INTRODUCTION

The material presented in this Mining and Reclamation Plan renewal (Volumes 1 through 5) represent document updates and pertain to mining activities during the next five years. Referenced material, such as consultants reports and other documents which have not changed, were previously submitted as part of the current mining plan. These documents, Volume A-1 through A-4, dated 1986 and bound in blue binders, should be retained as part of the new Mining and Reclamation Plan.
2.1 GENERAL ENVIRONMENTAL RESOURCES SUMMARY

The environmental resources in the Skyline project area have been individually studied and are addressed in this document. Much of the information presented in this environmental resources summary is either an update of or supplement to the material previously published by the U. S. Department of the Interior in the SITE SPECIFIC ANALYSIS--Part 2 of the final ENVIRONMENTAL STATEMENT OF DEVELOPMENT OF COAL RESOURCES IN CENTRAL UTAH. These documents also reflect updated information for the consultant's reports and should supersede the original documents where differences occur.

The Permittee has attempted to provide pertinent and complete reports for each environmental study discipline through the use of independent consultants who are recognized as experts in their individual fields. It is the Permittee's intent that by so doing, the reviewing agencies will have available to them reliable data for their environmental analysis.

With the exception of the community infrastructure analysis and the climatological and air quality monitoring program, the original environmental studies were sub-contracted through the hydrologic consultant. This approach was adopted to enable a complete integration of the vegetative, fish and wildlife aspects with hydraulic, hydrologic, and water quality considerations. The study area covers all areas to be affected during the entire life of the Skyline Mines.

The original hydrologic analyses and coordination of environmental resource studies were contracted to Vaughn Hansen Associates of Salt Lake City. Personnel from Earthfax, Inc. used these original data and those data collected during Skyline operation to prepare a "Probable Hydrologic Consequences" (PHC) report. In 1996, the PHC was re-evaluated by Mayo & Associates wherein consideration was given to the North Lease area. The PHC was again re-evaluated and Revised: 11/02
additional data added in 2002. The Probable Hydrologic Consequences for the permit area are discussed within Section 2.5.

Drs. Stanley Welsh and Joseph Murdock combined their efforts on the vegetative and soils requirements. Dr. Robert Winget, with frequent assistance from personnel of the Utah State Division of Wildlife Resources, conducted the aquatic studies. Dr. Clyde Pritchett supervised the mammals study, and Dr. Clayton White and Jimmie Parrish Ph.D. representing both Avocet Consulting Inc. and BIO/WEST, Inc. concentrated on the birds with particular emphasis on the area's raptors. Drs. Welsh, Murdock, Winget, Pritchett, and White are all associated with the faculty of Brigham Young University. The cultural resource surveys were performed by Archeological-Environmental Research Corporation of Salt Lake City with Dr. Rick Hauck serving as project director. A brief history of the Eccles Canyon Coal Mine was performed by Dr. John Bluth, also from Brigham Young University. The geological investigations were conducted by Mr. Roy P. Full, a consulting geologist of Salt Lake City, Utah, Mr. Donald Reitz, President of Resource Technology Corporation, Westminster, Colorado and the personnel of the Permittee. Radian Corporation of Austin, Texas conducted the climatological and air quality monitoring program. Kaiser Engineers of Oakland, California prepared the community infrastructure analysis. Additional vegetation and wildlife studies for the North Lease area have been conducted by Mt. Nebo Scientific and BIO/WEST, Inc. respectively (Refer to Sections 2.7, 2.8, 2.9 and 2.10 for additional information).

The original application contained copies of each of the consultant's reports. These reports have been summarized and updated, as appropriate, in this document to meet the requirements of the regulations. A summary of the cultural resources reports are presented in this section. The other reports are summarized in Parts 2 and 4 of the Application. Copies of the original reports are included in Appendix Volumes A-1 through A-4. The Permittee is also using aerial photogrammetric techniques for subsidence...
monitoring. These photos are providing continuing documentation of vegetative and other changes in the project area.

Numerous color photographs have been taken of the area which show both pre-project conditions and conditions as mining has progressed. Photographic subjects included the areas proposed for portal and load-out facilities, existing and proposed roads, the proposed conveyor route, streams, the existing gas pipeline, proposed waste material disposal and soil storage areas, and major geologic features. Photographs were taken from the ground and the air. A helicopter was utilized to obtain a different perspective of the proposed surface facilities area and to reach areas which were inaccessible from the ground. Some of these photographs are included in Volume A-1, the others are in the possession of the Permittee. Additional photographs were taken by the consultants of the vegetative reference plots and are presented in the Vegetation Report of the original Application.

2.1.1 Description of Cultural, Historical and Archaeological Resources

Prior to construction, the Permittee initiated a variety of cultural resource evaluations involving the Skyline permit and adjacent areas. These evaluations included the following:

- A detailed literature search for all known historic and prehistoric sites within the project area utilizing records of the Archeological-Environmental Research Corporation and the files at the State Historic Preservation Office.

- Previous negative-result surface evaluations within the general project area were used as a random sample survey (on the BLM Class II level) for cultural sites; hence additional sample surveys of the project area to determine site presence
and density were not taken, nor requested, by federal and state officials.

- All surfaces on both U. S. Forest and private lands disturbed during explorational activities and mine development (e.g., drill holes, access roads, and service areas) were intensively evaluated for historic and prehistoric cultural resources.

No prehistoric or historic cultural resources of any significance were observed during the surveys. The remains of two historic structures were found outside the project boundary. Both have marginal resource value and, since peripheral to the zone of activity, are not endangered by the Skyline project. No cemeteries, National Trails or Wild and Scenic Rivers, public parks or National Register status properties exist on or adjacent to the project area. No surface mines, active or abandoned, exist on the project mining area. The surface facilities area of the old abandoned underground Eccles Mine has been completely encompassed by the Skyline Mines portal facilities. The waste rock disposal area is an abandoned contour mine.

Investigations as to potential cultural resources within rock disposal and the adjacent areas have been conducted. Results of these investigations are presented in Appendix A-3. Results of the cultural resource investigation were transmitted to the State of Utah Historical Preservation Office (SHPO) concurrently with a request for approval, which was granted on November 12, 1981 (also see Appendix A-3). Additional work was conducted in 2006 - expanding the area disturbed area to the southeast. The report is detailing the investigation is included in Appendix A-3. No sites of significance were noted in the area proposed for disturbance.

Montgomery Archaeological Consultants investigated James Canyon to determine the potential cultural resources at the dewater drill location, associated access road, and pipeline. The investigation resulted in the documentation of three historical sites that consisted of two aspen art and a historical road. The sites are recommended as not eligible for NRHP inclusion. Montgomery

recommended that the sites be considered "no historical properties affected" pursuant to Section 106, CFR 800. During construction and drilling, the sites will not be disturbed. Results of the cultural resource investigation are presented in Appendix A-3.

North Lease

Statements regarding cultural and historical resources found within the North Lease area are made within the 1995 Environmental Assessment completed by the USDA Forest Service, USDI Bureau of Land Management, and the USDI Office of Surface Mining Reclamation and Enforcement; within the 1990, 1991, 1995, 1996 and 2002 cultural resources reports, which provide additional historical search data. A copy of the cultural resource reports are included within the Archeological Reports section of Volume A-3. A copy of the environmental assessment is included in Volume 5, as Section 23.

According to the environmental assessment, "Leasing of the tract should not result in significant impacts to cultural or paleontological resources; threatened, endangered, or sensitive plant or animal species; or flood plains". Appendix B of the environmental assessment further states that "There are no properties included in the National Register of Historic Places on or near the proposed lease tract". The AERC report entitled "Cultural Resource Evaluation of Proposed DrillHoles & Associated Access Routes in the Upper Winter Quarters Canyon and Winter Quarters Ridge Locality of Carbon County, Utah" states that "No significant cultural or paleontological resources were observed within the various development areas during the archaeological survey." Similar conclusions are reported in the other archeological studies performed in the Winter Quarter's Canyon area.

Revised: 11/02

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The sites which have been identified in the various surveys include historic campsites and wagon trails. These sites were not listed by SHPO. Prehistoric materials have only been identified as isolated finds.

In the Historical and Cultural Resources Chapter from the UCO, Inc. coal mining permit application (September, 1982), Clayton W. Cook of the Utah Archeological Research Corporation writes "the new construction of the proposed Scofield Mine in Winter Quarters Canyon by UCO will not eradicate historically significant structures or sites because the hospital, recreation hall, LDS church and Wasatch Store left little if any physical evidence. In addition, little remains of what was Finn Town...little new evidence is expected to be found in Winter Quarters Canyon" (Volume A-3, Archeological Reports). The proposed Scofield Mine was adjacent to the North Lease in Winter Quarters Canyon.

In summary, no known Cemeteries, National Trails, National Wild and Scenic Rivers, Public Parks or National Register status properties are known to exist in the North Lease project area. Furthermore, the mining of the North Lease should have no potential for damaging historic/archeological sites or structures.

As recorded in the Questar Pipeline Company's, Main Line No. 41, Reroute at Skyline Mine, Final Environmental Impact Statement, USFS, July 1990 prepared by Dames & Moore (Volume A-3, Archeological Reports) "The contacts initiated with local Native American communities have, to date, not resulted in the identification of any traditional use areas or sites having special importance or sacred values. In addition it states that "the probability of finding important or significant fossil remains is considered low".

Revised: 11/02
Winter Quarters Ventilation Facility (WQVF)

In 2010 permitting for construction of a ventilation facility in Winter Quarters Canyon was initiated. An area approximately 7.93 acres in size was permitted to construct a pad. The site is located approximately ¾-mile west of the main historic Winter Quarters town site. Skyline Mine has submitted a cultural resource survey identifying the WQVF pad site as being on the westernmost edge of the Winter Quarters mining district. In addition, Skyline submitted a second amended report that was necessary to identify changes to WQVF pad, which in turn modified the features to be impacted with the construction of the site. The pad site will potentially impact eleven (11) features which comprise of earthen and or stone foundation alignments. No standing structures exist in the area. Earlier cultural resource surveys indicate "little new evidence is expected to be found in Winter Quarters Canyon" (Cook 1981). No remnant standing structures are within 1/2-mile of the pad site. The Winter Quarters mining district is apparently eligible or qualifies for the National Historic Register, however landowners controlling the site have adamantly opposed being listed on the Registry when approached by SHPO on previous occasions.

The existing road through the Winter Quarters canyon will be improved with the addition of road base, gravel, to improve drainage from the road. The footprint of the road will not change, and historic features will be avoided.

Evaluation of the cultural resources survey and discussions with both DOGM and SHPO personnel concluded the best mitigative measure to address the impact to the westernmost edge of the Winter Quarters town site was to design and construct an interpretive sign to be placed at the mouth of the canyon that summarizes for the public aspects of the cultural history of the area. The reports detailing the initial investigation, and the second amended report are located in the CONFIDENTIAL FILE.

Revised: 7-22-10
North of Graben (NOG) Bleeder Shaft

Preliminary studies for permitting construction of the NOG Bleeder Shaft was conducted in 2014. The bonded permit area is approximately 3.00 acres, with approximately 1.7 acres being disturbed with construction activities. The area surveyed for cultural resource was significantly larger than the area to be disturbed. Both Class I and Class III cultural resource inventories were conducted in the area. Two (2) isolated occurrences and one (1) new cultural resources sites were identified in the vicinity of the site, but none of the sites will be impacted. In addition, the sites were documented and evaluated for eligibility for inclusion in the National Register of Historic Places, but determined not to be eligible. See CONFIDENTIAL FILE for Environmental Planning Group (EPG) report, "A Cultural Resources Inventory for the Skyline Mine Expansion and Transmission Line Construction Project, Carbon and Emery Counties, Utah."

Swens Canyon Ventilation Facility (SCVF)

In 2014 preliminary studies for permitting construction of the Swens Canyon Ventilation Facility and power line were initiated. An area of approximately 9.7 acres was proposed for addition into the permit area for the SCVF pad site. A power line corridor of approximately 15-foot by 2.6 miles, totaling 4.8 acres was proposed for addition into the permit area. A Cultural Resource survey was conducted by Environmental Planning Group, LLC (EPG) covered areas of approximately 13 acres for the pad area and a 200-foot wide corridor for the power line respectively. A Class I cultural resource file search and Class III cultural resource inventory was conducted in the area. A total of five (5) isolated occurrences and three (3) new cultural resources sites were identified, documented, and evaluated for inclusion in the National Register of Historic Places (NRHP). None of the sites were recommended for eligibility in the NRHP. Therefore, the project will have no adverse effect on those sites. See Confidential File for EPG report (A CULTURAL RESOURCES INVENTORY FOR THE SKYLINE MINE EXPANSION AND TRANSMISSION LINE CONSTRUCTION PROJECT, CARBON AND EMERY COUNTIES, UTAH).

Revised 5-27-16
2.1.2 Threatened and Endangered Species

No currently approved threatened or endangered species, plant or animal, have been identified on the project or adjacent areas with the exception of an occasional transient Bald Eagle, which may pass through the project area during the winter. The mining operation has no impact on these transitory birds. However, a northern goshawk, a candidate for T&E listing, has been identified as a resident adjacent to the permit area. A plan for monitoring and protection of raptors may be found in Sec. 4.18.

Should any threatened or endangered species be identified in the future, their discovery will be promptly reported to the Division.

The Scofield Waste Rock site was expanded into approximately 5 acres of previously undisturbed ground in 2007. Surveys were conducted to identify T&E species of both plants and animals. The surveys did not find any such species. Species listed in Carbon County are found in different elevations and habitats. Results of the surveys are located in Appendix A-2, Volume 2. Additional discussions on vegetation and wildlife are discussed in Sections 2.7 and 2.9, respectively.

Winter Quarters Ventilation Facility

Permitting of the Winter Quarters Ventilation Facility consists of permitting approximately 7.93 acres located along the base of the south-facing slope. Improvements to the existing road encompass approximately 4.9 acres of previously disturbed ground; additional disturbance was added. Particular attention was taken to stay outside the stream buffer zone of Winter Quarters Creek keeping construction activities a minimum of two (2) bankfull widths from the stream. Surveys were conducted to identify T&E species of both plants and animals. The surveys did not find any such species.

Revised: 7-22-10

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Div. of Oil, Gas & Mining
North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft consists of approximately 3.00 acre permit area located on a south-facing slope approximately 200 feet below the existing Granger Ridge USFS road. The total watershed area contributing to the pad is approximately 0.8 acres. The site includes a 0.19 acre topsoil stockpile area, a short access road, the pad, and a minor re-routing of the existing road to utilize flat ground on top of the ridge to minimize the disturbance associated with the pad. Surveys were conducted to identify T&E species of both plants and animals. Surveys (provided in Appendix A-2) did not note any such species. Although habitat for the three-toed woodpecker exists in the area, none were identified.

Flat Canyon Lease

Statements regarding cultural and historical resources found within The Flat Canyon Lease area are addressed within the USDA January 2002 Flat Canyon Coal Lease Tract Final Environmental Impact Statement (EIS). A minimum of ten (10) Class I inventories have been complete in the leasing area, with additional reconnaissance being conducted for the EIS (Elkins and Montgomery, 2001). Of six (6) historic sites inventoried, only one site was recommended as eligible for the National Registery. This site is located on private lands within the project area. A copy of the EIS is included in Appendix A-4 Volume 2.

According to the Record of Decision (ROD) issued for the Flat Canyon Coal Lease Tract EIS, "No effects to cultural resources are anticipated." Potential effects to historic resources on private lands would be mitigated in accordance with the National Historic Preservation Act in consultation with the State Historic Preservation Office." In addition, "No effects to significant paleontological resources are expected. Prior to conducting surface operation disturbance surveys are required."

Additional SHPO concurrence was confirmed in 2016 during an Environmental Assessment conducted by Office of Surface Mining (OSM). See Appendix A-4 for concurrence letter.

Revised 12-30-16
2.2 GEOLOGY

Comprehensive geological evaluations of the Skyline permit area, performed by and for the Permittee, have established the baseline environmental data necessary for mine development. Future studies will be necessary to refine present concepts, monitor the existing geological/hydrological environment and provide additional data to be used for the continual mine planning process. Continuation of this work will maximize the recovery of coal reserves by allowing increased accuracy in predicting coal seam discontinuities and will optimize safety by early identification of geology-related potential mine hazards.

2.2.1 Stratigraphy

Rocks mapped on the Skyline permit area (Plate 2.2-1) and adjacent areas (Plate 2.2.1-2) are of Upper Cretaceous age. Also shown on Drawing 2.2.1-1 are faults which have been encountered either during the mining process or as a part of exploration activities. The oldest stratigraphic unit, the Star Point Sandstone, underlies and intertongues with the lower portion of the coal-bearing Blackhawk Formation. Overlying the Blackhawk is the Castlegate Sandstone, the basal member of the Price River Formation, and the youngest unit exposed in the area. Figure 2.2-A shows the generalized stratigraphic sequence.

2.2.2 Star Point Sandstone

The Star Point Sandstone is a prominent cliff-former and an important marker horizon throughout the region. The unit is the basal formation of the Mesaverde Group in the Wasatch Plateau, which overlies the Mancos Shale.

Only the upper part of the Star Point Sandstone is exposed in the area as it intertongues with the lower Blackhawk Formation. The upper most tongue of Star Point outcrops in the Skyline Mine 3 portal area. Major outcrops occur east of the Connelville Fault in the South Fork of Eccles Canyon and about 1,800 feet east of the Manti LaSal National Forest boundary in Eccles Canyon.

Revised: 11/04/02
FIGURE 2.2-A GENERALIZED COLUMNAR SECTION -
ECCLES CANYON AREA
Gas well with 100 ft. buffer zone

COASTAL STATES ENERGY COMPANY
GAS WELL LOCATIONS
PREPARED BY ROY P. PULL, MINING GEOLOGIST
BASE MAP FROM U.S. GEOLOGICAL SURVEY TOPOGRAPHIC MAPS
SCALE: 1:24,000
JOB NO.: 7-6-1
The upper part of the Star Point Sandstone is mostly a fine to medium-grained, sub-rounded to well rounded, light-colored sandstone, with a "salt and pepper" appearance. Approximately the top 20 feet tend to have a pronounced white appearance in outcrop. The massive beds exposed in the surrounding Skyline area are moderately well consolidated.

2.2.3 Blackhawk Formation

The Blackhawk Formation is the coal-bearing portion of the Mesaverde Group in the Skyline area. The lower formational contact with individual tongues of the Star Point Sandstone is generally sharp. Only on the high ridges in the northwest corner of the permit area is the upper formational contact with the overlying Castlegate Sandstone present. The Blackhawk formation is atypically thick in the Skyline area and ranges from 1,700 to 1,900 feet in thickness where the complete section is present.

Due to its lenticular bedded nature, no persistent marker horizon occurs within the Blackhawk Formation. The lower coal-bearing unit of the Blackhawk consists of 100 feet of fine-grained sandstone and siltstone, with zones of dark, carbonaceous shale and siltstone. The uppermost carbonaceous zone in this unit contains, in places, one or more thin lenticular coal beds. The thickest of these beds is usually referred to as the Flat Canyon seam, only a portion of which is considered mineable.

Three mineable coal seams are present in the basal coal zone of the upper coal-bearing unit of the Blackhawk formation. In ascending order, they are the Lower O'Connor "A", the Lower O'Connor "B", and the Upper O'Connor seams. These coals are of high-volatile B rank and in general contain few partings and little pyrite. These coal seams are attrital, with midlustrous attrital being the most common coal lithotype. Some resin is observed in all three seams.

The upper coal zone of the upper coal-bearing unit of the Blackhawk Formation generally contains carbonaceous shales and thin coal beds. This zone occurs from 480 to 590 feet above the Storrs Sandstone tongue of the Star Point. These coals are discontinuous with only local development of mineable thicknesses. In the southeast corner of the leasehold area, a coal bed known as the

Revised: 03/04/93
McKinnon seam appears to be of mineable thickness over an area of approximately 1,100 acres. Similar to the lower mineable coals, the McKinnon seam is of high-volatile B rank. This seam differs from the lower mineable coals in that partings are common and lateral thickness changes are pronounced. In addition, the McKinnon seam is often very rich in megascopic resin.

The Blackhawk Formation consist mainly of lenticular sandstone, siltstone and claystone deposits. Because of the lenticular nature of bedding in the formation, it is difficult to correlate individual horizons (with the exception of the major coal seams). The sandstones are thin to thick bedded, ranging in grain size from very fine to coarse. Argillaceous rocks include claystone, clay shale, silty shale and siltstone. Carbonaceous and coaly rocks are present in every gradation ranging from slightly carbonaceous shale to coal.

2.2.4 Intrusive Igneous Rocks

Igneous dikes classified as "lamprophyre" cut the sedimentary rocks in the area. The age of the intrusive rocks is in the 20 to 30 million year range and no dikes have been observed to cut Tertiary rocks in the area. Where dikes cut the coal seams, a band of from one to five feet of metamorphosed coal is found adjacent to the dike. The dominant trend of the dike swarm is nearly east/west.

2.2.5 Surficial Deposits

Unconsolidated soil, gravel, alluvium, landslide deposits, etc., mask many of the geological features of the Skyline permit area. A description of these deposits is included in the Geotechnical section.

2.2.6 Structural Geology

The Clear Creek anticline is a major structural feature of the northern Wasatch Plateau. In the Skyline area, large faults of the Pleasant Valley fault zone form a north-south oriented graben along the axis of the anticline. The permit area is situated on the western limb of the anticline. Strata dip to the northwest at the north end of the permit area, almost west at Eccles Canyon, and southwest at the south end of the permit area. Dips range from three to six degrees on the permit area.

