	0.001	-0.001	0.002	0.001
- Calcium	40.8	255	64.5	34.4	155	58.3	33	102	56
- Chromium	-0.001	0.062	0.006	-0.001	0.037	0.006	-0.001	0.04	0.006
- Copper	-0.001	0.23	0.03	-0.001	0.11	0.031	-0.01	0.11	0.031
- Cyanide	-0.001	-0.001	-0.001	-0.01	-0.01	-0.01	-0.001	-0.001	-0.001
- Hardness (Total)	279	338	309				256	379	318
- Hydroxide									
- Iron (Dissolved)	-0.01	0.04	0.016	0.02	0.02	0.02	-0.01	0.69	0.15
- Iron (Total)	0.04	1230	55.2	0.06	33.8	6.7	0.09	35.6	6.9
- Lead	-0.02	0.05	0.007	-0.001	0.013	0.001	-0.001	0.03	0.004
- Magnesium	28.8	55.7	45	25.9	57.6	46.4	23	65	44.4
- Manganese (Dissolved)	-0.01	1.7	0.21				-0.01	0.02	0.01
- Manganese (Total)	-0.01	0.085	0.033	0.002	1.7	0.25	-0.01	1.6	0.194
- Mercury	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
- Molybdenum	-0.01	-0.01	-0.01				-0.01	-0.01	-0.01
- Organic Carbon (Total)									
- Phenols	-0.001	0.066	0.012	-0.001	0.042	0.006	-0.001	0.096	0.015
- Potassium	1.5	11.9	2.8	1.4	5.8	2.6	1.5	6.2	2.6
- Selenium	-0.001	0.004	0.001	-0.001	0.004	0.001	-0.001	0.004	0.001
- Silica									
- Silver	-0.001	0.006	0.001	-0.001	-0.001	-0.001	-0.001	0.002	0.001
- Sodium	39.5	142	76.2	37.6	126	72.5	35	139	72.3
- Zinc	-0.01	0.285	0.045	0.003	0.175	0.036	-0.01	0.21	0.045

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Location designation was changed to the station identification in parenthesis in 1994
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

	SULPHER CANYON			CRANDELL CANYON						BEAR CANYON	GENTLE WASH
	B-19 (BN-221) (2)			B-25			B-26			BEAR CANYON	GENTLE WASH
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	NS (5)	NS (5)
Period of Record	6/78 - 3/95			4/81 - 10/83			4/81 - 10/83				
Field Measurements											
- Temperature	-4	32	13.3			23	2	11	6.4		
- pH	6.4	9.2	8			8.2	7.7	9.2	8.4		
- Specific Conductivity	84	1500	683				476	2040	981		
- Dissolved Oxygen	6.2	10.8	8.8								
Laboratory Parameters (3,4)											
- Specific Conductance	1484	1484	1484			514					
- Acidity	-0.01	38	7.1			-0.01	-0.01	8	2.6		
- Chemical Oxygen Demand											
- Dissolved Oxygen											
- Total Dissolved Solids	315	880	504			410	395	1480	774		
- Total Suspended Solids	-0.1	215	27.9			475	54	736	367		
- Total Settleable Solids	-0.4	-0.4	-0.4								
- Turbidity											
- Nitrogen (Ammonia)	-0.05	-0.05	-0.05								
- Nitrate	-0.01	0.51	0.05			0.06	0.04	14.4	4		
- Nitrite	-0.01	0.04	0.02								
- Oil and Grease	-0.01	24.2	2.27			0.8	-0.2	3.8	1.5		
- Alkalinity	162	496	296			294	56	329	192		
- Bicarbonate	44	496	341			358	68.3	401	235		
- Carbonate											
- Chloride	2.5	87	30.7			14	14	153	62.8		
- Fluoride	0.17	2.26	0.42			0.23	0.23	0.43	0.32		
- Sulfate	38	224	99.2			80	103	730	345		
- Phosphate (Ortho)	-0.001	0.72	0.185			0.4	0.04	0.93	0.38		
- Aluminum	-0.05	-0.05	-0.05								
- Arsenic	-0.001	0.025	0.002			0.006	-0.001	0.059	0.024		
- Barium	0.07	0.23	0.18			0.22	0.05	0.68	0.31		
- Boron	0.07	0.38	0.16								
- Cadmium	-0.005	-0.005	-0.005			-0.001	-0.001	0.005	0.002		
- Calcium	4.2	120	64.8			30.4	32	161	82.6		
- Chromium	-0.001	0.005	0.001			0.008	-0.001	0.051	0.014		
- Copper	-0.001	0.05	0.01			0.03	0.009	0.13	0.05		
- Cyanide	-0.001	-0.001	-0.001								
- Hardness (Total)	325	325	325								
- Hydroxide											
- Iron (Dissolved)	-0.02	1.04	0.38								
- Iron (Total)	0.015	4.25	0.55			4.16	0.36	42.5	17.7		
- Lead	-0.001	0.006	0.002			0.009	-0.001	0.042	0.021		
- Magnesium	5.3	56.4	40.1			7.52	10.1	104	62.6		
- Manganese (Dissolved)	-0.01	-0.01	-0.01								
- Manganese (Total)	0.004	0.16	0.04			0.16	0.005	0.78	0.26		
- Mercury	-0.0002	-0.0002	-0.0002								
- Molybdenum	-0.01	-0.01	-0.01								
- Organic Carbon (Total)											
- Phenols	-0.001	0.222	0.028			-0.001	-0.001	0.029	0.008		
- Potassium	0.17	4	1.9			3.6	2.4	21	9.7		
- Selenium	-0.001	0.005	0.001			-0.001	-0.001	-0.001	-0.001		
- Silica	4.6	27	12.1								
- Silver	-0.001	0.002	0.001				-0.001	-0.001	-0.001		
- Sodium	19.4	223	51.6			9.5	14	220	76.7		
- Zinc	-0.01	0.227	0.022			0.21	0.01	0.45	0.2		