Revised: 03/04/93
Major faults are nearly vertical, trending north-south to northeast-southwest in the area. The largest of these, the Connelville Fault, forms much of the eastern boundary of the permit area. Within the fault block east of the Connelville Fault, the Belina Mine has encountered very small displacement, east-west faults which deviate from vertical with hade of up to 30 degrees. Of the three major fracture/fault features known to have displacement, only the Connelville Fault is sufficiently developed to displace structural contours. The faults, known locally as the Valentine Fault and the North Joes Valley Fault, are thought to have considerably less displacement than the Connelville Fault. Both of these faults are located outside the permit area to the south and southeast. The Valentine Fault trends northeast and is located east of the Electric Lake Dam in Valentine Gulch. The North Joes Valley Fault dies out south of Electric Lake. The Connelville gradually disappears north of the permit area. The Connelville and Valentine Faults are vertically displaced downward to the west, and the North Joes Valley fault is vertically displaced downward to the east.

The O'Connor Fault is located approximately one to 1.5 miles east of and roughly parallel to the Connelville Fault and is offset down to the west. Both the O'Connor and Connelville Faults slowly die out to the south of the permit area. The Connelville Fault enters the Electric Lake basin north of Coal Canyon and the O'Connor Fault enters the Electric Lake basin south of Cox Canyon, just northwest of the dam. West of Electric Lake, a similar series of smaller southwest-northeast trending faults extend to the Gooseberry Fault, which appear to disappear north of Swens Canyon.

The Connelville Fault is a complex fault zone with a width of up to 1,000 feet. The cumulative displacement across the zone appears to increase from approximately 55 feet in the Winter Quarters Mine north of Skyline to 250 feet or more near the southern edge of the Skyline permit area. Individual faults within the zone have much smaller, and highly variable displacement. The Connelville Fault, as shown in Plate 2.2-1, is near the western edge of a complex zone, although segments of the zone may be encountered west of the map location shown.

Four major jointing and fracture orientations have been mapped on the leasehold. The most common orientation observed within the coalbeds and immediate roof and floor strata are a set of joints spaced approximately 1 to 3 feet apart with a N80°W orientation. This joint set is only occasionally observed in surface outcroppings. A second joint orientation observed in the mines as well as in surface outcroppings are a set of N5W to N5E joints, spaced from 1 foot to over 10
feet apart at the surface. They are only occasionally observed at coalbed depths. The last two orientations are a system of conjugate shear fractures and joints which are more commonly observed on the surface but occasionally appear at depth and are oriented at approximately N60W and S70W respectively.

As illustrated in Drawings 2.2.1-1 and 2.2.1-2, the majority of the approximately north-south trending faults west of the Connelville die out or terminate in the area of an east to west trending fault in Sections 22, 23, and 24, Township 13 South, Range 6 East. North of this fault, the majority of the faults and fractures trend approximately east to west. These faults appear to be sub parallel to the Fish Creek Graben located a few miles north of the North Lease area. While mining activities were occurring in Mine #3, the in-situ stress were measured in the rocks. The results of the test indicated the rocks were in compression in an east-west direction (Oral Communication, Mark Bunnell, Skyline Mine Geologist, July, 2002). Similar measurements were taken in Mine #2, and while less successful, the results of the testing indicated the rocks were in extension in an east-west direction. Most of the north-south trending faults appear to be normal faults with vertical offset and a slight amount of horizontal offset. The east-west trending faults can have both vertical and horizontal offsets. Mines #2 and #3 are separated by the east-west trending fault in Section 22, 23, and 24 (Mines #1, #2, and #3 are illustrated on Drawing 2.2.7-7). The change in the stresses appears to have a direct impact on the ground water inflow to the mine. Since the north-south trending faults are in extension, it is theorized that the water held under piezometric pressure within the sandstone units of the Star Point is released at mine faces where fault gouge is weak or gaps are present between fracture faces. The extensional forces would allow for the water to be forced into the space created by “pulling apart” the rocks. In the area where the rocks are in compression, the east-west trending faults do not have the same “gaps” as formed in the extensional areas and thus the water does not appear to have pathways through the fractures and faults within the Star Point Sandstone.

Drilling records and interviews with well site geologist indicate that in almost all areas of the mine, significant water is not encountered within the Blackhawk Formation. This suggests that the Blackhawk Formation continues to function as an aquitard whether the rocks are in the state of compression or extension.

As mining advances west of Electric Lake in the Flat Canyon Coal Lease, it is anticipated that water under piezometric pressure will be encountered in north-south trending faults. This has been accounted for in the Mine Plan.

Section 2.2.7, Mineable Coal Deposits, is confidential and consequently has been removed and submitted to the Division in a separate folder.

Revised: 12-30-16

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Div. of Oil, Gas & Mining
Pages 2-12 to 2-15 are located in the confidential binder.
2.2.8 Other Mineral Deposits

Natural gas is the only mineral resource, other than coal, reported in the permit area. The Clear Creek Gas Field was discovered in 1951 and is apparently nearing depletion. Two boreholes, presumably natural gas tests, have been drilled and abandoned on the site area. The T. F. Kerns No. 1 was drilled to a depth of 5,825 feet in Section 13, Township 13 South, Range 6 East. In Section 23 of the same Township and Range, the Superior Oil Federal No. 1-23 was drilled to 362 feet. Plate 2.2.8-1 shows the locations of both wells. Because the Superior Oil well was abandoned and never completed to mining depth or gas depth, full extraction mining will likely occur beneath it. The T.F. Kerns well will be protected by a 100 foot barrier as shown on Plate 2.2.8-1.

Geochemistry

Analyses were performed on 24 core samples of roof and floor strata for each of the three seams to be mined. The potential acid-forming or alkalinity-producing materials in the strata to be affected by mining are assessed (See Table 2.2.8-1). Samples included sandstone, siltstone, and shale material. Many samples contained carbonaceous material. No relationship is apparent between any of the analyses and the lithologic or stratigraphic position of a particular sample. The samples are all slightly alkaline and low in sulfur content.

Clay content of floor samples was not determined analytically. The lithology of the stratum immediately below the mineable coals varies from borehole to borehole. Accordingly, clay content will range from almost 100% in a pure claystone to less than 5% in a submature or mature sandstone.

Pyrite, marcasite, and sulfur content of the three mineable coal seams are determined by the standard "forms of sulfur" analysis (Table 2.2.8-2). Marcasite was not determined directly for the following reasons:
TABLE 2.2.8-1

SUMMARY OF 24 ANALYSES *

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</tr>
<tr>
<td>1:5</td>
<td>8.92</td>
<td>7.27</td>
<td>8.45</td>
<td>0.39</td>
</tr>
<tr>
<td>1:20</td>
<td>9.06</td>
<td>7.10</td>
<td>8.65</td>
<td>0.54</td>
</tr>
</tbody>
</table>

* Individual analyses are available at the mine site.
<table>
<thead>
<tr>
<th>Sulfur Forms (Dry Basis)</th>
<th>L. O'Connor B Percent</th>
<th>L. O'Connor A Percent</th>
<th>Flat Canyon Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyritic</td>
<td>0.11</td>
<td>0.42</td>
<td>0.02</td>
</tr>
<tr>
<td>Sulfate</td>
<td>0.01</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td>Organic (Diff.)</td>
<td>0.29</td>
<td>0.47</td>
<td>0.25</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0.40</td>
<td>0.90</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Revised: 12-30-16
The standard wet chemical analysis (ASTM D 2492) determines iron soluble in nitric acid, and calculates from this the pyrite content. This test does not separate marcasite values from pyrite values and merely reports the total as pyrite.

On a dry basis the three mineable seams average from 0.55 to 0.62 percent total sulfur by weight. On the same basis, pyritic sulfur averages from 0.07 to 0.21 percent. Even if all the pyritic sulfur were marcasite, it would not be sufficient to cause acid mine drainage problems.

The Permittee consulted with Commercial Testing and Engineering Laboratories, Inc. in Denver, Colorado, and Standard Laboratories, Inc. in Charleston, West Virginia, and did not find an accurate and quantitative method to determine marcasite content in coal.

The North Lease is a continuation of mining the Lower O'Connor “A” seam as was previously performed in Mine #3 (the existing Mine #3 workings are located within 50 feet horizontally of the planned new works of Mine #3 in the North Lease), the same geochemical conditions are anticipated. Lab analysis from drill holes in the North Lease of the floor, roof, and coal indicate the potential for generating acid or toxicity are low. Results are included in Appendix Volume A-3 Volume 2. Testing of material transported to the waste rock disposal site indicates that only a very small percentage of material that would be classified as acid and toxic forming has been found in the Lower O'Connor “A” seam. The handling of waste rock and material determined to be acid or toxic forming is described in Sections 4.4.5 and 4.16 of this M&RP.

The Flat Canyon Lease provides the same low potential for generating acid and toxicity from the mining of the coal. The merged Flat Canyon / Lower O'Connor A, and Lower O'Connor B seams will be mined. Lab analysis from drill holes support the coal and surrounding rock are consistent with the materials generated in Mines #1 and #2 located to the east and Mine #3 in the North Lease. Table 2.2.8-2 has been updated to illustrate the sulfur and acid-forming potential in the seams to be mined. Plate 2.3.4-1D provides a fence diagram of the stratigraphy and the seams to be mined. Chemical and acid-base potential analysis of the roof, coal, floor of selected drill holes are provided in Appendix A-3. Locations for holes 95-21-1, 95-28-1, 99-33-1, and 98-3-2C are available on Plate 2.3.4-1D; sites used in the fence diagram. Analysis for hole/monitoring well 15-21-2 was also added to Appendix A-3. 15-21-2 was not illustrated in the fence Plate 2.3.4-1D as it is located less than ½ mile from 95-21-1 and provided no additional data.

2.2.9 Waste Rock Disposal Site

The stratigraphy of the waste rock disposal site area is very similar to that of the minesite permit area, consisting of inter- bedded sandstone, siltstone, and shale, with numerous carbonaceous and coaly zones. In November of 1976, Sanders Exploration drilled a borehole about 1,300 feet east of the waste rock permit site located in the SE 1/4, NW 1/4, Sec 4, T 13S, R 7E. The drill hole report for the site identified as S-4 can be found in Appendix Volume A-4. 

Geotechnical

The geotechnical data report by Dames and Moore dated October 30, 1979 is included in its entirety in Appendix Volume A-3. Much of that report is interpretive in nature and deals with facilities that have since been constructed.

Revised: 12-30-16
2.2.10 General Geology of the Rock Disposal Site

The coal-bearing Blackhawk Formation makes up the surface of the rock disposal site. This formation consists of alternating, laterally discontinuous layers of sandstone, siltstone, shale and coal. Only occasional sandstone ledges are exposed at the surface of the proposed site, with the remaining surface being covered with up to 20 feet of soil and weathered rock debris.

Two mineable coal seams occur beneath the site, including the Upper and Lower O'Connor seams. The pertinent data for these coal beds is as follows:

<table>
<thead>
<tr>
<th>Coal Bed</th>
<th>Thickness</th>
<th>Depth below Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper O'Connor</td>
<td>8.0'</td>
<td>45'</td>
</tr>
<tr>
<td>Lower O'Connor</td>
<td>18.0'</td>
<td>130'</td>
</tr>
</tbody>
</table>

Four faults of undetermined displacement have been mapped near the site. These faults are generally north-south trending and have acted as local barriers to mining in coal mines near the site.

Conversations with Mr. Frank Helsten of Scofield, Utah on September 17, 1981 and May 17, 1982, revealed that the strip mining work was done from 1948 to 1950. Mr. Helsten was the spot hole driller and indicated that no abandoned underground workings were intercepted when drilling the seam lying 45 feet beneath the floor of the pit. Mining of the below-lying seam was planned but not accomplished due to economic conditions at the time.

Two drill holes (92-91-03MW and S-4) in the general area of the proposed disposal site provide the basis of the available geological information. Well logs are found in Appendix A-4. The well locations are shown on Plate 2.3.6-1. Cross-section A-A' (Plate 2.2.1-2) shows the geology of the waste rock area.
2.2.11 Plans for Casing and Sealing Holes

All exploration drill holes not completed as ground water monitoring wells will be plugged and abandoned using procedures specified by the BLM or the Division. Typically, exploration holes are backfilled with cement to a point at least thirty feet above the uppermost mineable coal seam. A bentonite grout is then placed on top of the cement to within 100 feet of the surface. Surface casings will be removed to at least two feet below ground surface if possible. The remainder of the hole is filled to the surface with a neat cement grout. Occasionally, the governing agency may request a survey monument be placed in the cement cap.

If the exploration hole is to be completed as a monitoring well, it will be constructed by a State licensed driller and in accordance with the requirements set forth by the State Engineer's Office for monitoring well completions. Typical well construction will be as follows. Well screen with appropriately sized apertures and steel casing will be installed in the drill hole to below the lowest mineable coal zone in water-bearing strata. The screened zone will be sand packed and sealed from overlying strata with at least 2 feet of bentonite and the overlying hole annulus will be cemented to the surface. Well casing with a locking lid will be left at the surface extending above the surface approx. 2 ft. The wellhead will be properly identified with either a brass marker or a welded-on identification.

Once a ground water monitoring well is no longer in use, it will be completely plugged with a cement or cement/bentonite slurry to the to ground surface. The wellhead and casing will be removed to at least two feet below ground surface when possible. The surface will be reclaimed to approximate original contour.

In 2009, two (2) drill holes were developed to transfer rock dust from the surface to the underground workings. Each 3.5-inch hole (3-inch I.D) is approximately 255 feet in length, and completed with steel casing. At reclamation, the abandonment procedure outlined for exploration holes (at beginning of this section).

2.2.12 Winter Quarters Ventilation Facility

The Winter Quarters Ventilation Facility will be constructed to provide adequate ventilation for mining.

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north of Winter Quarters Canyon. The ventilation facility will include a 20-foot diameter vertical shaft, and / or a 20-foot wide slope driven at 18 degrees down, and 8-foot diameter escape shaft. The 20-foot shaft will have a 12-inch thick concrete liner, the slope will have a 8-inch thick concrete invert with the ribs and roof having a minimum 3-inch thick shotcrete liner, and the escape shaft will have a 6-inch concrete liner. When sealing at reclamation, the shaft(s) per 30 CFR Part 75.1711-1 and R645-301-551 will be completely backfilled to the surface using an engineered fill. When sealing the slope, sealing will consist of solid, substantial, incombustible material, such as concrete blocks, bricks or tile, or shall be completely filled with incombustible material for a distance of at least 25 feet into the opening. See Section 4.9 for additional details.

2.2.13 North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft is constructed to provide adequate ventilation for completion of the North of Graben mining district. The shaft was necessary due to encountered geologic conditions that required turning two (2) separate mining districts into one (1). The facility will include one (1) 5-foot diameter, unlined shaft. When sealing at reclamation, the shaft will be completely backfilled to the surface using an engineered fill, per 30 CFR Part 75.1711-1 and R645-301-551. Figure 4.9-C illustrates the backfilling of the shaft.

2.2.14 Swens Canyon Ventilation Facility

The Swens Canyon Ventilation Facility will be constructed to provide adequate ventilation and necessary power for mining both in existing leases and the Flat Canyon – Southwest Reserve lease. The facility includes two (2) vertical shafts of 16-foot and 8-foot diameters, respectively. Each shaft will be lined with either a concrete or steel liner which will remain in-place - below grade - at reclamation. When sealing at reclamation, the shafts will be completely backfilled to the surface using an engineered fill, per 30 CFR Part 75.1711-1 and R645-301-551. See Section 4.9 for additional details; Figure 4.9-B illustrates the backfilling of the shafts. The lithologic log for exploration hole 95-28-1, located approximately ½-mile west of the proposed site is added to Appendix A-4. Skyline intends to drill a hole on the pad location in 2016 prior to shaft construction.

2.2.15 Subsidence Monitoring

Please refer to Section 4.17 - Subsidence Control Plan for details of the Subsidence Monitoring program and commitments to mitigate any effects due to subsidence.
2.3 GROUND WATER HYDROLOGY

The principle factor controlling the occurrence and availability of ground water in any area is geology. Nearly all of the region surrounding the project area is underlain by rocks of continental and marine origin, consisting predominately of interbedded sandstones and shales (See Section 2.2). The existence of these relatively impermeable shales tends to limit the ability of the rock units to yield a significant amount of water for extended periods of time due to the recharge impediment.

The project area is located in the headwaters of the Price and San Rafael River Basins (See Figure 2.12-A page 2-123). Wells in these basins normally yield less than 50 gallons per minute. In the immediate vicinity of the project area essentially dry wells have been identified. Exceptions to these yield estimates occur where wells penetrate highly fractured sandstones.

Rock strata in the mountainous areas near the project area have low specific yields (0.2 to 0.7 percent) and low hydraulic conductivities. The volume of recoverable water is small, averaging less than 600 acre-feet per square mile in the upper 100 feet of saturated rock.

Ground water quality in the Price and San Rafael River Basins deteriorates in a downstream direction. Dissolved solids content in the ground water ranges from less than 125 milligrams per liter in the headwaters near the Skyline permit area to approximately 4,000 milligrams per liter near the confluence of the two rivers with the Green River. This large increase results from the contact of the water with fine-grained units, particularly the saline Mancos Shale.

Information presented in this section summarizes and updates the original consultants reports found in Appendix Volume A-1. A more

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In August 2001, significant volumes of water were encountered in Mine #2 of the Skyline Mine. The new inflows caused significant difficulties in mining the Lower O'Connor B seam and resulted in the mine restudying the hydrogeology of the mine area. A great deal of new information regarding the hydrologic characteristics of the Blackhawk and Star Point Formations has been obtained and detailed discussions regarding this new information are included in the July 2002 Addendum to the PHC (first submitted in July 2002 and amended in October 2002).

2.3.1 Geologic Setting of the Ground Water System

The Skyline permit area lies in the northern end of the Wasatch Plateau, on the west edge of the Clear Creek anticline. As such, the dip of the strata is generally towards the west, varying between six percent (three degrees) and ten percent (six degrees).

With the exception of local alluvial deposits, all of the units exposed on and immediately adjacent to the project area are formations of the Cretaceous Mesaverde Group. The Star Point Sandstone is a massive, medium-grained sandstone which is approximately 1,000 feet thick with interbedding tongues of Mancos shale in the project area. A generalized stratigraphic section of the Skyline property is shown in Figure 2.2-A.

The Blackhawk Formation, which immediately overlies the Star Point Sandstone, is comprised of interbedded sandstones, shales, siltstones, and coal. The sandstones of the Blackhawk Formation are fine-to-medium-grained, and have locally high clay contents.
shales of the Blackhawk Formation in the permit area are irregularly bedded and due to their tendency to swell when wet, they should, in most cases, form an effective barrier to vertical movement of ground water.

A sample of the claystone from the Blackhawk Formation was obtained from an in-mine hole and was analyzed and determined to contain 58 percent montmorillonite (Lab sheet located in Mine File 3.1.2.7). Two drill logs were evaluated for the amount of claystone/mudstone present as a demonstration of the swelling capabilities of the formation. Drill hole 74-26-3 (SW/NW, Sec. 26, T13S, R6E) was selected due to its proximity to Burnout Canyon Creek, and Well 91-35-1 (SW/SW, Sec.35, T12S, R6E) being located in the North Lease area between Winter Quarters and Woods Canyons. In drill hole 74-26-3, mudstone was interbedded throughout the entire 1400-foot depth at a rate of 26-feet per every 100-feet of depth, or 26.3 percent. Similarly, Well 91-35-1 averaged 27.2 percent claystone throughout its entire 1500-foot drill depth. Table 2.3.1 illustrates the distribution of claystone/mudstone in the two drill holes. Studies in Burnout Canyon Creek have also demonstrated the self-sealing nature – inhibiting vertical movement of flow through the bedrock in the area. Based on the claystone/mudstone component observed in Well 91-35-1, the same effects are anticipated when undermining portions of Winter Quarters and Woods Canyon creeks.

Revised 10-19-05

Table 2.3.1

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>D.H. 74-26-3 (amount of claystone in ft.)</th>
<th>D.H. 91-35-1 (amount of claystone in ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>100-200</td>
<td>40</td>
<td>18</td>
</tr>
<tr>
<td>200-300</td>
<td>19</td>
<td>17.5</td>
</tr>
<tr>
<td>300-400</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>400-500</td>
<td>20</td>
<td>49</td>
</tr>
<tr>
<td>500-600</td>
<td>36</td>
<td>100</td>
</tr>
</tbody>
</table>
The youngest geologic unit in the permit area is the Castlegate Sandstone, found only in a small area in the northwestern portion of the permit area. This unit consists of massive medium to coarse grained sandstones with interbedded conglomerates near the base.

Faults within the permit area commonly occur as zones of parallel to in-echelon fault segments with individual slips containing gouge zones ranging from 6 inches to 4 feet wide. Displacements are normally small (less than 20 feet) with the exception of the Connelville fault zone which forms the eastern boundary of the permit area. It is suspected that faults have only local hydrologic importance within the Blackhawk formation because of its clay content in the permit area. Water emerged from the Star Point Sandstone along 2 faults encountered in Skyline Mine 3, resulting in some water drainage from the floor but no water dripped from the roof. As mining in Mine 2 progressed down dip and two the west, several north-south trending fractures and faults (with minimal offset) were encountered that produced hundreds of gallons a minute of water from the floor. The location of the major inflows are illustrated on Drawing PHC A-2 in the July 2002 Addendum to the PHC. The flow from these features only slowly diminishes over time. Age dating analysis of the water indicate the flow from these fractures do not have modern water (tritium analysis) and contain water 6,000 to
25,000 years old (carbon 14 dating). Studies by consultants to Skyline Mine suggest the water is stored in the Star Point Sandstone and released through the fractures.

Significant inflows of ground waters were encountered in the 10 Left area of the mine (Drawing PHC A-2). This resulted in Skyline Mine drilling three mine dewatering wells in James Canyon. The first well, JC-1, was pumped at a rate of approximately 2100 gpm from November 2001 to October 2002. At that time, a new pump and motor was placed in the well and produced approximately 4200 gpm. JC-2 well was only capable of producing approximately 300 gpm and was shut in shortly after completion. The details of the two wells are discussed in detail in the July 2002 Addendum to the PHC. A third well, JC-3, was drilled and completed by PacifiCorp in March-April of 2003 to discharge water from the 10 Left area of the mine to Electric Lake. Details of the well are included in Section 3.2.11(a) of this M&RP. JC-3 is anticipated to produce approximately 4,700 gpm of mine water when completed.

In most cases it appears the faults within the Blackhawk Formation in the permit area are not allowing significant vertical movement of ground water. The most logical cause of this apparently low permeability along most of the faults is clay content. However, as discussed in Section 2.2, the north-south trending faults in the Mine 2 area appear to be the result of extensional forces acting upon the formations and resulting in pathways for the water to move upward out of the Star Point and into Mine 2. The formations in Mine 3 and North Lease areas are under compression and the east-west trending faults in the area do not create pathways for the upward migration of ground water. Therefore, as mining proceeds to the North Lease area, it is likely water encountered in the mine will come mainly from the draining of sandstone channels in the mine roof, as was the case in the previously mined portions of Mine 3.

A detailed discussion of the geological characteristics of the project area is presented in the preceding section (Section 3.2.11(a)).

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2.3.2 Characteristics of Seeps and Springs

As a result of field investigations during 1978, 174 seeps and springs were located on and immediately adjacent to the Skyline project area (Volume A-1, Hydrology). This equates to an average of one water source for approximately every 40 acres existing in the area. The quality of the subsurface water was evaluated at select springs and is shown in Appendix Volume A-1. Additional ground water quality data may be found in the tabulations submitted regularly to the Division of Oil, Gas and Mining and in Volume 4. The travel distance between water supplies is short for the wildlife and sheep which utilize the area. Should a frequently-used spring dry up, animals using the water supply should have other options for water in the area.

Seep and spring surveys were conducted in 1991, 1992, and 1993 in the North Lease/Winter Quarters area in preparation of leasing the federal coal underlying the area. The results of the surveys are contained with the Winters Quarters Canyon Data Adequacy documents that were submitted to the BLM and Manti LaSal National Forest. A copy of the document is also present in the Division's Public Information Center (PIC). The location, flows, and water quality data information is included in data adequacy documents. The PHC addendum prepared by Mayo and Associate in 1996 is included in Appendix A-1, Volume 2. It contains detailed information regarding the possible hydrologic consequences to mining in the North Lease area. A brief update to the Mayo document is included in the Appendix following the Mayo PHC.

A seep and spring investigation was conducted in 1997 of the Flat Canyon area and the UP&L tract. Thirty-seven seeps and springs were located on the UP&L tract (Volume A-1, Hydrology). This equates to an average of one water source for approximately every 25 acres existing in the area. Two springs have been selected for baseline monitoring, 2-413 and 3-290 (Plate...
These springs have been monitored since October 1997. A summary of the water quality and quantity data is provided in Volume A-1, Hydrology. Spring 2-413 was selected for monitoring because of its proximity to the Connellville Fault, mining activity, and accessibility while 3-290 was selected because it is located in an area where mining will not occur for some time (minimum of 5 to 6 years) and can be used as an 'undisturbed' site for comparison with 2-413.

The operator conducted a survey of springs in the South Fork of Eccles Creek area where mining will take place. This survey, conducted during August of 1988, varies slightly in locations from that found in the consultant's report. The differences are most likely the result of mapping errors. The results of this survey may be found on Figure 2.3.2-1.

Geologic conditions play an important role in the occurrence of springs in the project area. A majority of the springs issue from west-facing slopes, often at a sandstone-shale interface considerably above the adjacent stream bed. Apparently, water which infiltrates into the soil and is not consumptively used percolates down until an impeding shale lens is met. It then follows the shale member downdip until an outlet is reached (either the surface or a discontinuous sandstone member). Thus, deep ground water recharge is apparently slow in the project area due to the presence of large amounts of shale.

Very few seeps and springs in the project area appear to be fault-related, due to the sealing ability of the Blackhawk Formation. Instead, spring water appears to originate in the small surface depressions or basins in the immediate vicinity.

Sustained flows from individual springs tend to be low. Only four of the springs were measured having flows greater than equal to 10
gallons per minute during the fall, low-flow inventory. Most measurements were two gallons per minute or less. Approximately 30 percent of the sources were seeps. Some of these had dried entirely during previous summers. Flows at a given spring may vary by as much as one order of magnitude during the year, with the higher flows occurring during the snowmelt season. This observation further substantiates the theory that water supplying the springs is generally very local in origin. Water originating from a deeper, more regionalized source would normally provide a more constant flow. It also implies that flows from springs are quite sensitive to the amount of precipitation received during the previous winter.
The Burnout Creek area is the subject of a subsidence study which is directed by the U.S.F.S. Six springs and seeps have been monitored in this area and in the adjacent Upper Huntington Creek from 1981 through April 1998, as a part of the ongoing groundwater monitoring program. Three additional springs SMS-1, SMS-2, and SMS-3, Plate 2.3.6-1 were monitored. In general spring flow rates in this part of the permit area were decreasing. This is likely due to the drought conditions (Climatology, Volume 4). All water samples from these springs are of a calcium-bicarbonate character. Five of the springs have similar chemistries and TDS concentrations (200 mg/l) and issue from the Blackhawk Formation. Sample S10-1, which issues from the Castlegate Sandstone, has the same calcium-bicarbonate character of water, but lower TDS concentrations and correspondingly lower levels of chemical constituents. Chemical concentrations for all these springs have remained relatively consistent through time.

2.3.3 Stream Seepage

A very small percentage of the average annual flow of Huntington Creek above Electric Lake is contributed by ground water. In contrast, ground water yield accounts for nearly 64 percent (8.59 inches) of the average annual yield of Eccles Creek above Pleasant Valley Creek. The principle cause of the high ground water yield in Eccles Canyon relative to Huntington Creek is the Star Point Sandstone, which is present over approximately 25 percent of the surface of Eccles Canyon but does not appear on the surface in the Upper Huntington Creek Basin.

To better define recharge-discharge conditions for major streams in the area, seepage studies were conducted on the Main Fork of Eccles Creek, the South Fork of Eccles Creek, and Huntington Creek. The studies were conducted by measuring the flow rate and collecting a water quality sample at selected points along the stream segment and at points of major tributary inflow. Data from that study are presented in Volume A-1, Hydrology.

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Significant changes occur in the Main Fork of Eccles Creek when it crosses the Star Point Sandstone. These changes are especially noticeable at the O'Connor Fault, which crosses the stream at a point about one mile downstream from the confluence of the Main and South Forks. This fault apparently acts as a conveyance structure in the fractured Star Point, discharging water into Eccles Creek.

Another significant change in the characteristics of Eccles Creek occurs near the mouth of the canyon at the Pleasant Valley Fault. This probable flow barrier appears to be bringing water to the surface which had previously been flowing in the rock beneath the stream channel.

Changes in conditions along the South Fork of Eccles Creek can be largely accounted for by surface phenomena (hillside springs, tributary inflow, etc.). The Connelville Fault zone has little apparent effect on the recharge-discharge characteristics of the stream. This confirms the previous conclusion that faults in the Blackhawk do not act as conduits to the surface, but rather, seal to prevent vertical water movement.

Downstream changes in the characteristics of Huntington Creek can also be largely accounted for by tributary inflows, hillside springs, etc. The flow losses which do occur in the lower portions of the stream (immediately upstream from Electric Lake) can presumably be attributed to recharge of the alluvium. This recharge water is suspected to travel below the surface of the shale-alluvium interface towards Electric Lake.

2.3.4 Aquifer Characteristics

Measurements at a network of observation wells installed in the project study area indicate that, prior to March 1999, ground water flowed in a west to southwest direction, generally following the dip of the strata. Flow gradients averaged approximately 250 feet per mile over most of the project area although a gradient...
averaging 700 feet per mile was encountered in the southern portion of the lease area. This anomaly is probably associated with a fault zone which passes through one of the observation well sites. The fracture has apparently connected the sandstone lenses of the Blackhawk Formation with the underlying Star Point Sandstone, thereby significantly increasing the water yield characteristics of the rock at this point and influencing the piezometric head in the area.

The differences between the elevation of water in the observation wells and that of surrounding springs indicates that two ground water systems occur in the Skyline project area. A shallow system, very local in extent and discontinuous, provides water to numerous seeps and springs through thin sandstone layers in the Blackhawk Formation. A deep ground water system is present in the saturated rocks surrounding and below the coal. Except where it out crops and supplies spring flow to Eccles Creek below the O'Connor fault (Vaughn Hansen Associates), this deep system has little apparent effect on the surface hydrologic regime of the permit area since the water is located well below the perennial streams of the permit area. The system continues to dip to the west and southwest beyond the permit area and remains below the Sanpete Valley floor. It is not known to outcrop down dip. A fence diagram depicting the relationship of the wells with their location and with the geology may be found in Drawing 2.3.4-1 A through 1D.

Beginning in March 1999 and continuing through October 2002, the potentiometric surface within the Star Point Formation began to change as a result of ground water inflows to the mine. A new potentiometric map (Drawing 2.3.4-2) was drawn in November 2002 to graphically illustrate the changes to the potentiometric surface. The new surface has a gradient toward 9, 11, and 12 A and B panels of the mine. It is anticipated this gradient will continue until Skyline completes mining in the Mine #2 area and the abandoned workings are allowed to flood.

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Drawing 2.3.4-2 illustrates a potentiometric surface of the water in the Star Point Sandstone. The potentiometric surface is based on data from wells completed in the Star Point Sandstone throughout the permit area. Drawing 2.3.4-2 is based on geologic information provided in Section 2.2.6, and the numeric hydrologic model presented in the PHC Appendix J and K that provides additional information indicating the gradient of the Star Point Sandstone regional aquifer is from south to north. The original 2006 illustration has been updated with 2010, 2013, and 2016 data to demonstrate the regional aquifer has not significantly changed with the dewatering associated with mining.

Springs in the Blackhawk Formation are fed from perched water in shallow sandstone lenses underlain with shale well above the regional ground water level.

Useable quantities of water from wells in either the Storrs Sandstone or the lower tongues of the Star Point Sandstone are unlikely unless a fracture zone is encountered. Drawdown and recovery tests, which were conducted at two different depths in an open test well located in the proposed portal area, indicated that the transmissivity of the Blackhawk Formation is approximately 18 gallons per day per foot (Volume A-1, Hydrology). No significant difference in transmissivity exists between the coal zone and the Aberdeen Sandstone. The low transmissivities and discharge rates (approximately 5 gallons per minute) indicate that the Blackhawk Formation is, at best, a poor aquifer.

Potentiometric surfaces are below the ground surface, even in the canyon bottoms, with the deeper holes under the Blackhawk showing a generally higher potentiometric surface than the shallower holes. East of the permit area, where the Star Point Sandstone is exposed, the potentiometric surface intersects the ground surface in the canyons, thereby producing springs along the bottoms of the canyons. Water table conditions exist primarily in shallow alluvial deposits along larger perennial streams. Potentiometric surfaces, as currently understood, are shown on Plate 2.3.4-2 and

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Comparison of the 1992 Plate 2.3.4-2 and the 1980 Plates 7, 11, and 12 showed little change in the shape of the potentiometric surface overtime. However, static water level data (Volume 4) indicates that the water table had fallen by 30 to 40 feet from 1982 to 1992. This decrease in water levels in the monitoring wells was likely due to ongoing drought conditions (Climatology Data, Volume 4) and dewatering associated with mining operations (see the PHC for further discussion).

Hydrographs of water levels in the nine monitoring wells drilled into the Blackhawk-Star Point aquifer are presented in the 1991 Annual Report. As indicated by these hydrographs, seasonal water-level fluctuations are typically less than 3 feet, but range as great as 15 feet. The seasonal fluctuations correlate well to snow melt and rainfall events, but in some cases there is a lag time of one to two months. Seasonal fluctuations that are in direct response to precipitation intersect faults or fractures. Lag times of one to two months are caused by association with fracturing, but have no direct connection to these fractures. Due to scale and contour interval of the potentiometric surface map, fluctuations of this magnitude are too small to be seen.

Since water was encountered in the western portion of Mine #2 in 2000, all of the monitored wells south of Mine #3, within the Mine #2 area, and to the west of Mine #2 have shown increased drawdown (July 2002 Addendum to the PHC). This drawdown is the result of the dewatering of the Star Point Sandstone beneath the mine through the intercepted faults and fractures.

Prior to intercepting water in Mine #2, the potentiometric surface gradient was to the west in the southern permit area. After 16 years of pumping water from Mine #2, continued well monitoring, and extensive numeric hydrologic modeling of the Starpoint Sandstone it appears the potentiometric surface gradient is now may be generally trending south to north (Drawing 2.3.4-2). The numeric hydrologic model incorporated data from 17 wells, of which eight (8) were still operational during the study. This added data provided a somewhat better understanding of the potentiometric gradient than from the original limited data, however due to the complexity of this inactive hydrologic system is difficult to predict. Although the SRK model conducted the most comprehensive look at the data, Mayo and Associates (1996) did not construct a piezometric surface map because they considered the deep water systems as discontinuous and the water surface correlations were not meaningful.

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2-29b
The cone-of-depression centered along the fault system encountered in Mine #2 in the potentiometric surface will likely remain unless the surface drops below the lowest levels of the mine in the southern portion of the permit area.

A number of wells in the permit area have become non-functional over time, whether through mining or other factors causing a breach in the well. Wells no longer in service that are abandoned or scheduled for abandonment include W79-35-1A and -1B, W20-4-2, W20-4-1, W99-28-1, and W99-21-1. Well W15-21-2 monitors the Star Point Sandstone west of proposed mining in Little Swens Canyon. Wells 79-35-1A and -1B, 20-4-1, 20-4-2, have not been replaced with other wells in the area adequately monitoring the Star Point groundwater surface.

Water levels measured in the two monitoring wells located in the North Lease area, 91-26-1 and 91-35-1, exhibit very little fluctuation in the ground water surface within the upper Star Point Sandstone since the wells were completed. As described by Mayo in the PHC prepared for the North Lease area, the sandstones beneath the coal in this area appear to have low transmissivity. This has remained true until mining north of Winter Quarters started to take place. In 2012 Well 91-35-1 was breached at approximately the previous depth to water level (~1,250 ft. This well is no longer monitored and is scheduled for abandonment. In 2014 Well 91-26-1 was breached and is scheduled for abandonment. Well 16-24-1 monitors the Star Point Sandstone north of both the two (2) wells and proposed mining. As stated in Section 2.2 of this document, the east-west trending fractures and faults are the result of compressional forces which do not result in the opening of the fracture faces and thus do not appear to easily conduct water.

The history of the inflows to the mine and measured ground water levels suggest the northern portion of the permit area, Mine #3, is distinct from the southern portion of the permit, Mine #2. The separation appears to occur at the fault between the two mines. Though the fault has only a few tens of feet of offset, it essentially forms the terminus of the north-south trending faults. South and west of the east-west trending fault in sections 22, 23, and 24, heavy water flows from the mine floor at faults and fractures were encountered and the monitoring wells both within the southern portion of the permit area and to the west in the Flat Canyon area have experienced increased drawdown that appears to have stabilized. Although the two wells completed in the North Lease area have shown some drawdown, the effect of the southern drawdown of the potentiometric surface within the Star Point appears to be unrelated. Additionally, flows into Mine #3 historically came from sandstone channels overlying the coals seam and typically dried after a short period of time. Very few inflows came into the mine through the floor and were typically less than a hundred gallons. It is anticipated that the same ground water conditions encountered in Mine #3 will be encountered as mining moves into the North Lease area.
Wells W22-2-2 and W14-2B and W14-2A (2011-2016 apparent communication with surface run off) have failed casings associated with subsidence. Well W22-2-1 is the shallow well paired with W22-2-2. At the time of the Vaughn Hansen Associates (1979) report, the deeper of these two wells had an artesian potentiometric head which rose to a level above the water level in the shallower well. By 1982 the water level in W22-2-2 had dropped below that of W22-2-1. This was probably due to both the drought and dewatering of the area by the mining operations.

As of 2013 almost eight (8) years of mining have been completed in the North Lease. Groundwater conditions have remained consistent with minimal, short-lived inflows being encountered in the Mine. As 900-1300 feet of overburden separate the mine workings from the springs and streams, no impacts to the water resources are anticipated. Water Rights 91-3917 and 91-1039 and will be added to the Skyline water monitoring program as sites S26-1 and S25-32, respectively. These sites are located directly above longwall mining activity and should identify any impacts due to mining. Water Rights 91-1043 and 91-1044 will be monitored with site CS-26 located in Lower Wife Creek. See PHC Addendum Appendix L for baseline water monitoring in the area. As has been demonstrated in the 30 years of water monitoring in Mines 1 and 2 located in the Huntington drainage, and the multiple years of water monitoring in the Winter Quarters areas of Mine #3, there has been no adverse effects to water quality. Summarized in the Petersen Report (located in Appendix L), the low concentrations of TDS, total iron, and low manganese are due to a combination the flow regime, and abundance of carbonate minerals in the Blackhawk formation. Also, when increased total iron and total manganese concentrations have typically been noted they have been associated with high flow, high suspended sediment events, suggesting the increased load is associated with the presence of sediments in the surface water and not the stream water itself. The stiff diagrams included in the Petersen report identify how the water chemistry of the water monitoring sites is similar with the monitoring sites throughout the Skyline area.
2.3.4.1 Waste Rock Disposal Site

Information concerning the ground water system in the area of the waste rock disposal site indicates the site is isolated from the regional groundwater system. An isolated hydrologic system is a permeable rock or soil unit that contains water that is not in hydraulic communication with other permeable zones that lie either vertically (above or below) or laterally (spatially) from the system in question. This is seen in the case of the waste rock site.

The monitoring well at the waste rock facility, 92-91-03MW is located in T13S-R7E-Sec4 SW NW. The ground surface at well 92-91-03MW has an elevation of 7,852 feet AMSL. The depth to water in this well is 117.9 feet below ground level (7,734.1 feet AMSL). An exploration hole is also located in the area of the waste rock facility, S-4. This hole is located in T13S-R7E-Sec4 SE NW. Well logs for both wells are found in Appendix A-4 and the well locations are shown on Plate 2.3.6-1. Cross-section A-A' (Plate 2.2.1-2) shows the geology and hydrology of the waste rock area. The groundwater identified in this well is felt to represent the regional water table in the Blackhawk-Star Point Aquifer.
The logs of well 92-91-03MW and exploration hole S-4 (Appendix A-4 and Plate 2.2.1-2) indicate the presence of a substantial amount of shale and siltstone, of the Blackhawk Formation, between the ground surface and groundwater table. Given the typical lack of vertical movement of water in the siltstones and shales of the Blackhawk Formation, these materials would significantly limit the likelihood of surface flow or leachate from the waste rock migrating vertically downward to the depth of the groundwater table.

No seeps or springs have been found in the waste rock area, indicating a lack of groundwater occurrence in the hillsides above the waste rock area. This is further substantiated by the lack of surface water baseflow, as recorded by the surface water monitoring stations in the waste rock area since May of 1984 (Volume 4). Additionally, the drainages in the waste rock area do not exhibit any evidence (scouring, deposition or high water marks) of having transported water in the past several years (personal communication Mark Bunnell - Skyline Mine: 1992).
The above described characteristics of the hydrology and geology of the waste rock disposal area indicate that the waste rock area is separated from the groundwater table by impermeable beds and the leachate migration potential is limited. Therefore, the waste rock disposal facility is isolated from the regional groundwater system.

The water elevation in 92-91-03MW (7,734.1 feet) is roughly equivalent to the surface water level in Pleasant Valley Creek (elevation 7,710 feet) about ¾ mile to the west. Due to the absence of surface water or perched groundwater sources in the area of the waste rock facility there is only a gentle hydraulic gradient (0.01 ft/ft) to the west towards the Pleasant Valley Creek. With no drive mechanism, the movement of water from this area toward the Pleasant Valley Creek is very slow. Based on typical hydraulic conductivity and porosity values of 0.02 foot per day and 0.14, respectively (see PHC, Section 2.2.2), for the Blackhawk Formation, it is estimated that the average linear velocity is 0.001 foot per day (0.5 foot per year). This velocity results in a travel time for waters underlying the waste rock site to reach Pleasant Valley Creek of about 4,800 years.

Additionally, the absence of any seeps or springs associated with the fault immediately east of well 92-91-03MW suggests the fault does not act as a conduit for flow from the Pleasant Valley Creek to the waste rock area.

Therefore, the site is isolated from the regional groundwater system, located above the water table and has little inflow and no outflow. There is no known hydrological connection between the waste rock site and Pleasant Valley Creek.

The waste material placed in the site has tested negatively for toxicity. A discussion of these tests may be found in Section 4.4.5.

Revised: 03/04/93
The groundwater situation is complicated by the presence of underground workings of the old Union Pacific Mine. The present condition of these workings is unknown and unobtainable due to an underground smoldering fire.