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) Location designation was changed to the station identification in parenthesis in 1994
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit
(5) No monitoring station exists

TABLE 3.1
SURFACE DRAINAGES - WATER QUALITY SUMMARY

DRAINAGE MONITORING LOCATIONS (1)

	BARN CANYON	DRY CANYON	MATHIS CANYON						DEEP/BUCK CANYON		
	BARN CANYON NS (2)	DRY CANYON NS (2)	B-211			B-353			B-263		
Period of Record			Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
			6/94 - 3/95			7/94 - 3/95			7/94 - 9/94		
Field Measurements											
- Temperature			1.5	25.1	13.8	9.3	21	14	1	21.1	11.05
- pH			7.9	8.6	8.4	8.3	9	8.6	8.27	8.44	8.36
- Specific Conductivity			704	910	760	501	573	527	513	548	530.5
- Dissolved Oxygen			5.9	9	7.2	7	7.4	7.2	5.8	6	5.9
Laboratory Parameters (3,4)											
- Specific Conductance			740	749	745	517	539	528			
- Acidity											
- Chemical Oxygen Demand											
- Dissolved Oxygen											
- Total Dissolved Solids			408	444	426	248	296	272			
- Total Suspended Solids			2	2	2	-2	-2	-2			
- Total Settleable Solids			-0.1	-0.1	-0.1	-0.1	-0.1	-0.1			
- Turbidity											
- Nitrogen (Ammonia)			-0.05	0.06	0.04	-0.05	-0.05	-0.05			
- Nitrate			0.02	0.06	0.04	-0.02	-0.02	-0.02			
- Nitrite			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			
- Oil and Grease			-1	-1	-1	2	2	2			
- Alkalinity			325	330	328	250	275	263			
- Bicarbonate			305	314	310	250	275	263			
- Carbonate			16	20	18						
- Chloride			9	13	11	4	5	4.5			
- Fluoride											
- Sulfate			86	99	93	29	31	30			
- Phosphate (Ortho)			-0.005	-0.005	-0.005	-0.005	-0.005	-0.005			
- Aluminum			-0.5	-0.5	-0.5	-0.05	-0.05	-0.05			
- Arsenic			-0.001	0.001	0.001	0.001	0.002	0.002			
- Barium											
- Boron			0.05	0.05	0.05	0.02	0.03	0.025			
- Cadmium			-0.005	-0.005	-0.005	-0.005	-0.005	-0.005			
- Calcium			44	51	47.5	62	66	64			
- Chromium											
- Copper			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			
- Cyanide											
- Hardness (Total)			361	372	366.5	290	304	297			
- Hydroxide											
- Iron (Dissolved)			-0.02	-0.02	-0.02	-0.02	0.02	0.015			
- Iron (Total)			0.03	0.08	0.055	0.08	0.29	0.185			
- Lead			-0.02	-0.02	-0.02	-0.02	-0.02	-0.02			
- Magnesium			57	64	61	33	34	33.5			
- Manganese (Dissolved)			-0.01	-0.01	-0.01	-0.01	0.01	0.008			
- Manganese (Total)			-0.01	-0.01	-0.01	-0.01	0.02	0.013			
- Mercury											
- Molybdenum			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			
- Organic Carbon (Total)											
- Phenols											
- Potassium			2	2	2	2	2	2			
- Selenium			0.001	0.001	0.001	-0.001	-0.001	-0.001			
- Silica											
- Silver											
- Sodium			26	36	31	11	11	11			
- Zinc			-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			

NOTES: (1) Monitoring locations shown on Regional Hydrology Map, Map 15 of the Willow Creek Mine - Mining and Reclamation Permit.
(2) No monitoring station exists
(3) Laboratory analyses for total constituent concentration reported as mg/l except for specific conductance (umhos/cm) or otherwise noted
(4) "-" indicates result below laboratory detection limit