2.3.4.2 Coal Loadout Site

Several soil borings were advanced by Dames and Moore (1979) in the coal loadout area as part of their geotechnical investigation performed for the Skyline Mine in the summer of 1979. Two of these soil borings, TH-2, and TH-2C, were spudded in alluvial deposits and encountered the Blackhawk Formation at approximately 32 feet below ground surface (el. 7,900 feet) and 26 feet below ground surface (el. 7,912), respectively. Groundwater in each of these borings was encountered and measured at the time of drilling. The groundwater level in TH-2 was measured at approximately six feet below ground surface (el. 7,926 feet). The groundwater level in TH-2C was measured at approximately four feet below ground surface (el. 7,934 feet). The alluvial fill was not cased during drilling and therefore the groundwater in the alluvium was not isolated from the occurring in the bedrock.

The groundwater potentiometric surface map constructed by Vaughn Hansen Associates (Plate 2.3.4-2, 1979) suggests that potentiometric surface in the bedrock aquifer in the area of the loadout facilities is at or just beneath the ground surface. Using the information provided on the potentiometric map and from the Dames and Moore soil borings (1979), a cross-section was constructed as located on Figure 2-30A to illustrate the groundwater surface in the area of the coal loadout facilities (see Figure 2-30B). The alluvial fill aquifer and the bedrock aquifer were assumed to be at or near equilibrium.

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LIMIT OF DISTURBED AREAS FOR LOADOUT FACILITIES

ALLUVIAL GROUNDWATER SURFACE PROJECTED DOWN GRADIENT 300'FT FROM DRILL HOLE TH-2 (DAMES & MOORE 1979)

LIMIT OF DISTURBED AREAS FOR LOADOUT FACILITIES

SEDIMENT POND

ROAD

EGGLES CREEK

BEDROCK GROUNDWATER SURFACE PROJECTED FROM UTAH FUEL WELL WI7-1

ALLUVIAL FILL

BLACKHAWK FORMATION

PROJECTED ALLUVIAL BEDROCK CONTACT FROM DRILL HOLE TH-2 (DAMES & MOORE 1979)

VERTICLE SCALE: 1" = 30'
HORIZONTAL SCALE: 1" = 50'

COASTAL STATES ENERGY COMPANY
NO. 11350
WILLIAM S. HENRIQUES
STATE OF UTAH
VERTICAL SCALE: 1" = 30'
HORIZONTAL SCALE: 1" = 50'

GROUNDWATER ELEVATION

ALLUVIAL FILL

BEDROCK-ALLUVIAL CONTACT

GROUNDWATER SURFACE

T.D. 15'

STAR POINT FORMATION

CONVEYOR ROUTE

PAVED ROAD

ECCLES CREEK

DRILL HOLE TH-5
(DAMES & MOORE, 1979)
COASTAL STATES ENERGY COMPANY

MAP DRAWN BY:
WILLIAM S. HENDRICKSON

NORTH-SOUTH HYDROLOGIC CROSS SECTION C-C' THROUGH WELL 13-2 AND CONVEYOR ROUTE ECCLES CANYON

VERTICAL SCALE: 1" = 30'
HORIZONTAL SCALE: 1" = 50'

INCOrpORATED
EFFECTIVE:
MAR 2 3 1993

UTAH DIVISION OIL, GAS AND MINING
The coal loadout facility is outside any subsurface mining activity planned by Skyline and is constructed at and above ground surface. No impact to the groundwater due to loadout facility operations is anticipated. Therefore, no additional groundwater monitoring program is proposed for this area.

2.3.4.3 Conveyor Route in Eccles Canyon

Groundwater conditions within the lower portion of Eccles Canyon change from the point of confluence between the Main Fork and South Fork of Eccles Creek and the point of confluence between Eccles Creek and Mud Creek at the mouth of Eccles Canyon. As discussed previously, Vaughn Hansen Associates (1979) has suggested that Eccles Creek does not gain significant flow from the Connelville Fault but does experience significant inflow from the O'Conner Fault and the Star Point Formation. Additionally, Vaughn Hansen Associates (1979) has mapped the potentiometric surface of the bedrock aquifer at ground surface from the point where Eccles Creek flows over the O'Conner Fault downstream to the mouth of the canyon. Most of the springs and seeps found during a survey performed by Vaughn Hansen Associates (1979) are located on the south side of Eccles Canyon and within the alluvial fill of Eccles Creek. One spring has been mapped in the southwest quarter of Section 17, T13S, R7E on the south facing slope of Eccles Canyon at an elevation of approximately 8,050 feet. This spring has been denoted as monitoring location S17-2 in the Skyline Mine Hydrologic Monitoring Program.

Two cross-sections (B-B' and C-C'), Figures 2-30C and 2-30D) have been created at locations depicted on Figure 2-30A to illustrate groundwater conditions along the conveyor route in Eccles Canyon. The cross-sections were created based on information provided in the Dames and Moore geotechnical report (1979) and the Vaughn Hansen Associates hydrologic report (1979). Section B-B' is drawn through the location of Dames and Moore's soil boring TH-5 and...
downstream of the point where Eccles Creek flows over the O'Conner Fault. Soil boring TH-5 was advanced to a depth of 15.5 feet below ground surface but did not penetrate the full thickness of the alluvial fill. The Star Point Formation underlies the alluvial fill at an assumed depth of approximately 20 feet and forms the canyon walls. Groundwater was measured in the boring at the time of drilling at approximately 8 feet (el. 8,084 feet) below ground surface. The Vaughn Hansen Associates bedrock aquifer potentiometric map illustrates the potentiometric surface in this area to be at or near ground surface within the canyon floor. Also, according to Vaughn Hansen Associates (1979), the stream is gaining in the area of the cross-section B-B'. This would suggest that the potentiometric surface of the bedrock aquifer is higher than the stream channel and the stream is draining the bedrock aquifer through faults and fractures and/or through permeable sandstone beds. However, the Piezometric surface within the bedrock in this area probably does not closely follow the steep topography of the canyon.

Cross-section C-C' illustrates the groundwater conditions through a section of the canyon above the confluence of the Main and South Forks of Eccles Creek and through well W13-2. The section is entirely within the Blackhawk Formation. Well W13-2 was spudded in the alluvial fill and terminated in the Blackhawk Formation at a total depth below ground surface of 1,055 feet. Surface casing was installed to isolate the alluvial fill from bedrock. After completion, the water level in the well was measured at approximately 42 feet (el. 8,382 feet) below ground surface. Soil borings advanced by Dames and Moore upstream and downstream of the section suggest that the alluvial fill in the canyon floor is saturated below the current stream bed elevation. Additionally, soil boring TH-8 was drilled on the north wall of the canyon at a point approximately 150 feet east of the cross-section line and 30 feet above the stream channel. The boring was advanced to a total depth of 39 feet and no groundwater was encountered. The lack of
groundwater in the boring and the depth to groundwater measured in well W13-2 suggests that the alluvial fill aquifer and the bedrock aquifer are separate and distinct in this area.

As illustrated by both cross-sections B-B' and C-C', the conveyor system is generally located well above the groundwater surface in Eccles Canyon. The only locations where the conveyor system approaches the groundwater surface are near its terminus at the coal loadout facility and near monitored spring S17-2. As with the coal loadout facility, the conveyor system is an above-ground structure and should not effect groundwater within the canyon floor. The only spring potentially effected by the conveyor system is in the current monitoring program, no additional groundwater monitoring is proposed.

2.3.4.4 Winter Quarters Ventilation Facility (WQVF)

Groundwater level will be monitored in the vicinity of the Winter Quarters Ventilation Facility (WQVF) by one (1) deep groundwater well (08-1-5) completed below the coal seam.

No springs are located in the immediate vicinity of the WQVF site. The site is located on a dry, south-facing slope. No subsidence is anticipated in the area that could impact the groundwater resources in the area of the Ventilation Facility.

A Seismic Refraction survey was conducted over the WQVF area to help determine the depth to bedrock (report located in Appendix A-1, Volume 2). The survey suggests weathered bedrock is approximately 10 feet below the existing ground surface in the vicinity of the decline slope. In addition, exploration hole 08-1-2, indicated a depth to competent bedrock at approximately 47 feet below the surface. No appreciable water was encountered in this hole. The decline slope will be driven bearing away from the creek at a negative 16-18 degree slope. Similarly, the proposed vertical shaft(s) is sited to be located approximately 70-feet north of the existing stream channel, encountering weathered bedrock approximately 10 feet below the surface at the approximate elevation of the stream. No problems with surface water or near surface groundwater are anticipated.

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2.3.5 Uses of Water in the Aquifers

2.3.5.1 Surface Water Rights

The water rights on and adjacent to the Skyline property which were on record with the Utah Division of Water Rights as of, July, 2002 are listed in Volume 4. The locations of these water rights can be found on Plate 2.3.5.1-1.

In addition to those existing water rights identified in Volume 4, the Forest Service has water rights claims pending action in District Court for the Seventh Judicial District in and for Emery and Carbon Counties. The claims for U.S.F.S. water rights in Upper Huntington Creek, Upper Fish Creek, Eccles Creek and the South Fork of Eccles Creek are recognized by the Utah Division of Water Rights as perfected rights by diligence of use. However, these rights have not yet been recognized by the Seventh Judicial District Court. Therefore, they are still pending rights; however, they will be treated as an actual rights until the court makes its decision. The U.S.F.S.
2.3.4.5 Mine #4 - Flat Canyon Lease Area

As mining moves west of Electric Lake into the Mine #4 area and the Flat Canyon lease, the initial mining will be conducted in the merged Flat Canyon - Lower O'Connor A seam (FC-LOA) which is located stratigraphically approximately 65 feet below the Lower O'Connor B seam (LOB) which is the primary mining unit in Mine #4. The FC-LOA seam area may be used as a sump for any mine water that needs to be discharged from the mine while mining the LOB seam (see Plate 3.3-4). As has been stated previously, based on the Cretaceous to Tertiary-age bedrock formations outcropping the Flat Canyon area there are two distinct groundwater systems in the area. The active-zone near surface groundwater system includes the North Horn Formation through the Blackhawk Formation, and the Star Point Sandstone and Mancos Shale representing the inactive-zone groundwater system. Skyline Mine has been actively monitoring both systems since increased inflows into the mine were encountered. The aquifer characteristics of these two systems were reevaluated in 2014 using both baseline information for the Flat Canyon tract and groundwater monitoring information. The information is discussed in detail in by Petersen Hydrologic, Inc. in PHC Addendum Volume 2 in Appendix N, Appendix O, and Appendix P, respectively.

As briefly discussed in Section 2.3.2 - Characteristics of Seeps and Springs, aquifer characteristics in the Mine #4 - Flat Canyon lease area are similar to what has been observed in Mines #1 and #2 located east of Electric Lake. The active-zone, near surface geology of the Blackhawk formation provides recharge to the creeks in the Huntington basin. The lower-inactive zones of the Blackhawk act as an aquitard for modern, meteoric water contributing no significant water to the Star Point Sandstone aquifer due to the interbedded and discontinuous nature of the sandstone, mudstone, and shaley units. This is supported by rock testing cores of shales from the Blackhawk Formation by the United States Geologic Survey that indicated impermeability to water (in both vertical and horizontal directions) even at pressures of 5,000 psi (UDOOGM 2013). A primary difference from Mines #1 and #2 is with the regional dip trending to the west, the mineable coal seam is separated from the surface with more overburden, ranging from 700 to 1,900 feet, which further reduces the likelihood of potential impacts to the surface hydrology associated with subsidence. The near-surface groundwater system in the Blackhawk Formation will be monitored in a number of ways. A total of ten (10) springs will be monitored in the Little Swens, Swens and Boulger canyons to monitor not only the Blackhawk Formation, but also the overlying Price River and Castlegate Formations. The Quaternary-age alluvium in Boulger Canyon will be monitored in a number of ways.

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monitored with springs, increased stream flow monitoring, and a series of piezometers designed to monitor the near-surface groundwater adding to the creek. No monitoring of the inactive zones of the Blackhawk takes place since no distinct aquifer exists due to the discontinuous nature of the beds. Exploration drilling of the lower, inactive Blackhawk formation typically does not encounter sufficient saturated zones to warrant a monitoring well. This is supported through mining where water is rarely encountered coming from the roof of the mine. When roof-water is encountered it typically is sourced from a channel-sand, with a short duration of flow.

Below the mine is the Star Point Formation which acts as the regional aquifer. The Star Point Formation is an approximately 1,500-ft thick massive, fine- to medium-grained sandstone that is moderately well consolidated. Two sandstone members of the Star Point Formation, the Storrs and Panther, interfinger with basal portions of the Blackhawk Formation in the Skyline Mine area. Groundwater flow through the unfractured Star Point Formation is very slow to non-existent with hydraulic conductivities ranging from $1.46 \times 10^{-6}$ to $2.25 \times 10^{-5}$ cm/sec (Mayo and Associates, 1997a). This slow movement is supported by radiocarbon and tritium data (Petersen Hydrologic 2016, PHC Appendix P). The Star Point Formation provides a confined aquifer in the Mine #4 - Flat Canyon area. As described in detail in Section 2.5 Hydrologic Impacts of Mining Activities and July 2002 Addendum to the PHC (modified October 2002, April 2003, and June 2004) the Star Point does not transmit water easily. However, fractures located along fault zones often provide a source of high transmissivity within the sandstone. Wells JC-1 and JC-2 provide clear evidence of the disparity between the fractured-unfractured transmissivity of the Star Point Formation. JC-1 is a pumping well completed in a fracture zone located below the mine and is able to produce 4,000 gpm consistently. Conversely JC-2 was drilled immediately adjacent to JC-1, did not encounter a fracture zone, and produce only minimal water.

six (6) monitoring wells (W98-2-1, JC-2, W99-4-1, W20-28-1, W15-21-2, and W16-24-1) that currently monitor the regional Star Point Formation aquifer below the coal seams to be mined. The ground water wells are located in Little Swens (W15-21-2), Swens (W20-28-2), Boulger Canyon (W99-4-1), wells located east of Electric Lake (W98-2-1 and JC-2), and north in Andrew Dairy Canyon (W16-24-1). Well 15-21-2 was added in 2015,

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and well 16-24-1 was added as a replacement well to monitor the Star Point Sandstone north of the mining area. Five (5) other wells that previously monitored the aquifer are blocked and have been abandoned or scheduled for abandonment. A fence diagram depicting the relationship of the wells with their location and with the geology are illustrated on Plate 2.3.4-1D. Well 15-21-2 was not added to the fence diagram because it is located within ¼ mile of well 95-21-1 and didn’t modify the illustration significantly. The currently monitored wells illustrate a potentiometric gradient surface ranging from 700 to 1000 feet above the coal seam (Plate 2.3.4-2). The potentiometric gradient has remained consistent since 2001 when pumping from Mine #2 began. As observed in Mine #2, it is possible that water from the underlying Star Point aquifer may be transmitted into the mine through fault gouge in the associate southwest-northeast trending faults. As illustrated on Plate PHC A-2, Mine Inflow Map (PHC Addendum - Vol.1), faults are encountered numerous times during the mining process but only act as a conduit for water from the Star Point Formation when the fault conditions are favorable. Attempts to conduct advanced drilling to specifically encounter water have been unsuccessful. Any groundwater that is encountered will be diverted from the mine into Eccles Creek.

Additional details of the groundwater monitoring for both the near-surface active-zone and deeper, inactive zones are addressed in Section 2.3.7 - Groundwater Monitoring Program of this M&RP.

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pending rights are: 93-3659 through 93-3667 and 93-3676 through 93-
93-3679. These rights are listed in the water rights tables presented
in Volume 4.

Surface water rights in the area are primarily for stockwatering and
irrigation. Stockwatering rights are almost entirely directly on
the stream. Irrigation rights are centered around the town of
Scofield and in Flat Canyon, southwest of the center of the
property. Irrigated lands consist almost entirely of pasture. Only
stockwatering rights are present on the lease area.

2.3.5.2 Ground Water Rights

Ground water rights on and adjacent to the Skyline Property, on
record with the Utah Division of Water Rights as of July, 2002, are
listed in Volume 4, 1st and 2nd binders and presented on Plate
2.3.5.2-1. Again, rights are primarily for stockwatering and
irrigation (mainly lawns and gardens). A limited number of wells
are located in the area.

Ground water rights within the North Lease area include seven
springs ([93-5, 93-3678, 91-1035, 91-1036, USFS] [91-3918, 91-3638,
91-3917, Allred]) and a water right number (91-463, assigned to
Eureka Energy) designated as stockwatering on a reservoir. Three of
the water rights are assigned to D. Euray Allred and the other four
are assigned to the USFS. In conjunction with the lease modification
in 2013, a review of existing groundwater rights that will now be
undermined was conducted. Existing water rights as confirmed by
Division of Water Rights personnel include 91-3916, 91-3917, and 91-
3940 through 91-3944 (excluding 91-3942) and are used for
stockwatering. These water rights are claimed by the USFS or the
Euray Allred family. Based on field investigations and a field tour
of the area with Mr. Phil Allred, springs 91-3917 and 91-1039 will
be monitored. These springs are named S26-1 and S25-32,
respectively. The landowner agrees with the monitoring locations and felt monitoring of spring 91-3916 was not necessary since it has less consistent and lower flow and is not developed for use as the other two (2) springs. Based on DOGM request water rights 91-1043 and 91-1044 will be monitored with Lower Wife Creek named CS-26.

Also shown on Plate 2.3.5.2-1 are exchanges of Scofield Reservoir water for ground water in Pleasant Valley Creek Basin. These are also listed in Volume 4. All exchanges are wells, with the exception of 91-940. Most of the exchanges serve the industrial and domestic needs for mining companies in the area.

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2.3.6 Ground Water Quality

The high cost associated with properly constructing and developing the observation wells drilled in the formations found in the area precluded the collection of reliable water quality data from the wells.

Several core holes, however, have been used to obtain limited ground water information. As these wells are being drilled, static water levels were measured above the coal zone, in the coal zone, and below the coal zone in the Star Point Sandstone. The wells were finally cased down to the Star Point and the bottom 20 feet of the casings were perforated. Measuring the static water levels at different stages of drilling showed that deeper ground water had a higher piezometric head than the shallow ground water. Because of this, four shallow wells were drilled adjacent to four of these deep wells, and casings with perforations in the bottom 20 feet were installed. Piezometric heads were measured in shallow and deep holes showing the vertical piezometric gradient associated with the ground water. Data obtained from these wells are shown in graphic form in Volume 4.

The instability of the Blackhawk Formation made it difficult to keep uncased holes open for several hours. Reliable water quality samples could therefore not be obtained from the core holes. Several holes were more than 1,000 feet deep and one was more than 2,000 feet deep.

Two wells have been drilled in Eccles Canyon to determine aquifer characteristics of the Star Point Sandstone. The locations of these wells, W13-1 and W17-1, are shown on Plate 2.3.6-1. Well W13-1 extends through the Blackhawk Formation into the Star Point Sandstone and was cased. During the draw down and recovery tests, the casing had not yet been installed. The well was later abandoned due to the lack of production. Revised: 11/02
One well, W2-1 (98-2-1) has been completed in the UP&L tract in the Blackhawk Formation through and below the Lower O'Conner 'B' seam. Water level measurements have been obtained from this well since 1998. The water level measurements are summarized in a table included in a section of Appendix Volume A-1, Hydrology, titled 'UP&L Tract'. A detailed description of the effects of dewatering the southern portion of Mine #2 is included in the Addendum to the PHC that was produced in July 2002 and revised in October 2002. Essentially, the water level has dropped in this well significantly since mine dewatering and the pumping of the James Canyon JC-1 well began. The July 2002 Addendum to the PHC also discusses the effects of drawdown on wells located to the west in the Flat Canyon Area.

The water quality analyses were measured from samples collected after periods of pumping from the well. Well W17-1 is located adjacent to Eccles Creek in the canyon bottom and extends through alluvial materials before penetrating the Star Point Sandstone. The well had been pumped for a few hours when the water quality sample was collected. Well 13-1 was drilled near the portal area topsoil stockpile as a water supply source, but was abandoned because of insufficient flow. The data, however, are useful in showing groundwater quality. Results of the laboratory analysis of these samples are contained in the Hydrology section of Appendix Volume A-1.

A comparison of water quality data collected from the permit area springs, local mines, and a well indicated that the springs were of a quality similar to that of the deep ground water system of the area. Thus, inferences on ground water quality have been drawn principally from data collected almost entirely from springs.

Almost without exception, the ground water in the area is of a strong calcium bicarbonate type. However, the sulfate and magnesium influence during the period of record shows an increase.
downstream in Eccles Creek (VC-9) and in Pleasant Valley Creek (M-1) near Scofield. These increases are probably due to dissolution of evaporites found in the Mancos Shale tongues within the Star Point Sandstone which outcrops in lower portion of Eccles Creek and Pleasant Valley Creek (Plate 2.2.1-1). Although the quality of the deeper ground water is expected to be more uniform, the data show that three distinctive qualities of spring water can be found in the project area. Springs issuing near the outcrop of the Castlegate Sandstone in the northwest corner of the project area have a very low dissolved solids content (normally less than 100 milligrams per liter). This results from the lack of shaley layers in the Castlegate. Local conditions have probably resulted in the slightly higher concentrations in the springs issuing in the headwaters of Eccles Canyon (dissolved solids concentrations between 300 and 350 milligrams per liter). Springs issuing over the remainder of the project area have dissolved solids content which generally varies from 180 to 260 milligrams per liter, averaging 220 milligrams per liter. (See Water Quality Data - Volume 4 and Hydrology Section - Appendix Vol. A-1.)

Seasonal changes in ground water quality constituents show no consistent trends. Concentrations are generally lower in spring water than noted in surface water samples, although the differences do not appear to be very significant. In many cases, trace metal concentrations were consistently below the detection limit of routine laboratory techniques.

The sample analysis reports located in the Hydrology Section of Appendix Volume 1-A, as submitted by Commercial Testing and Engineering Company, Denver, Colorado, are tendered to document that no potential acid-forming or toxic-forming material is to be found either above or below the coal seams. The equipotential figures do show some alkalinity producing tendencies occur.
The analysis reports are arranged by seam, i.e., McKinnon, Upper O'Connor, and Lower O'Connor A; and then by sample location, e.g., roof, floor.

The locations of the exploration holes at which these samples were taken are shown on Plate 2.3.6-1.

Obtaining groundwater data from abandoned mines in the area has been investigated but found not practical. The only abandoned portal in the permit area is the old Eccles Canyon Mine. This portal was sealed and covered during construction of the Skyline portal area surface facilities and is no longer accessible.

There are several abandoned mines in the adjacent area, located in Winter Quarters, Pleasant Valley and Boarding House Canyons. A search of UDOH and EPA (Storet) records did not reveal any discharge data from these old portals.

2.3.7 Groundwater Monitoring Program

Use of the Groundwater and Surface-Water Monitoring Plans

The purposes of groundwater and surface-water monitoring plans are to provide verification that mining-related impacts to groundwater and surface-water systems do not occur, and to determine the magnitude and character of potential impacts if they do occur. Comparisons between monitoring data (for the parameter of interest or concern) collected during baseline pre-mining conditions should be made with monitoring data (for the same parameter or interest of concern) collected during the operational and/or reclamation phase of mining to determine impacts. When changes to monitored parameters subsequent to mining in an area are observed in the monitoring data, an analysis of all data should be performed to determine the cause(s) of the change in the hydrologic condition. In utilizing the monitoring data to detect or quantify potential mining-related impacts, it is necessary to evaluate all factors relevant to the prevailing hydrologic conditions together with the monitoring data. This is because other factors, which are not related to the mining activity, may cause changes in the prevailing hydrologic conditions. In particular, climatic variability (which may result in increased or decreased groundwater and surface-water flow rates, changes in water levels in wells, and changes in water quality) should be carefully evaluated together with the monitoring data. Other factors that may influence coal mine hydrology include grazing practices, land use, and range condition. A convenient and useful means of evaluating regional climatic data is through the use of the Palmer Hydrologic Drought Index, which is a monthly value that indicates the severity of wet and dry spells that is generated by the National Climatic Data Center and available on-line at http://www1.ncdc.noaa.gov/pub/data/cirs/drd964x.phdi.txt.
The ground water monitoring program outlined in this section is a continuation of a program approved with the original Mining and Reclamation Permit Application. It incorporates practices designed to provide the baseline data necessary to validate the determination of the probable hydrologic consequences of proposed and existing mining and reclamation operations. The program also is designed to meet site specific requirements and incorporates the flexibility for change if necessary. Selection of the monitoring sites was an arduous process using the following criteria. An original baseline survey or Hydrologic Inventory was compiled in 1979, utilizing data collected from 1974 through 1979, where all possible springs, seeps and streams were monitored. Additional water monitoring data was collected for the North Lease from 1991 through 1993. Following the completion of the inventory and consultation with both DOGM and the U.S. Forest Service (USFS), representative monitoring sites were selected. Important parameters included geologic unit, critical area where damage may occur, quantity of flow, reasonable year round access, and representative distribution.

A monitoring program is being conducted at each of the ground water stations identified on Table 2.3.7-3 and depicted on Plate 2.3.6-1. Samples are collected quarterly, with the 1st Quarter (January-March) having a shortened list of sites due to inaccessibility during winter months. Also due to weather conditions, sampling in the 2nd quarter (April-June) can be conducted through July 15 in years when snowmelt conditions prohibit monitoring completion by July 1.

In areas where mining has been completed and only field measurements are required, baseline laboratory
analyses is conducted during the 3rd Quarter (July-September) every five (5) years beginning in 2010 and successively in 2015, 2020, 2025, etc. In other than the stated years, 3rd Quarter sampling will be identical to 2nd and 4th Quarter laboratory analyses. 4th Quarter monitoring (October-December) should be conducted prior to December due to snow conditions eliminating access.

Water quality samples are collected from the 33 selected springs in the project area. The samples are comprehensively analyzed each year for the parameters listed in Table 2.3.7-1 and Table 2.3.7-2. All water samples collected for use in this permit have been collected and analyzed according to methods in either the "Standard Methods for the Examination of Water and Wastewater" or the 40 CFR parts 136 and 434. A listing identifying the station types is shown on Table 2.3.7-3.

In addition to the collection of the outlined water quality data, water level data has been collected from each of the wells (if functional) as scheduled on Tables 2.3.7-1, 2.3.7-2, and 2.3.7-3, and noted on Plate 2.3.6-1. Water quality samples will be collected from the Waste Rock Disposal Site Well 92-91-03. Summary information on these observation wells is found on Table 2.3.7-4. Six (6) wells, W79-10-1A, 79-14-2B 20-4-2, 99-28-1, 79-22-2-1 and 79-22-2-2 have experienced casing failures, and have been properly abandoned. There are no plans to replace these wells.

The amount of water discharged from each mine on each monitoring occasion will also be monitored at the mine mouth through the use of a totalizing flow meter or similar device. Significant changes in the source of water in the mine will be noted during the period of operation. Underground water pumped from each mine will be monitored for water quality. Mines #1, #2 and #4 (Flat Canyon lease) discharge is sampled at Station CS-14. Mine #3 discharge from the North Lease is sampled at Station CS-12. Mine #2 water is also discharged at JC-3.
Should the concentrations result in a discharge which exceeds the UPDES discharge permit limitations or indicates potential disturbance to the hydrologic balance, an attempt will be made to isolate the contributing source and an evaluation made of possible appropriate remedial action. The best alternative remedial action will be implemented as soon as practicable to ensure protection of Eccles Creek water quality. A copy of pertinent sections of the current UPDES permit (expires April 30, 2020) is appended to this section as Exhibit 2.3-1. The permit is renewed every five (5) years.

As required, ground water quality data collected from the property area will be submitted to the Utah Division of Oil, Gas, and Mining. Such reports will be submitted within 90 days after completion of the quarterly monitoring program. An annual report which will include a summary of water quality data and water well level data for the previous year will be submitted within 90 days of the end of each year.

In 2002, several new sites were added to the monitoring program. Sites MC-1, MC-2, MC-3, MC-4, MC-5, and MC-6 are surface water sites on Mud Creek (Site MC-6 was added in November 2002 as agreed upon by the operator and the Division). These sites were identified as part of a study to determine the impacts of increase mine discharge on Mud and Eccles Creeks. EarthFax Engineering, Inc. was contracted to write and implement a work plan to evacuate the impacts in July 2002. A copy of the work plan is included in Volume 4 of this M&RP. The study calls for establishing and characterizing reference sites on Eccles and Mud Creeks to: 1) determine depth to ground water at the sites, 2) obtain historic flow data for the stream for comparative purposes, 3) gather and evacuate historic aerial photos of the streams, 4) collect additional water quality data, 5) evaluate bank stability indexes along with vegetation information, and conduct long-term monitoring at the selected sites. The initial field work for this project was

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completed in August 2002. Annual updates to the study have been submitted with the annual reports. This study concluded after the 2005 information was submitted based on the initial parameters of the study which indicated the study would last through one (1) year after discharge from the mine decreased to a sustained flow less than 5,000 gpm.

Samples obtained at the MC-sites were monitored for total flow, TDS, TSS, and total phosphorous. In addition a stream stability cross-section and reach survey was conducted approximately 75 yards downstream of the MC-6 monitoring location. The results of these analyses were reported with the other mine water quality monitoring reports while the study was being conducted (2002-2005).

Sites MD-1, JC-1, JC-3, and ELD-1 were also added to the monitoring site list. MD-1 is a composite sample of all the water discharged from Skyline Mine to Eccles Creek. JC-1 and JC-3 are samples of the water discharged from the two James Canyon ground and mine dewatering wells. ELD-1 reports the total flow-only from both JC-1 and JC-3. MD-1 and ELD-1 are monitored for total flow and the results are reported to the Division on a monthly basis. Quarterly, MD-1, JC-1, and JC-3 are also monitored for TSS, TDS, and total phosphorous. Total phosphorous was taken off the analysis for MD-1 in 2016 to coincide with the UPDES permit. Since JC-3 is a PacifiCorp UPDES site, it is monitored each month for flow, TSS, TDS, oil and grease, and total iron.

Spring monitoring sites WQ1-1, WQ1-39, WQ3-6, WQ3-26, WQ3-41, WQ3-43, and WQ4-12 were added to the permit. Surface water sites CS-19, CS-20, and CS-21 were added as were wells 91-26-1 and 91-35-1. Springs S26-1 and S25-32 and Stream CS-26 were added with the North Lease Modification in 2013. All of these sites are in the North Lease area. Location of these samples sites are illustrated on Drawing 2.3.6-1.

Skyline Mine has also obtained numerous water samples from within the mine for age-dating purposes. Samples have been analyzed for both stable and unstable isotopes; the majority being analyzed for tritium and carbon 14 content. The analyses results of these samples is discussed in detail in the July 2002 Addendum to the PHC. The results of repeated tritium sampling and analysis in a few location in the mine, specifically those in the 9 and 10 Left panel areas that began in August 2001, suggest that the majority of the water is not younger than 50 years. Only a few carbon 14 samples have been obtained from these
sites but the results indicate the waters are several thousand years old. The sampling sites in the 9 and 10 Left panel areas became inaccessible as that portion of the mine was sealed in September 2002. Remaining significant inflow sites, particularly the east submains site (previously identified as the west submains) and a few of the sites in the 11 and 12 left panel areas, will be accessible through June of 2004. The mine will obtain carbon 14 and tritium samples from these sites on a quarterly basis. The results of these analyses will be compared to previous analyses to determine if the age of the water is getting perceptively younger. A report detailing the location of where samples were obtained and the results of the age-dating analyses will be submitted to the Division each quarter in conjunction with the quarterly water monitoring results.

Mine #2 will be sealed by the end of 2004, with the exception of the west mains. The west mains will be maintained to allow access to the 14, 15, and 16 Left sumps. Skyline will complete mining the 11 and 12 Left A and B panels before the end of 2004. No additional significant inflows are anticipated in these areas. If sustained significant flows of ground water (flows greater than 800 gpm) are encountered in the headgates or tailgates of these panels, tritium and carbon 14 samples will be obtained and sampled on a quarterly basis as long as the sites are accessible. If similar flows are encountered as Mine #3 extends into the North Lease area, the same age-monitoring program will be applied.

Samples will also be obtained from the JC-1 well and analyzed for carbon 14, tritium, and stable isotopes deuterium and oxygen 18 for age dating purposes. JC-1 is, at this time, a ground water discharge site that is assumed to discharge water similar to or the same as the mine inflow waters in the southern portions of Mine #2. Discharge from JC-1
should be accessible for the next several years. The results of the analyses will be monitored for changes in ages that may indicate changes in the source of the mine water inflows. These samples will be obtained as outlined in Table 2.3.7-1.

Samples of water discharging from springs 8-253 (Flat Canyon area), 2-413 (James Canyon), S24-1 (Sulfur Spring in Huntington Canyon), and S15-3 (Upper Huntington Creek) will be collected during the 2nd Quarter (April – June) and 4th Quarter (October – December) monitoring period and analyzed for tritium content. Additional tritium samples will be obtained from EL-1 (inflow to Electric Lake above JC-1 and JC-3 discharge) and EL-2 (outflow from Electric Lake) during the 2nd, 3rd, and 4th Quarter water monitoring periods. These samples will be collected for a period of three years beginning in the spring of 2004. The purpose of collecting these tritium samples, along with the tritium samples from JC-1, is to monitor the change in tritium content, if any, in the local aquifers and Electric Lake during spring, summer, and fall and over the three year period.

Surface-water will be monitored in the vicinity of the Winter Quarters Ventilation Facility (WQVF) by two (2) stream sites located both up- and downstream of the site, CS-20 and CS-24, respectively. The stream sites will monitor the surface-water ensuring neither the shaft or slope is compromising the surface water system. Groundwater Well 08-1-5 screened from 297-317 feet below the surface and will monitor the water elevation below the coal seam. No springs exist on the south facing slope where the WQVF pad is located. Spring WQ1-1 is located on the north-facing slope, is approximately 1/4-mile east of the WQVF pad and monitors near surface groundwater south and east of the WQVF site.

Both surface-water and groundwater monitoring sites were added in Woods Canyon as mining was extended to the east in Section 36, T12S, R6E. CS-25 will monitor stream flow downstream of all mining activity. Shallow ground water along Woods Canyon Creek will be monitored by piezometers WC-1, WC-3, WC-5, WC-7 and WC-9. The shallow ground water wells were discontinued after the 2016 field season as mining was completed in 2015 (See Plate 2.3.6-1a for historic WC- locations). Spring WQ36-1 will monitor groundwater within the Blackhawk formation above active mining areas.

Mine #4 Flat Canyon Area Monitoring

The monitoring site selection criteria has remained relatively consistent throughout the years with representative sites being selected from the baseline data. With the addition of the Flat Canyon lease, initial seep and spring data was collected beginning in 1997 in preparation of the Flat Canyon EIS. Baseline sampling in the Mine #4 – Flat Canyon lease area resumed in 2006 and continued through 2016. The number of sites were refined based on proposed mining by adding some stream sites upstream of mining and selecting spring sites representative of the geologic units in areas proposed for undermining.

In the Mine #4 – Flat Canyon lease area the groundwater monitoring will include the addition of ten (10) springs in the near-surface active zone. Springs SW32-276 and SW32-277 are located in the Price River formation, SW4-268, SW4-429, and SW5-590 are in the Castlegate Sandstone, and SW21-104, SW28-110, SW28-111, SW4-169, SW4-174 are in the Blackhawk Formation.
respectively. Spring SW21-104 was added to provide a spring in Little Swens Canyon in the area to be subsided. Spring S33-268 is an important spring since it is used by the campground, yet problematic because it is monitored at the storage tank overflow - the only accessible location. When use at the campground is high, the spring cannot be monitored because the tank is not overflowing due to demand.

To monitor the shallow Quaternary alluvial groundwater in the Boulger Canyon area a total of six (6) shallow piezometers will be added in 2017. Piezometers P17-4-1 (E & W), P17-33-1 (E & W), and P17-34-1 (N & S) are located adjacent to stream monitoring sites CS-30 and CS-33 (upstream of Boulger Reservoir) and CS-34 (below Boulger Reservoir). Plate 2.3.6-4 will provide the baseline potentiometric gradient information from wells once the information is collected.

Monitoring in the deeper inactive-zone of the Star Point Sandstone, both Wells 15-21-2 and JC-2 have been added to monitor water levels. To monitor water quality of the Star Point Formation, JC-1 has added operational lab analysis to the analytical schedule. Microscopic Particulate Analysis (MPA) has also been added to JC-1 to be collected during baseline sampling to check for communication with active-zone surface waters. Similar to monitoring in Mine #2, if sustained significant flows of groundwater (flows greater than 800 gpm) are encountered in the headgates or tailgates of panels in Mine #4, both lab analysis and tritium will be obtained and sampled on a quarterly basis as long as the sites are accessible. An MPA sample will also be collected from the in-mine site during baseline sampling if it is accessible. Plate 2.3.6-3 Mine Inflow Map will identify where inflows are encountered.

**Surface Water Monitoring**

Surface-water monitoring for the Flat Canyon lease area includes the addition of upstream-of-mining sites on the following creeks: Little Swens (CS-27), Swens Creek (CS-28), Flat Canyon (CS-29), Boulger above the reservoir (CS-30), and CS-31 on upper Boulger Creek above mining, respectively. To provide in-stream-flow information, stream sites CS-32 through CS-34, and CS-35 have been added to sections of Boulger Creek and Swens Creek, respectively, to monitor individual sections streams and tributaries. This is in addition to stream, springs, and wells that have been included in the Water Monitoring program for a number of years (See Appendix A-1, Volume 2 for baseline water analysis).

Table 2.3.7-1 provides the comprehensive water quality analytical schedule for all surface- and groundwater stations; Table 2.3.7-2 outlines field, operational lab, and baseline lab analysis; Table 2.3.7-3 groups the monitoring stations by drainage basin; Table 2.3.7-4 provides a summary of well information on the groundwater monitoring wells, and Plate 2.3.6-1 graphically illustrates the location of all the hydrologic monitoring stations. Plate 2.3.4-2 will provide the baseline potentiometric gradient information from wells.

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## Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations)

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Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations) (continued)

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<td>SW4-429</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>SW5-590</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>SW32-276</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>SW32-277</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>SW-33-268</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2-413</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3-290</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>8-253</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ1-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ1-39</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ3-6</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ3-26</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ3-41</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ3-43</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ4-12</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>WQ36-1</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Streams (cont.)

Springs

S10-1
S12-1
S13-2
S13-7
S14-4
S15-3
S17-2
S22-5
S22-11
S23-4
S24-1 Sulfur Spring
S24-12
S25-32
S26-1
S26-13
S34-12
S35-8
S36-12
SW21-104
SW28-110
SW28-111
SW4-169
SW4-173
SW4-429
SW5-590
SW32-276
SW32-277
SW-33-268
2-413
3-290
8-253
WQ1-1
WQ1-39
WQ3-6
WQ3-26
WQ3-41
WQ3-43
WQ4-12
WQ36-1

Incorporated

FEB 13 2017

Div. of Oil, Gas & Mining
Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations) (continued)

<table>
<thead>
<tr>
<th>Sample Site</th>
<th>1st Quarter</th>
<th>2nd/3rd/4th Quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Field Analysis</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>JC-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>JC-2</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>JC-3</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ELD-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>W79-10-1B</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>W79-26-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>W2-1(98-2-1)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>W99-4-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>W20-28-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>92-91-03</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>08-1-5</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>15-21-2</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>16-24-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>P17-4-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>P17-33-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>P17-34-1</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sustained In-mine Flow &gt;800 gpm</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* Field Measurements and Laboratory Analyses are defined in Table 2.3.7-2

*Field parameters will be taken in conjunction with samples collected for Lab Analyses

1 Sites with at least two (2) years of laboratory analysis data will be sampled once every five (5) years for the currently approved laboratory parameters in Table 2.3.7-2 beginning in 2010. If field parameter monitoring indicates any trending changes, regular laboratory analysis may be resumed until trend is adequately characterized.

2 2nd Quarter sampling may extend to July 15 in years when spring snow conditions do not allow access before June.

3 Baseline Lab Analysis will be conducted every five (5) years beginning in 2010 in the 3rd quarter. (ie. Years 2010, 2015, 2020, etc.) (JC-1 and in-mine shall include Microscopic Particulate Analysis (MPA))

** Flow measurements discontinued at CS-6 in 12/2009, lower Eccles flow documented with VC-9

*** CS-14 represents mine in-flows and discharges from Mines #1, #2, and #4 (the SW districts of the Mine.)

Revised 12-30-16

2-36b

INCORPORATED

FEB 13 2017

Div. of Oil, Gas & Mining
### Table 2.3.7-2
**Water Quality Analytical Schedule**

#### Field Measurements
- Flow or Depth to Water
- pH
- Specific Conductance
- Temperature, Water

#### Laboratory Measurements
- Bicarbonate
- Carbonate
- Calcium, dissolved
- Chloride
- Iron, Total
- Magnesium, dissolved
- Manganese, total
- Nitrate + Nitrite
- Phosphorus, Total
- Potassium, dissolved
- Sodium, dissolved
- Sulfate
- Total Alkalinity
- Total Hardness
- Total Suspended Solids
- Total Dissolved Solids
- Cation / Anion balance

#### Baseline Laboratory Measurements
- Acidity
- Alkalinity, Total
- Barium, dissolved
- Boron, dissolved
- Bicarbonate
- Calcium, dissolved
- Carbonate
- Cation / Anion balance
- Chloride
- Copper, dissolved
- Hardness, Total
- Iron, Total and dissolved
- Lead, dissolved
- Magnesium, dissolved
- Manganese, Total and dissolved
- Nitrate + Nitrite
- Phosphorus, Total
- Potassium, dissolved
- Sodium, dissolved
- Sulfate
- Total Suspended Solids
- Total Dissolved Solids

---

Revised 06/09/06

2-37

INTEGRATED

JUN 15 2006

Div. of Oil, Gas & Mining
### Table 2.3.7-3
**MONITORING STATION IDENTIFICATION**

**ECCLES CANON/MUD/FISH CREEK DRAINAGES**

<table>
<thead>
<tr>
<th>STREAM STATIONS</th>
<th>15 Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-3</td>
<td>CS-6</td>
</tr>
<tr>
<td>CS-9</td>
<td>CS-11</td>
</tr>
<tr>
<td>CS-19</td>
<td>CS-20</td>
</tr>
<tr>
<td>CS-24</td>
<td>CS-26</td>
</tr>
<tr>
<td>VC-9</td>
<td>VC-10</td>
</tr>
<tr>
<td>VC-11</td>
<td>VC-12</td>
</tr>
<tr>
<td>CS-25</td>
<td>NL - sites (varies)</td>
</tr>
<tr>
<td>VC-6</td>
<td>VC-9</td>
</tr>
<tr>
<td>NL - sites (varies)</td>
<td></td>
</tr>
</tbody>
</table>

**HUNTINGTON CANYON**

<table>
<thead>
<tr>
<th>STREAM STATIONS</th>
<th>21 Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-7 (F-5)</td>
<td>CS-8</td>
</tr>
<tr>
<td>CS-10</td>
<td>CS-16</td>
</tr>
<tr>
<td>CS-17</td>
<td>CS-18</td>
</tr>
<tr>
<td>CS-22</td>
<td>CS-23</td>
</tr>
<tr>
<td>UPL-10</td>
<td>F-10</td>
</tr>
<tr>
<td>EL-1</td>
<td>EL-2</td>
</tr>
<tr>
<td>CS-27</td>
<td>CS-28</td>
</tr>
<tr>
<td>CS-29</td>
<td>CS-30</td>
</tr>
<tr>
<td>CS-31</td>
<td>CS-32</td>
</tr>
<tr>
<td>CS-33</td>
<td>CS-34</td>
</tr>
<tr>
<td>CS-35</td>
<td></td>
</tr>
</tbody>
</table>

**MINE DISCHARGE STATIONS**

<table>
<thead>
<tr>
<th>4 Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-12 (Mine #3)</td>
</tr>
<tr>
<td>CS-14 (Mines #1, #2, #4)</td>
</tr>
<tr>
<td>MD-1 (Composite CS-12 &amp; CS-14)</td>
</tr>
<tr>
<td>SRD-1 (Total Mine Site Discharge to Eccles Creek/Scofield reservoir)*</td>
</tr>
</tbody>
</table>

**FRENCH DRAIN STATIONS**

<table>
<thead>
<tr>
<th>1 Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-13</td>
</tr>
</tbody>
</table>

**WASTE ROCK DISPOSAL SITE**

<table>
<thead>
<tr>
<th>4 Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRDS #1</td>
</tr>
<tr>
<td>WRDS #2</td>
</tr>
<tr>
<td>WRDS #3</td>
</tr>
<tr>
<td>WRDS #4</td>
</tr>
</tbody>
</table>

**GROUNDWATER STATIONS**

<table>
<thead>
<tr>
<th>SPRINGS</th>
<th>39 Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>S10-1</td>
<td>S12-1</td>
</tr>
<tr>
<td>S13-2</td>
<td>S13-7</td>
</tr>
<tr>
<td>S14-4</td>
<td>S15-3</td>
</tr>
<tr>
<td>S17-2</td>
<td></td>
</tr>
<tr>
<td>S22-5</td>
<td>S22-11</td>
</tr>
<tr>
<td>S23-4</td>
<td>S24-1 Sulfur</td>
</tr>
<tr>
<td>S24-12</td>
<td>S25-4</td>
</tr>
<tr>
<td>S34-12</td>
<td></td>
</tr>
<tr>
<td>S35-8</td>
<td>S36-12</td>
</tr>
<tr>
<td>2-413</td>
<td>3-290</td>
</tr>
<tr>
<td>2-390</td>
<td>S36-13</td>
</tr>
<tr>
<td>S34-12</td>
<td></td>
</tr>
<tr>
<td>S28-41</td>
<td>WQ3-43</td>
</tr>
<tr>
<td>WQ4-12</td>
<td>8-253</td>
</tr>
<tr>
<td>WQ1-39</td>
<td>WQ3-6</td>
</tr>
<tr>
<td>WQ3-26</td>
<td></td>
</tr>
<tr>
<td>S26-1</td>
<td>SW21-104</td>
</tr>
<tr>
<td>SW28-110</td>
<td>SW28-111</td>
</tr>
<tr>
<td>SW4-169</td>
<td>SW4-173</td>
</tr>
<tr>
<td>SQ4-429</td>
<td></td>
</tr>
<tr>
<td>SW5-590</td>
<td>SW32-276</td>
</tr>
<tr>
<td>SW32-277</td>
<td>SW32-277</td>
</tr>
<tr>
<td>SW33-268</td>
<td></td>
</tr>
</tbody>
</table>

**WELLS (MONITORING)**

<table>
<thead>
<tr>
<th>17 Well Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>W79-10-1B</td>
</tr>
<tr>
<td>92-91-03</td>
</tr>
<tr>
<td>W79-26-1</td>
</tr>
<tr>
<td>W2-1(98-2-1)</td>
</tr>
<tr>
<td>W99-21-1</td>
</tr>
<tr>
<td>JC-1</td>
</tr>
<tr>
<td>JC-2</td>
</tr>
<tr>
<td>W20-28-1</td>
</tr>
<tr>
<td>W08-1-5</td>
</tr>
<tr>
<td>ELD-1 (Total of JC-1 and JC-3)</td>
</tr>
<tr>
<td>P17-33-1</td>
</tr>
</tbody>
</table>

**WELLS, CULINARY** - Referenced but not monitored

<table>
<thead>
<tr>
<th>5 Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>W13-1</td>
</tr>
<tr>
<td>W17-1</td>
</tr>
<tr>
<td>W24-1</td>
</tr>
</tbody>
</table>

**NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES)**

<table>
<thead>
<tr>
<th>001 Portal Area</th>
<th>002 Loadout</th>
<th>003 Waste Rock Area</th>
<th>004 Winter Quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>JC-3 James Cyn</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Sites are monitored for total flow only and the results are reported to the Division on a monthly basis

** See Table 2.3.7-4 for well detail

Revised 12/30/2016

INCORPORATED

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Div. of Oil, Gas & Mining
Woods Canyon Piezometer locations

LEGEND
- Piezometer location

WC-4

Canyon Fuel Company, LLC
Skyline Mines

SCALE: 1" = 400' DATE: 9-16-10 CHK BY: GAC
REVISING

DMG. NO.: Fig. 2.3.7-1 Pg. 2-380 DR: BY: GAC
TABLE 2.3 .7-4
SUMMARY INFORMATION ON GROUNDWATER OBSERVATION WEllS

Screened
Well
Designation

W10-1

W14-2

Other
Designation

Year

Monitored

Operational

Drilled

yes/no

Status

Collar

Total

Top of

Elev

Depth of

Casing

Date & Current Water

Well
Drilled
Elevations, Mean
Elevation Elevation(
(FT)
Sea level
(FT)
FT)

(FT)
above
collar

level Elevation, Mean

Aquifer Represented/

Interval, Top &

Monitored Formation

Bottom

Name & Type

W79-10-1A*

1979

No

Abandoned

Star Point - Sandstone (Storrs Tongue)

W79-10-1B*

1979

Yes

Active

Blackhawk

W79-14-2A*

1979

Yes

Active

Blackhawk

7393.0-7373.05

8342.0-8322.0

Total
Depth

Ground

Sea level

Vertical Distance

Historical Range of
Water level
Elevation, Mean Sea

Name of Associated
Coal Seam

level

from Screened

Well location,

Interval to Associated
Coal Seams (Above or

Township, Range, &
Section

Below)

2190

9379.4

7189.4

2.8

Sept. 2002; 9017.3

9034.6-8891. 7

1110

9382.8

8272 .8

2.8

6/15/16; 8950.4

9039 .3 - 8891 .7

122

9051.7

8929.7

3

6/24/16; 9028.51

9049.1- 8963 .1

965

9047

8082

3

..

585

9040

8455

2.5

1395

9041.8

7646.8

2.5

lower O'Connor "A"

Through Coal Seam

T 13 S, R 6 E, Sec. 10
T 13 S, R 6 E, Sec.10

lower O'Connor "A"

Through Coal Seam

T 13 S, R 6 E, Sec. 14

'\;)'

W79-14-2B*
W22-2

-

1979

No

Casing failed 6/89

Starpoint

.~

"

.-

.- .

"'~;"~

W79-22-2-1 *

1979

No

Blocked

Blackhawk

W79-22-2-2*

1979

No

Casing failed 9/85

Starpoint

W26-1

W79 -26-1*

1979

Yes

Active

Blackhawk - Sandy Siltsone

8411.0-8391.0

200

9012

8812

2.8

6/15/16; 8949 .5

8976.5 - 7598.3

W35-1

W79-35-1A*

1979

No

Blocked

Star Point - Sandstone (Storrs Tongue)

8092 .0-8072.0

1000

8726.4

7726.4

2.5

8/27/12; 8296.1

8557.7 - 8171.6

~.

,.".

-

-,'

-"-=

T 13 S, R 6 E, Sec. 14

~-""'-

T 13 S, R 6 E, Sec. 22

".

T 13 S, R 6 E, Sec. 22
Lower O'Connor "B"

Through Coal Seam

T 13 S, R 6 E, Sec. 26

Lower O'Connor "A"

5' Below Coal Seam

T 13 S, R 6 E, Sec. 35

Not associated with
W79-35-1B*

1979

No

Blocked

Blackhawk - Sandy Siltsone

8542.4-8504.4

220

8726.4

8506.4

98-2-1

1998

Yes

Active

Starpoint - Sandstone (Panther Tongue)

8030.4-8000.4

1519

9271

JC-l

n/a

2001

Yes

Active

Star Point - Sandstone (Storrs Tongue)

7918 .0-7858 ,0

1000

JC-2

nfa

2002

Yes

Active

Star Point - Sandstone (Storrs Tongue)

7886-7946

1000

W2-1

T 13 S, R 6 E, Sec. 35

10/29/14; 8611.2

8618.5 - 8534.6

coal seam

7752

6/10/16; 8403 .31

8551.4-8325 .3

Lower O'Connor "B"

Through Coal Seam

8797

7797

No Current Data

No Current Data

Lower O'Connor "B"

11.5' Below Coal Searr T 13 S, R 6 E, Sec. 35

8796

7796

No Current Data

No Current Data

Lower O'Connor "B"

Below Coal Seam

T 13 S, R 6 E, Sec. 35

No Current Data

No Current Data

Lower O'Connor "B"

Though Coal Seam

T 13 S, R 6 E, Sec. 35

6/10/16;8533

8562 .1- 8483 .6

Lower O'Connor "B"

Through Coal Seam

T 14 S, R 6 E, Sec. 4

Through Coal Seam

T 13 S, R 6 E, Sec.21

2.5

T 14 E, R 6 E, Sec. 2

8061.7-8018.0,
JC-3

nfa

99-4-1

n/a

99-Ll-l

1999

r'"

1999

Ye s

Active

Star Point - Sandstone (Storrs Tongue)

7730.5-1-7711.1

Yes

Active

Star Point - Sandstone (Storrs Tongue)

7551.0-7521.0

No

-,locked

,

Star Point - Sandstone (Panther Tongue)

7431.3-7401.3

1470
2050

n/a

1999

No

Abandoned

Star Point - Sandstone (Panther Tongue)

7477.0-7447.0

2100

20-4-1

n/a

2000

No

Blocked

Star Point - Sandstone (Storrs Tongue)

7491.0-7464.0

1570

n/a

2000

No

Abandoned

20-28-1

n/a

2000

Yes

Active

'"

7297 ~

9347
9351
8874
e,

-

Flat Canyon (Middle
\..

12/18/14; 8287

8320.3 - 8277.3

-

Seam)
Flat Canyon (Middle

7251

11/21/08; 8420.8

8420.8 - 8343.3

Seam)

ThroughCoal Seam

T 13 S, R 6 E, Sec. 28

7304

10/24/14;8798

8798 - 8448.1

Lost Core

Lost Core

T 14 S, R 6 E, Sec. 4

Star Point - Sandstone (Storrs Tongue)

7574.0-7544.0

2200

9554

7354

6/19/10; 8472.53

8478.7 - 8383.2

Lower O'Connor 'A"

16' Below Coal Seam

T 14 S, R 6 E, Sec. 4

Star Point - Sandstone (Panther Tongue)

7420.0-7390.0

1690

8871

7181

6/24/16; 8371

8393 .7 - 8355.4

Lower O'Connor "B"

Through Coal Seam

T 13 S, R 6 E, Sec. 28

Starpoint

7698.1-7668.1

1876.7

9235

7358.3

6/19/15;7851

7956 - 7802.7

Lower O'Connor "B"

Through Coal Seam

T 12 S, R 6 E, Sec. 26

7616.9-7586.9

2450

9262

6812

11/8/12; 7955

8021.3 - 7911.2

Lower O'connor "B"

Through Coal Seam

T 12 S, R 6 E, Sec. 35

7728.5-7977.5

132

7720

7852

6/14/16; 7977 .5

7921.7 - 7867.9

Lower O'Connor "A"

Below Coal Seam

T 13 S, R 6 E, Sec. 4

327

8144

8140.5

6/14/16; 7868

7834.5-7972.3

Lower O'Connor "B"

Below Coal Seam

T 13 S, R 6 E, Sec. 1

91-26-1

North Lease

1991

No

Blocked

91-35-1

North Lease

1991

No

Blocked

Starpoint

"

7372

j1

99-28-1

20-4-2

8842

92-91-03

nfa

1992

Yes

Active

Starpoint

8-1-5

n/a

2008

Yes

Active

Starpoint

..

3

Lower O'Connor "A"/
15-21-2

n/a

2015

Yes

Active

Star Point - Sandstone

7014.0-7044.0

2142

Approx.
16-24-1

nfa

2016

Yes

Active

Star Point - Sandstone

7541.0-7571.0

600

9186

7044

Approx.

Approx.

8111

7511

10/20/16; 8350.4

8313.8 - 8350.4

Flat Canyon

Below Coal Seam

T 13 S, R 6 E, Sec 21

••

.*

Lower O'Connor "A"

Below Coal Seam

T 12 S. R 6 E, Sec 24

I/\JL,;UHPO RATED
Note :

* The screen interval was determined by using the lowest minable coal seam; the screen was placed 3 feet below top of the coal seam; and a 20 foot screen was installed .

""'--'------'1 Denotes wells not in monitoring program

FEB 13 2017

** New well, data will be reported to DOGM

Div. of Oil, Gas & Mining
Revised 12-30-2016

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2.4 SURFACE WATER HYDROLOGY

As previously discussed, the Skyline permit area is located in the headwaters of the Price and San Rafael River Basins. Snowmelt is the primary source of water for the perennial streams in the two basins, with only a small amount of the total flow in the region being derived from rainfall. As a result, flow volumes per unit area are high in the headwaters and low near the mouths of the two basins.

The quality of surface water in the headwaters region is excellent, with total dissolved solids (TDS) concentration normally varying between 100 and 400 milligrams per liter. However, this quality deteriorates rapidly as the streams cross the saline Mancos Shale downstream and receive irrigation return flows from Mancos-derived soils. TDS concentrations in the Price and San Rafael Rivers, near their confluence with the Green River, generally vary between 1,500 and 4,000 milligrams per liter. Sediment yields in the two basins experience similar geographic variations, with the bulk of the sediment yielded at the mouths of the two major rivers coming from those areas which are underlain by the highly erodible Mancos Shale. Data summaries presented in this section are taken from the Skyline water quality monitoring program, Mundorff (1972) and Southeastern Association of Governments (1979). Information presented in this section summarizes and updates the original consultant's reports found in Appendix Volume A-1.

2.4.1 Drainage Basin Characteristics

Portions of five perennial watersheds drain the Skyline project area reporting to Scofield Reservoir include the Eccles Canyon, Green Canyon, Winter Quarters Canyon, Woods Canyon (all tributaries of Mud Creek in the Price River Basin) and Upper Huntington Creek (a tributary of the San Rafael River) reporting to Electric Lake include Little Swens Canyon, Swens Canyon and Boulger Canyon. Channels draining the permit area form dendritic patterns, with stream channels of
the area flowing in all four major directions. All surface streams have been classified by the Utah Division of Health as follows:

- **1C** - protected for domestic use with prior treatment process,
- **2B** - protected for secondary contact recreation,
- **3A** - protected for cold water aquatic life, and
- **4** - protected for agricultural uses including stock watering.

Electric Lake has been classified as 2B, 3A, and 4 while Scofield Reservoir has been classified as 1C, 3A, and 2B.

Slopes on the permit area are steep, averaging approximately 31 percent. Dominant drainage aspects are to the west in the Huntington Creek Basin and to the east in the Price River Basin. The landscape varies greatly, with most of the permit area being covered with conifer and aspen vegetative communities.

Because of the climatological conditions of the area (high precipitation and low evapotranspiration resulting in excess water), there are numerous water sources in the Skyline project area. Most of these are undeveloped springs, seeps, and streams. The one notably developed water body located in the project area is Electric Lake, a 31,200 acre-foot reservoir whose upstream tip covers a portion of the southwest section of the project area in the Huntington Creek Basin. This reservoir is owned and operated by Utah Power and Light Company as a storage facility for water used at coal-fired power plants. Upstream of Electric Lake, Boulger Reservoir is primarily managed as a recreational fishery by the DWR. In the event Boulger Reservoir is undermined, mitigation of both the dam and reservoir will be done through prior consultation with the respective regulatory agencies. Drainage of the reservoir may be necessary during mining. Perennial sections of the streams are identified on Figure 4-1, page 2-41a.

The thick vegetative cover on the project area has resulted in a well-maintained soil of high organic matter content, thus developing a more open soil structure with high infiltration rates. As a result, the potential for runoff from a rainfall event on the project area is low. Thus, snowmelt produces most of the runoff from the area during periods when soils are frozen and/or saturated.
2.4.2 Flow Characteristics

The seasonal distribution of flows in the perennial streams draining the project area is typical of western high elevation, snowmelt streams, where the majority of the flow occurs within a relatively short period of time in late spring and early summer (April, May and June). Flows in Huntington Creek above Electric Lake can be expected to vary from 1 to 100 cubic feet per second while those of Eccles Creek above Mud Creek normally vary between 1 and 50 cubic feet per second and those in Mud Creek vary between 5 and 380 cubic feet per second.

The watersheds draining the project area yield an average of approximately 13.5 inches of water annually to the Price River Basin. However, because the relatively impermeable Blackhawk Formation underlies all of the Huntington Creek Basin above the southern boundary of the project area (either on the surface or directly beneath the surface member), the yield to the San Rafael River Basin is slightly higher (averaging approximately 16 inches per year).

A significant surface water quality sampling program has been conducted in Eccles Creek, Burnout Creek, Flat Canyon Creek, Boulger Creek, and Huntington Creek as well as Winter Quarters Creek, Woods Creek and others in a representative sampling of seeps and springs throughout the Skyline permit area. The following briefly describes the major water quality characteristics of the permit area.

Surface water in the Skyline project area is of a calcium bicarbonate type. Total dissolved solids concentrations in the area are generally lowest during the months of April through June when flows are highest and affected by the diluting effect of direct snowmelt. As flows decrease and the majority of the flow is derived from seepage of local groundwater systems, the dilution effect becomes less pronounced and dissolved solids concentrations tend to increase. As a result, the dissolved solids content of surface water in the area varies from less than 100 milligrams
per liter (headwaters of Huntington Creek during the high flow season) to slightly greater than 500 milligrams per liter (Eccles Creek during low flow conditions). Suspended solids concentrations in the area tend to vary proportionately with flow rate. During the snowmelt runoff season, concentrations are also naturally higher in Eccles Canyon than in the Huntington Creek drainage basin. Channel erosion, although relatively low throughout the area, appears to be more extensive in the steeper Eccles Canyon than in the Huntington Creek Basin and is probably the source of most of the increased sediment concentrations. Mud slides, when present, add considerably to the suspended solids concentration.

Hydrogen ion activity (pH) tends to be rather constant in the surface waters on and adjacent to the Skyline project area, varying normally between 6.5 and 8.6. The basic condition of the water with low acidity and high alkalinity indicates that acid drainage problems do not develop as a result of mining in the permit area.

Total and dissolved iron measurement values vary widely throughout the area, with the potential source being the iron contained in Blackhawk Formation cementing agents. Total iron, which varied in measurements from less than 0.01 to over 45 milligrams per liter during the observation period, tends to be somewhat directly related to the flow rate, and is associated with sediment loading. In contrast, dissolved iron tends to be much more constant.

Total manganese concentrations in the area were low, varying normally between 0.01 and 2.0 milligrams per liter with occasional higher concentrations associated with sediment loading. No distinct seasonal variations were noted.

The Burnout Creek area was the subject of a subsidence study directed by the U.S.F.S. A portion of the study included monitoring the flows in the stream biweekly and performing annual stream gradient surveys. Four surface water monitoring points were monitored in this
area and in the adjacent Upper Huntington Creek since 1981 as a part of the surface water monitoring program. Eight flumes, F-1 through F-8 (Plate 2.3.6-1) were installed and are presently being monitored as part of the modified subsidence study. However, only one flume, F-5, is currently part of the quarterly water monitoring program. Flume F-5 is the same sampling point as CS-7 of the quarterly water monitoring program. In general, stream flow rates were never found to be affected by the undermining of the creek. Portions of the mine works underlying Burnout were filled with water beginning in 2003. Water samples from all four monitoring stations are of a calcium-bicarbonate character. Chemical concentrations have remained relatively consistent through time.

Baseline concentrations of various constituents were normally well within the State of Utah standards for waters of the Skyline project area.

A summary documenting the water quality data in the mine area may be found in Volume 4.

Additional baseline data has been collected in the James Canyon drainage as part of the Burnout Canyon study. Flows have been obtained from flume F-9 since 1993 in James Canyon. This information is contained in Volume A-1, Hydrology. Laboratory Analysis was added to Stream Site F-10 due to the facilities associated with the construction of the JC-wells drill pad. Water quality samples collected since the early 80's and 90's from streams that have been undermined by the Skyline Mines (Burnout, Eccles, other tributaries of Upper Huntington Creek, Plate 2.3.6-1 and 2.3.6-1a) indicate water quality is not noticeably affected by underground mining activities.

Prior to March 1999, Skyline Mine discharged water to Eccles Creek at an average rate of approximately 350 gpm. From March 1999 through November 2002, the discharge rate gradually increased to between 9,500 and 10,500
The increase in discharge rate is related to increased ground water inflow to the Mine #2 area of the Skyline Mine. A flow of 10,500 gpm in Eccles Creek due to the increased mine discharge is approximately 42 times the minimum measured base flow (approximately 250 gpm) of Eccles Creek. The increased flow to Mud Creek of the 10,500 gpm of mine water discharge represents an increase of approximately 10.5 times the minimum measured base flow (approximately 1,000 gpm measured in 1981) at the USGS flow gaging station located below the confluence of Mud and Winter Quarters Creeks. The average daily flow of Mud Creek at the USGS gaging station from 1979 to 2001 is approximately 2,700 gpm. The mine discharge rate of 10,500 gpm is about 4 times average daily flow of Mud Creek.

The discharge to Eccles Creek diminished after July 2003 when the JC-3 well was completed by PacifiCorp. The JC-3 well was completed in the 10 Left area of the mine and pumps mine water to Electric Lake. The rate of discharge from JC-3 has varied between approximately 1,500 and 5,100 gpm. The rate of discharge to Eccles Creek after July 2003 has subsequently varied between 900 gpm and 6,000 gpm, dependant upon the operation of JC-3 and allowing of portions of the mine to flood. The anticipated changes to mine inflow volumes is discussed in greater detail in the July 2002 Addendum to the PHC, Appendix F and K.

An ongoing study of the effects of the increased flows on Eccles and Mud Creeks was initiated in the winter of 2001. EarthFax Engineering, Inc. was contracted with to establish six monitoring stations on Mud Creek and three on Eccles Creeks. The flow, water chemistry, stream channel morphology, vegetation are monitored at these sites for any significant changes that could be related to the increase in mine water discharge. Initial results of the study indicate that no significant effects have been noted at the monitoring sites due to increased discharges. However, the study will continue until the mine discharge volumes return to pre-
March 1999 levels. Data collected will be included in the mine's annual report.

In December 2009 as part of the UPDES water discharge permit renewal, an outfall (004) was added in Winter Quarters Canyon in anticipation of the Winter Quarters Ventilation Facility (WQVF) construction. The Outfall is permitted to discharge both storm water and mine water. A numeric hydrologic model using FlowMaster was conducted by Earthfax Engineering (Appendix A-1, Volume 2). The model indicated approximately 6,200 gallons per minute (gpm) could be added to Winter Quarters Creek without the velocity exceeding five (5) feet per second (fps). Velocities below 5 fps are considered non-erosive and should not impact the creek. In the event discharge from Outfall 004 routinely exceeds 6,200 gpm additional armoring to the outfall location, and investigation of the impacts to Winter Quarters creek will be initiated.

2.4.3 Sediment Yield

Prior to March 1999, the Skyline project area had a sediment yield which averaged approximately 0.44 acre-feet per square mile per year, based on methods developed by the Pacific Southwest Inter-Agency Committee (1968) (Volume A-1, Hydrology, page 49). This converts to a total annual yield of 1.25 acre-feet of sediment to the Price River Basin and 3.07 acre-feet of sediment to the San Rafael River Basin. The majority of this sediment is yielded as suspended sediment, with only a small fraction occurring as bedload. After March of 1999, the sediment yield to the Price River basin through Mud Creek increased by approximately 7%. This increase in load was determined by the Division using the results of TSS monitoring at Valley Camp sites VC-1 and VC-9 on Mud Creeks and Skyline site CS-6 on Eccles Creek. The Division calculated an average sediment yield for Eccles and Mud Creeks at 2,710 tons/year prior to March 1999 and 2,908 tons/year since March 1999 through June of 2002. The sediment yield will be monitored for Eccles and Mud Creeks and reported each year in the mine's annual report.

The suspended load in the stream flow of Eccles and Mud Creeks is being monitored as a result of the increased mine discharge. In addition to the stations already monitored on Eccles Creek as part of the existing monitoring program, six new sites have been added. These sites are MC-1, MC-2, MC-3, MC-4, MC-5 and MC-6. As discussed in the previous section, the sites are monitored for TSS. The first sampling of these sites occurred in June 2002 and the results reported to the Division. No significant increase to the TSS levels above background were noted during the initial sampling. (Site MC-5 is located on Mud Creek above the confluence with Eccles Creek and assumed to represent background).

In 2010 due to the addition of the Winter Quarters Ventilation Facility (WQVF) a variance of the 100 foot stream buffer zone was necessary. In consideration of the variance, the WQVF pad incorporated the following elements in the design to address sediment yield:

Revised: 3-24-10
- All disturbance is a minimum of two (2) stream widths from the stream eliminating a need for a Stream Alteration Permit.
- Drainage from the upper undisturbed road was improved to minimize storm runoff to the site.
- A sediment pond with associated UPDES permit has been designed that any storm water entering the site will be treated prior to discharge.
- ASCA’s 37 and 38 are established to treat disturbed area storm water runoff until vegetation is re-established and the sediment pond is operational.

2.4.4 Monitoring Program

The surface water monitoring program outlined in this section has been updated based on the findings and conclusions of the 1996 PHC by Mayo and Associates and as a result of a cooperative effort between the operator, the Division, and the Forest in an effort to better understand and monitor the effect of increased ground water inflows to the mine and mine discharge. It incorporates practices designed to provide the baseline data necessary to validate the determination of the probable hydrologic consequences of proposed and existing mining and reclamation operations. The program also is designed to meet site specific requirements and have the flexibility for change if necessary. Specific attention has been given to insure that proper upstream and downstream monitoring is included within the monitoring program for all disturbed areas, and that adequate sampling of potentially impacted flow regimes is completed. Selection of the monitoring sites was an arduous process using the following criteria. An original baseline survey or Hydrologic Inventory was compiled in 1979, utilizing data collected from 1974 through 1979, where all possible springs, seeps and streams were monitored. Additional water monitoring data was compiled for the North Lease area from 1991 through 1993, including the North Lease modification from 2011-2014. Following the completion of the inventory and consultation with both DOGM and the U.S. Forest Service (USFS), representative monitoring sites were selected. Important parameters included geologic unit, critical area where damage may occur, quantity of flow, reasonable year round access, and representative distribution. In the Mine #4 - Flat Canyon lease area, the original seep and spring surveys were conducted beginning in 1997, with almost continuous monitoring be conducted from 2006 through 2016. Operational monitoring locations were selected in conjunction with a PHC study conducted by Petersen Hydrologic, Inc. (PHC Addendum Volume 2 Appendix N) and DOGM personnel while acquiring the Flat Canyon lease.

A PHC study completed in 1996 entitled "Investigation of Surface and Groundwater Systems in the vicinity of the Skyline Mines, Carbon, Emery, and Sanpete Counties, Utah; Probable Hydrologic Consequences of Coal Mining at the Skyline Mines and Recommendations for Surface and

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Groundwater Monitoring" by Mayo and Associates, recommended some changes to the original monitoring plan. These changes were made by Mayo and Associates after a careful review of local hydrogeology, monitoring conditions, sampling parameters, and sampling data. The changes proposed by Mayo and Associates are considered valid and reasonable and are therefore incorporated herein. An evaluation of UPDES and waste rock disposal site monitoring stations were not included within the scope of work completed by Mayo, but continue to be an integral part of the water monitoring program.

A copy of the 1996 PHC evaluation is included within Appendix A-1 Volume 2 of this MRP. An update to the PHC, "Addendum to the PHC, July 2002" has also been included in this M&RP. Since the modifications to the PHC have taken place over time and conditions within the mine have changed, it should be assumed that where the most recent text conflicts with text in earlier modifications or original text, the latest supercedes the earlier.

Surface water monitoring programs are conducted at each of the appropriate stations identified in Tables 2.3.7-1, 2.3.7-2, 2.3.7-2A and 2.3.7-3 and shown on Drawings 2.3.6-1 and 2.3.6-2. Samples are collected quarterly, with the 1st Quarter (January-March) having a shortened list of sites due to inaccessibility during winter months. Also due to weather conditions, sampling in the 2nd quarter (April-June) can be conducted through July 15 in years when snowmelt conditions prohibit access prior to June 1. Baseline laboratory analyses is conducted during the 3rd Quarter (July-September) every five (5) years beginning in 2010 and successively in 2015, 2020, 2025, etc. In other than the stated years, 3rd Quarter sampling will be identical to 2nd and 4th Quarter laboratory analyses. 4th Quarter monitoring (October-December) should be conducted prior to December due to snow conditions eliminating access.

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Surface water stations in Eccles Canyon were sampled more frequently than those on Huntington Creek during the initial phases of mining.

With the addition of the Flat Canyon lease, a total of eight (8) stream sites were added to the water monitoring program to insure any impacts to the surface hydrology of the area were documented. The sites were primarily added in locations upstream of areas proposed for mining, with stream locations already being monitored downstream of the proposed areas to be mined. Sites added upstream of mining include Little Swens (CS-27), Swens (CS-28), Flat Canyon (CS-29), and Boulger above the reservoir (CS-30), respectively. To monitor tributaries of the prominent streams within the areas to be mined, flow-only sites were added to auxiliary tributaries in Swens (CS-35) and Boulger Creek (CS-32 through CS-34). The added sites provide additional sites to monitor any potential in-stream impacts.

As additional monitoring for the stream flows (and required in Special Stipulations for Coal Lease UTU-77114 #27), the stream gradient of perennial streams to be undermined will be monitored as outlined in Section 4.17.4 Mitigation of Subsidence Effects of the M&RP. Monitoring of the sections of perennial streams being undermined using longwall mining methods will be monitored both before and after mining takes place, with the information being added to Appendix A-1. The method of monitoring will include an on-ground survey using survey-grade equipment. Monitoring of the vegetation along the streams is also outlined in Section 2.7 of the M&RP if specific low-flow criteria are encountered.

Stream monitoring station CS-24 was added in Winter Quarters Canyon, with the addition of sediment pond discharge point UPDES-004 from the Winter Quarters Ventilation Facility. Stream site CS-24 is located downstream of the ventilation facility pad, and UPDES-004 represents the discharge from the pad site. Sampling frequency and analysis are located in Tables 2.3.7-1 and 2.3.7-2, respectively.

Stream monitoring station CS-28 was added in Swens Canyon upstream of the Swens Canyon Ventilation Facility. Site CS-16, located at the mouth of Swens Canyon, which previously had been reduced to field parameters-only analysis will return to 2nd-4th quarter lab analysis monitoring with CS-28. Refer to Tables 2.3.7-1 and 2.3.7-2 for monitoring details.

Stream monitoring station CS-25 was added in Woods Canyon as mining progressed east in Section 36, T12S, R6E. CS-25 is located downstream of any mining activity. In addition, nine (9) piezometers (WC-1 through WC-9N) were added in the canyon to monitor the near surface groundwater associated with Woods Canyon Creek.

Sampling will continue at all surface water stations throughout the post-mining period and until the reclamation effort is determined successful by the regulatory authority. Samples will also continue to be analyzed for the parameters outlined in Tables 2.3.7-1, 2.3.7-2, and 2.3.7-3 throughout the post-mining period, unless deletions in the list of parameters is determined to be appropriate.

Several monitoring stations were added to the monitoring schedule with the incorporation of the North
Lease Tract. CS-19 and CS-21 have been added to monitor the quantity and quality of the water in Woods Canyon Creek and CS-20 has been added to monitor the quantity and quality of the water in Winter Quarters Creek - monitoring both mining upstream and water quality upstream of the Winter Quarters Ventilation Facility (WQVF). CS-24 was added in Winter Quarters Creek below the (WQVF) to monitor any affects associated with the pad.

As part of the Skyline Mine subsidence monitoring plan, a total of 42 new water monitoring sites have been identified in the North Lease area (Plate 2.3.6-2 Table 2.3.7-2A). Sites NL-1 through NL-42 have been selected to monitor flows on the perennial reaches of both Winter Quarters and Woods Canyon drainages one year prior to, during, and one year following longwall undermining of the perennial section of stream. The sites will be monitored monthly in June through October. If inaccessible earlier than June or later than October, the mine will monitor the sites. The results of the monitoring will be reported with the other required monitoring data. The purpose of this monitoring is to determine the effects, if any, on the stretches of perennial streams in the Winter Quarters Creek and Woods Canyon Creek drainage that will be subsided due to mining. Monitoring points, in perennial reaches running perpendicular to the longwall panels, are positioned above the gate-roads and center of each panel. Longwall panels are approximately 850-feet wide, creating a flow-monitoring spacing of approximately 425-feet. Monitoring points in perennial reaches running parallel to the longwall panels are spaced at approximately 850-feet. Since monitoring is dependent on the timing of mining, monitoring points will be added and dropped as mining advances. As mining advances through the perennial sections of the drainage, and the monitoring indicates no affects to flow, the Permittee may modify the spacing of the monitoring points. This monitoring will also help indicate if mitigation is required for loss of surface or ground water and, subsequently, habitat associated with the water. The program was discontinued after the 2016 field season as mining in the 11-Left panel undermining Woods Canyon creek was completed in May 2015.

Skyline has conducted field studies to determine the location of the perennial portions of both Winter Quarters and Woods Canyon Creeks. The perennial nature of the streams were determined using a variety of parameters including vegetation and surface flow monitoring. Field studies were initiated and completed in October and November 2002 and October 2003. Copies of the studies are included in Volume A-1, Volume 2 Hydrology Section. The studies will be used by the Forest in their environmental assessment of the potential effects of undermining Winter Quarters and Wood Canyon Creeks. As mining progressed north of Winter Quarters Canyon, the longwall panels were rotated 90 degrees which extended mining further east. Agapito Associates, Inc. conducted an evaluation of the impacts to the surface based on extending mining to the east. The study indicated longwall mining can be safely extended to the east as outlined without having adverse affects to the surface. The study is located in Appendix A-1, Volume 2. Sampling will continue according to Tables 2.3.7-1, 2.3.7-2, and 2.3.7-3 as approved at all surface water stations throughout the post-mining period and until the reclamation effort is determined.
successful by the regulatory authority. Changes will be made to the monitoring program only when additions or deletions to the list of parameters and/or schedule is determined to be appropriate, and when approved by the regulatory agency.

In addition to the above outlined monitoring program, UPDES discharge permits have been acquired as necessary. Monitoring and operation of all surface water discharges are conducted in accordance with conditions of this permit. Discharges of water from disturbed areas will be in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining contained in 40 CFR part 434. A copy of this permit (UPDES No UT-0023540) is appended to Volume A-1, Hydrology Section. The monitoring locations are shown on Map 2.3.6-1.

As required, water quality data collected from the surface water monitoring stations will be submitted to the Utah Division of Oil, Gas, and Mining. Such reports will normally be submitted within 90 days of the completion of each quarterly monitoring program.

The Permittee conducted a search for seeps or springs in the downslope area west of the rock disposal site in the spring of 1984 and found no seeps or springs. Should surface flow occur, surface water monitoring will be carried out, though the exceedingly ephemeral nature of the water flows in the area will necessarily affect the frequency of sampling. The Permittee commits to the following surface water monitoring program when surface flow is present.

1. Four monitoring stations will be established: two stations on the drainage from the east and two sites on the drainage from the south.

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Stations will be located both above and below the rock waste disposal site in each of the drainages. (See Drawing 2.3.6-1.)

2. When flow is present, these stations will be monitored, when accessible, at the same frequency and for the same constituents as the stations in Eccles Creek. The data will be tabulated and reported in the same manner as the Skyline water quality data.

3. The data from these stations will be evaluated for non-point source contribution from ground water aquifers. This procedure offers the best potential for detection of ground water contamination.

The Upper O'Connar seam required a breakout to improve ventilation. The breakout is on a south facing slope in a side canyon of the South Fork of Eccles Creek (see map no. 3.2.11-1). A new road was built across this canyon to gain access to the breakout area. The conyon flows water in all but the driest of years. During construction, the creek was sampled above and below the site of a daily basis. The samples were tested for total suspended solids and settleable solids as n aid to regulating construction activities and in implementing control measures. Construction related solids fluctuations were encountered throughout this phase of the project.

The volume of water discharged from the mine increased significantly in August 2002 after large volumes of ground water were encountered within the mine. The mine was concerned about what effects the increased flows might have on Eccles and Mud Creeks. EarthFax Engineering, Inc. was contracted to perform a stream bank stability analysis on the streams using flows ranging between 5,000 and 30,000 gpm. The initial results of the report indicated that the stream banks would be stable at flows up to 30,000 gpm for short periods of time, but would compromise culverts at road crossings. Further study was requested by the Division and EarthFax was again contracted to continue the study of the effects on Mud and Eccles Creeks of sustained increased discharges from the Skyline Mine. The

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study will continue as long as the mine is discharging flows in excess of the pre-
September 2001 rates plus one year. Mine discharge decreased below a sustained
5,000 gpm in December 2003. The last update was submitted with the 2006 Annual
Report. The study consisted of the following:

Reference sites were established on Eccles and Mud Creeks corresponding to cross
sections used in previous investigations (EarthFax Engineering, 2002) and were
monitored from 2002 through 2005. The reference sites were established in general
conformance to the recommendations of Harrelson et al. (1994). This involved the
following:

- Establishing benchmarks at each site. Benchmarks will consist of cement
  or boulder monuments, with a metal marker stamped with the site number.

- Establishing monumented cross sections. The endpoints of cross sections
  will be marked with roof bolts or steel reinforcing bar that has been
driven into the ground. These bars will be painted to increase
  visibility.

- Surveying the channel at each site. Surveying will be performed using a
  level and survey rod, with both the cross section and longitudinal profile
  of the stream being surveyed.

- Establishing photo points. As recommended by Harrelson et al. (1994),
  convenient locations will be selected to take photographs
  upstream, downstream, and across the channel at each cross section
  location.

- Collecting streamflow data. The flow will be measured at each site,
  using standard procedures, with a rotating-cup flow meter. Indicators
  of bankfull stage will also be gathered.

Samples of the bed and bank materials were collected at the newly established
stations to evaluate geomorphic and stability relationships at those locations.
Similar samples were collected in February 2002 at the remaining sites (EarthFax
Engineering, 2002) and are still considered valid.
The depth to groundwater was determined at each of the reference sites. In areas where the flood plain is narrow (along all of Eccles Creek and the upper portion of Mud Creek), this was accomplished with one temporary piezometer installed in the alluvium adjacent to the stream. The piezometer was installed using portable flighted augers and a hammer drill. Perforated PVC pipe was installed in the hole and the water table allowed to stabilize for a period of at least 4 hours prior to measuring the depth to water. The relative elevation of the piezometer was established by standard surveying techniques from the previously-established benchmark at each site.

Flow data on file with the U.S. Geological Survey was gathered for Eccles Creek near Scofield, Utah (station 09310600) and for Mud Creek below Winter Quarters Canyon at Scofield, Utah (station 09310700). The data were provided to the Division in electronic form.

Historic aerial photographs were gathered of Pleasant Valley between the town of Scofield and the confluence of Mud Creek and Eccles Creeks. Both private sources (on file with aerial photography companies) and government sources (USDA, USGS, EROS) were searched. These photographs were evaluated to assess historic land use in this reach of Pleasant Valley. This information, together with the additional data collected as part of this study, were used to evaluate whether or not Pleasant Valley could be classified as an Alluvial Valley Floor. The Division used this study along with the EarthFax Eccles and Mud Creek study and made a determination that portions of Pleasant Valley could be considered alluvial valley floor but the increased discharge from the mine would not have a significant impact on the valley sediments or vegetation.

Water-quality samples are collected at the monitoring points. In addition to the collection of flow data as indicated in Section 2.1, these samples are analyzed for total dissolved solids (TDS), total suspended solids (TSS), and total phosphorus.

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these samples are analyzed for total dissolved solids (TDS), total suspended solids (TSS), and total phosphorus.

As field information is gathered, sufficient data will be gathered to determine the bank erodibility hazard (Rosgen, 1996; 2001) for each reference site. These data will include measurements of the following values:

- Bank height
- Bankfull depth
- Rotting depth
- Root density
- Bank slope
- Degree of surface protection of the bank

The in-stream velocity gradient (between the core of maximum velocity and the stream bank) and the ratio of average hydraulic stress and near-bank hydraulic stress will also be calculated. Each of these indexes will be compared with typical values provided by Rosgen (1996; 2001) to provide another assessment of bank stability in addition to that provided previously (EarthFax Engineering, 2002).

Flow and water-quality data (TDS, TSS, total phosphorus) are collected at the monitoring points on a seasonal basis and will continue to be until one year following a sustained reduction in mine-water discharge to a rate of 5,000 gpm or less (i.e., pre-September 2001 levels). Channel cross sections and longitudinal profiles will be collected from each reference site annually during the same period. The study was discontinued after the 2006 data collection and report.

The study was re-established in 2015 based on two (2) reasons. Following the 2006 survey, no appreciable changes had been noted from 2003 – 2006. Base flows from 2006-2015 have consistently ranged from 2000 – 5000 gpm, and the Mine wanted an update on the stability of the channel. Also, with the addition of Flat Canyon lease UTU-77114 there is a potential for increased discharges from the Mine. The 2015 survey indicated the mine discharge had no significant erosional impact to the morphology of the stream channel. On the contrary, the channel showed aggradation at all three (3) surveyed locations. Using Rosgen (1996) criteria, Earthfax calculated in their 2001 report that the bankfull discharge of approximately 15,000 gpm is the most effective in channel maintenance. The Earthfax October 2001 report also indicated that infrequent flows of 30,000 lending support to the initial prediction that the creek can safely handle 30,000 gpm is correct (See Appendix A-1 Volume 1 for the Earthfax report). To be consistent with previous reports, annual surveys will be conducted if sustained mine discharges are in excess of 7,500 gpm. The flow rate increase from 5,000 gpm to 7,500 gpm for initiating was a collaborated decision between the Division and Mine personnel based on the aggradation of the monitored stations over the 10+ years between surveys and information from the 2001 Earthfax report. These surveys will be submitted in the respective Annual Report.
LEGEND

• PERENNIAL STREAM EXTENT (GPS Fall 2015)
• PERENNIAL STREAM EXTENT NO27 (GPS Fall 2015)
• DRAINAGE
• FLAT CANYON COAL LEASE TRACT

NOTES:
1. COORDINATE BASE ON UTM GRS 1980
2. DRAINAGE BASE PREPARED BY INTERSTATE SURVEYS, SALT LAKE CITY, UT
3. SEE PLATE 1.6 FOR PERMIT AND ADJACENT AREAS

Flat Canyon Coal Lease Watershed Boundaries and Perennial Stream Reaches

Canyon Fuel Company, LLC Skyline Mines

INTEGRATED

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LITERATURE CITED


2.5 HYDROLOGICAL IMPACTS OF MINING ACTIVITIES

Presented in the following subsections are summaries of the hydrological impacts of the mining activities of the Skyline project. The details backing the conclusions stated in this section and supplemental discussion can be found in the PHC evaluations included as part of this section, and within the Hydrology Section of Appendix Volume A-1 Volumes 1 and 2. Details of the consultant's flow calculations may be found in the flood plan calculations also in Appendix Volume A-1. The PHC was also updated in July 2002 October 2002, April 2003, and June 2004 and 2016 by the addition of the Addendum to the PHC associated with the drilling of the wells in James Canyon, the significant inflows to Mine #2, and the ground water model prepared by HCl, including updates to much of this information in 2016 with the addition of the Flat Canyon Lease. Additional PHC supporting studies for both the North Lease modification and the Flat Canyon Lease are located in Addendum to the Probable Hydrologic Consequences – Volume 2, Appendix L through R, respectively.

The potential hydrologic impacts discussed herein represent the latest information available and, generally, correspond to the consultant's original report. (See General Hydrologic Consideration Related to Coal Development and Subsequent Impacts, Vaughn Hansen Associates, February 1981, found in Appendix Volume A-1. Updated analyses of the "Probable Hydrologic Consequences" reflecting all current data are appended to this section.

- **Exhibit A of Section 2.5,** "Probable Hydrologic Consequences of Mining at the Skyline Mines, Carbon and Emery Counties, Utah"; prepared by Earthfax Engineering, Inc., Salt Lake City, Utah; dated September 30, 1992.
- **Addendum to the Probable Hydrologic Consequences, July 2002 (James Canyon Update - further updated in October 2002, April 2003, and June 2004).**

2.5.1 Potentially Affected Water Rights

Surface and groundwater rights in the general project area are primarily for stockwatering and irrigation. Stockwatering rights are located almost entirely and directly on the streams. The nearest irrigation rights are centered around the two areas of Scofield and in Flat Canyon, southwest of the permit area. Irrigated lands consist primarily of pasture. The pastures identified in Flat Canyon are located primarily west of proposed mining, and due to the glacio-lacustrine sediments deposited there, affects to the water rights are not anticipated. The pastures identified in Flat Canyon are located primarily west of proposed mining, and due to the glacio-lacustrine sediments deposited there, affects to the water rights are not anticipated. Only stockwatering rights are present in the Skyline permit area. A limited number of wells are located in the general area, none of which are located directly on the property or within the permit area. Recent large mine inflows to Mine #2 has resulted in concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As discussed in the July 2002 Addendum to the PHC (modified in October 2002, April 2003, and June 2004), the Star Point does not transmit water easily. Fractures within the Star Point in the mine area has allowed the sandstone to begin dewatering by discharging to the mine. The Star Point does not appear to have a significant discharge point located immediately down gradient of the mine. Indeed, the age of...
the water in the sandstone suggests it takes several thousand years to move through the aquifer in spite of the high transmissivity of the fractures within the sandstone. Therefore, it is unlikely any surface or ground water rights are being adversely affected. Because it is not certain that the ground water discharges into the Huntington Creek drainage, there is no evidence that water is being removed from that drainage to Eccles Creek, part of the Price River drainage. Tritium analysis of the water in the 10 Left area of Mine #2 and water from the James Canyon well JC-1 indicates a minor amount of modern water is being pumped from the well and the mine. However, this water is not necessarily originating from Electric Lake. Therefore, there does not appear to be a significant volume of surface water being transferred between drainage basins.

Mine #4 Flat Canyon Lease Area
Prior to acquiring the Flat Canyon Lease, studies were conducted to evaluate whether any impacts to water rights had occurred in the 1999-2014 within the Upper Huntington drainage associated with mining of the Skyline #1 and #2 mines. PHC Addendum Appendices N through R investigate both the effects to the active-zone groundwater and surface-water systems in the Flat Canyon Tract, and the inactive-zone groundwater conditions in the Star Point Sandstone in the vicinity of Skyline Mine. This is in addition to baseline water quality data included in Appendix A-1, Volume 2. The studies are updates to information provided in 2002 through 2005 that evaluate both the characteristics of the fault-related groundwater inflows encountered in the mine, and the numeric groundwater model of the area. The studies reaffirmed there are no apparent adverse effects to existing water rights. Based on the information provided in the studies, the Flat Canyon lease can be mined without adverse impacts to existing water rights which exist within the active-zone groundwater and surface-water hydrologic system. This is also supported by the quarterly monitoring data submitted to the Division.

In the event existing State water rights are confirmed to be impacted during mining activities conducted west of Electric Lake in the Mine #4 area, the Mine is committed to replacing any impacted delivery of water while mining is conducted. It is noteworthy to mention that the JC-1 well has delivered approximately 500 ac-ft. of water per month to Electric Lake since about 2005 in the absence of any water rights being impacted by mining. Methods of water delivery may include mine-water discharge to the surface in the Huntington Creek drainage (assuming water quality standards are met), completion of a well similar to the JC-1 well to intercept water prior to entering the Mine, or any other best technology currently available (BTCA). Any method of water delivery will be done in consultation with the Mine, UDOGM, Utah Division of Water Rights, and U.S. Forest Service personnel.

2.5.2 Mining Impact on Water Quantity

Due to the high shale content of the Blackhawk Formation, recharge to the deep groundwater system through the Blackhawk Formation is slow. Fractures in the formation seal readily due to swelling of the bentonitic shale when wet. As a result, the impact of mining (including subsidence) on the quantity of water in the permit area will be minimal. This has been verified through the results of the subsidence study in Burnout Canyon. (A discussion of the mining impacts on the aquatic resources may be found in Section 2.8.) The Burnout Canyon study resulted in the determination that no significant impacts had occurred to the stream drainage as a result of mining induced subsidence. While the gradient of the stream was flattened in a few locations and slightly increased in others, the overall change in the stream morphology was not significantly different than changes that occur in
similar stream systems naturally. Biweekly flow monitoring and aerial photographic surveys continue each year as mining continues in the area. Additionally, three years of macroinvertebrate studies and two years of fish population surveys have been conducted starting in 2000. These studies are described in greater detail in Section 2.8.1.

The purpose of the Burnout Canyon study was to determine the impacts of undermining perennial streams in the Skyline Mine area. The intent of the study was to determine if significant impacts would occur by undermining the Burnout stream and, if no significant impacts occurred, then the Forest would consider allowing the undermining of perennial streams with similar geologic and geomorphic conditions to occur. Skyline Mine intends to undermine Winter Quarters Canyon based on the positive results of the Burnout Canyon study. Skyline has collected or committed to collect additional baseline data necessary to adequately monitor environmental parameters possibly affected by subsiding Winter Quarters Canyon.

When subsidence occurs, the subsidence cracks tend to seal rapidly, preventing the deep percolation and subsequent loss of water previously destined for springs and other water sources. The location of a spring may change by a few feet, but no significant loss of water is anticipated. The sealing of potential cracks will be accelerated where subsidence occurs under stream bodies, due to the natural deposition of silt in the stream channel along with the swelling of the shale.

Although the Blackhawk Formation contains partially or completely saturated sandstone channels above the proposed mine workings, a relatively small quantity of water is being encountered in the mine due to the impermeable nature of the formation, which limits the recharge rate and the ability of the rock to readily yield water. Ground water within the Blackhawk formation above the mine workings was determined in the 1996 PHC to be found within highly localized perched aquifers. The 1996 PHC evaluation failed to locate a regional ground water aquifer within the immediate area. The relatively small quantity of water being encountered in the mine was believed due to 1) the general impermeable nature of the formation, which limits the recharge rate and the ability of the rock to readily yield water, and 2) the local nature of local perched aquifer systems.

The inflow to the mine had been less than 100 gallons per minute per active face, with mine entries generally dry approximately 100 to 200 feet up-dip from the face. Some roof bolt holes, however, continued to flow up to 2 GPM for an extended period of time. However, in 2002 a fractured
Channelized sandstone was encountered during mining of the southwestern permit area which produced approximately 1,400 gpm. This was repeated at several locations in areas of Mine #2 until the mine was discharging approximately 8,500 to 9,500 gpm in August 2002 and 9,000 to 10,500 gpm in October 2002. Even though the large inflows have significantly subsided since October 2002, the near future mining activities have been directed toward the North Lease area.

The PHC for the Skyline Mine was updated by an Addendum to the PHC dated July 2002 and further updated in October 2002, April 2003, and June 2004. The addendum contains significant information regarding the large inflows to the mine. To better understand the hydrologic system and the water within the Star Point Sandstone, Skyline Mine contracted with Hydrologic Consultants, Inc. of Lakewood, Colorado produce a ground water model of the Star Point Sandstone. This model endeavored to delineate the possible areal extent of the aquifer, the volume of water contained in the aquifer, and the potential sources and discharge locations of the aquifer. The model has been used to help determine what, if any, impacts are occurring to the waters available in the mine area, including State appropriated water rights. The model was completed and improved in June 2004 and a copy of the report describing the results of the modeling effort has been added to the PHC.

As described in the July 2002 Addendum to the PHC, draining of the ground water contained within the Star Point Sandstone does not appear to have a significant impact on discharges of ground water in the mine or adjacent area nor does it appear that the water entering the mine is causing a loss of surface water in the Huntington or Price River drainages. The majority of the flows into the mine enter through faults and fractures that trend generally north-south to northeast-southwest. The flows move up through the floor of the mine in almost all cases. The water is apparently stored in the Star Point Sandstone under significant potentiometric head. Ages of the water indicate that water moves very slowly through the Star Point system in spite of the fractures and faults that appear to be open enough to allow water to flow freely into the mine in isolated locations. This suggests that the aquifer does not have a discharge point that releases large volumes of water nor is the aquifer replenished at a high rate of inflow. While the Star Point is exposed in out crop north, south, and east of the mine, significant volumes of water would need to be entering the system at an elevation great enough to create the potentiometric head encountered in the Star Point beneath the Mine #2 workings. Plate 2.3.4-2 illustrates changes to the potentiometric surface of the regional aquifer as result of extracting water from the mine from 2001 through 2013. During that period, the potentiometric surface has changed very little. The plate, in conjunction with studies by Petersen Hydrologic, Inc. (PHC Appendix M) suggest Skyline continues to monitor stream flows in Winter Quarters, Woods, Huntington, Eccles, and Mud Creeks to identify any impacts if they occur in these drainages related to the mine inflows. Plate 2.3.4-2 illustrates changes to the potentiometric surface of the regional inactive Star Point Sandstone aquifer as result of extracting water from the mine from 2001 through 2016. During that period, the potentiometric surface has changed very little while even showing a small recovery. Section 2.3.4 discusses qualifiers of using the potentiometric surface to complex geologic conditions.

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No springs or water production wells in the mine permit or adjacent areas have reportedly been negatively impacted by the large mine inflows. There has been some concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As stated previously, this is discussed at length within the July 2002 Addendum to the PHC.

Water encountered in the mine is either utilized underground as processed water or is pumped from the mine. Procedures for handling of mine water are discussed in detail in Section 3.2. Indigenous water associated with the coal will be removed from the area. This, however, will represent only a small fraction compared to the water flowing from the Wasatch Plateau. The water pumped from the mine is added to the flow of Eccles Creek and into Electric Lake and has a positive effect on the aquatic flow systems.

The construction of surface facilities utilized in conjunction with the Skyline Mines (yard areas, roads, conveyor lines, etc.) resulted in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control measures be provided for all areas of surface disturbance, concentrations of suspended material were significantly reduced. Minimization efforts, however, met with varying degrees of success.

Sediment control structures such as sediment ponds, Alternate Sediment Control Areas (ASCAs), and Special Exemption Areas (SEAs) are discussed in detail in Section 3.2 - Components of Operations, subsections 3.2.1 and 3.2.12, respectively. Following construction, areas such as extensive outslopes of roads and ponds, sediment control will be managed by temporary devices such as silt fences, straw bales, wattles, or vegetative matting until vegetation is established.

Implementing the sediment control structures listed above, minimal to no adverse effects to the hydrologic balance are anticipated with the construction of the Swens Canyon Ventilation facility.

Over long periods of time, groundwater in the Wasatch Plateau can be expected to flow towards the lowlands if not removed, passing through saline shales and emerging to augment streamflow with a dissolved solids content that significantly exceeds the concentrations found in the headwaters area. Because the Skyline Mines will act as interceptor drains, the groundwater that is brought to the surface from the mines has a much lower dissolved solids content than would have existed if the water was to continue its downward movement through shaley layers. Thus, the mines will have some beneficial impact on the chemical quality of water in the region.

The increased stream flow resulting from mine discharges, particularly during the summer low flow period, appears to benefit the Eccles Creek fishery by creating flow and temperature stabilization. The increased flows to Scofield Reservoir most likely benefitted the fish population in the lake by maintaining a sufficient level of dissolved oxygen to avoid a general fish kill that frequently occurs in the lake during periods of drought periods, such as has been occurring in the mine area since 2000. The mine has also been discharging large volumes of water since August 2002 with TDS concentrations only slightly higher than background levels. This good quality water flows to and is

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**Mine #4 Flat Canyon Lease Area**

In preparation of acquiring the Mine #4 Flat Canyon Lease area, additional investigations were conducted to evaluate impacts to both the active-zone groundwater and surface water systems of the Flat Canyon Tract, and the groundwater conditions in the Star Point Sandstone in the vicinity of the Skyline Mine. Appendix N – Investigations of Groundwater and Surface-Water Systems in the Flat Canyon Tract and Adjacent Area; Probably Hydrologic Consequences of Coal Mining in the Flat Canyon Tract, Sanpete County, Utah, utilizes multiple years of data to demonstrate minimal effects to the hydrologic balance are anticipated to both the quality and quantity of the near-surface, active-zone groundwater and surface waters due primarily to the geology, and based on over 30-years of mining in the area. The potential for loss of surface waters to the deep groundwater system are minimal based on 1) overburden thicknesses greater than 1,000 feet, and 2) the underlying bedrock formations have low permeability, are lenticular, and discontinuous. PHC Addendum Appendix O and P (Petersen Hydrologic, Inc. 2016 and 2017) reinforce previous studies that indicate the primary source of the water encountered in the floor of the mine is from a large inactive, body of water, fed by faults that have the ability to draw water from a significantly large area, transporting the water using a system of regional faults. This is dual-porosity hydraulic conductivity is demonstrated in how the local potentiometric surface does not continue to draw down with pumping, yet shows relatively good recovery when pump water from the mine is reduced.

The availability of groundwater and surface waters should not be impacted by mining in the Flat Canyon tract when considering 1) the water monitoring data in the Star Point Sandstone and Blackhawk Formation, 2) reviewing the stable and unstable isotopic analysis, 3) the Microscopic Particulate Analysis (MPA), 4) the aquifer temperature data, and 5) the chemical data, Appendix P (PHC Addendum Volume 2) provides an updated detailed discussion of these criteria. The evaluation of the information continues to suggest the active-zone, near-surface groundwater system (primarily of the Blackhawk Formation) and the inactive-zone deep, groundwater system (Star Point Sandstone) are not in direct communication, with water in the Star Point Sandstone having a residence time measured in thousands of years. The water monitoring of the active-zone surface springs and streams have shown no sign of impact while the water encountered in the mine continues to indicate the water discharged is thousands of years old. As an additional qualifier stated in PHC Appendix N, the groundwater storage reservoir for the Star Point Sandstone is more than 1,000 feet thick, and covers a minimum of 36 square miles in the vicinity of the Mine. Although approximately 3.4 billion cubic feet of water has been discharged from the mine, it theoretically represents approximately a 22-foot thick sandstone portion of a sandstone 1000-feet thick.

As mining continues in Mine #4 west of Electric Lake and further down-dip in the Blackhawk Formation, it is likely mining will encounter water as fault-zones are encountered. Similar to conditions observed in Mine #2, these fault-zones can often act as a conduit for water from the inactive Star Point Sandstone to enter the mine. “In some cases, the fault plane and any associated damaged zones can facilitate the movement of water along these structures. In other instances, particularly where faults intersect clay-rich strata, the potential for groundwater movement through the fault and its associated fault gouge is low (Petersen Hydrologic, 2017).” Mining experience has demonstrated that a fault can be drilled or mined through numerous times. In anticipation of this inflow of old-age water (noted in Table 1, Appendix P), mine personnel have engineered a pumping system to manage up to approximately 15,000 gpm of discharge.
The 15,000 gpm is based on inflows experienced in Mine #2 where a maximum inflow was approximately 8,000 gpm. Being further down-dip the Star Point Sandstone increased inflows are anticipated. Prudent engineering suggested a doubling of the highest inflows thus far encountered were appropriate. It is noteworthy that mine-water discharges from the Mine #2 area have declined substantially from more than 8,000 gpm in early 2003 to less than 2,000 gpm in 2016. Although there are other contributing factors such as flooding much of the workings, the lowering likely reflects a local lowering in the hydraulic head of the Star Point Sandstone groundwater system (Petersen Hydrologic, 2016). The U.S.D.A. Forest Service (2002) suggests that the mechanics of the Star Point Sandstone groundwater systems are not well understood. Within the Star Point Sandstone, groundwater flow occurs primarily where the sandstone bedrock is significantly fractured or faulted. In areas of unfractured Star Point Sandstone, discharge from the bedrock as springs is rare, and major springs are only associated with fault systems (Bills, 2000). This is evident in the JC-1 and JC-2 wells where JC-1 is a smaller well yet pumps significantly more water from a fractured zone, while JC-2 completed in the unfractured Star Point Sandstone produce only a fraction of the water. However, the 13+ years of pumping from this groundwater system has had minimal effect on the local potentiometric gradient (illustrated on Plate 2.3.4-2), suggesting additional pumping from this system in Mine #4 will not depressurize the system sufficiently to change the confined aquifer characteristics significantly. Refer to Section 2.3.7 (Water Monitoring Program) for added in-mine and Star Point Sandstone water monitoring commitments.

Water pumped from the inactive Star Point Sandstone should not impact the water quantity and water quality in streams and groundwaters discharging from springs and seeps from the shallow active-zone groundwater systems in the Blackhawk Formation. Appendix P details the characterization of the Star Point Sandstone as an inactive aquifer that has not been in communication with surface waters for thousands of years. This is documented with the radiocarbon dating of in-mine waters. Similarly, the nearest proposed Flat Canyon Tract underground workings are located more than 1.5 miles northwest of locations near the dam where Star Point Sandstone bedrock is mapped beneath the reservoir. As described above, the deep, inactive-zone groundwater systems typically intercepted in the Skyline Mine underground workings are not believed to be in good hydraulic communication with overlying shallow groundwater systems. For these reasons, it is anticipated that mining in the Flat Canyon Tract will not appreciably impact shallow groundwater systems that may be present that are associated with the presence of the Electric Lake surface water body (i.e. it is considered unlikely that shallow groundwater systems near Electric Lake will be in good hydraulic communication with the deep, inactive-zone groundwaters that are anticipated to be intercepted in the proposed underground Skyline Mine workings in the Flat Canyon Tract. Further, it is considered unlikely that the Electric Lake water surface would provide a constant head source for the deep inactive-zone groundwater systems in the Flat Canyon area) (Petersen Hydrologic, 2017).

As discussed in Section 2.3.4.5 Aquifer Characteristics of the Mine #4 Flat Canyon area, due to the complex geologic system in the area the potentiometric gradient is difficult to determine (Pate 2.3.4-2). It is noteworthy to mention that due to the age of the water encountered in the Star Point Sandstone, there is no significant modern use of the water. Otherwise the water that is thousands of years old would be getting replaced with modern water. However, since the Mine induces communication with the Star Point Sandstone its impacts to the surface and near-surface groundwater system has been considered. Plate 2.5.2-2 (Mine Pools Current (2016) and Estimated Final) illustrates the projected gradient of the Star Point Sandstone.
aquifer both currently and at closure. Elevations of the mine-pools are based on a combination floor elevations and groundwater elevations of wells completed in the Star Point Sandstone. Pool volumes were calculated to hold approximately 9,192.6 ac-ft in Mine #3, 4,243.4 ac-ft in Old Mine #3, 6,195.5 ac-ft in Mine #2 and 11,884.2 ac-ft in Mine #4, respectively (See Appendix S for calculations). Also included on the plate are the elevations of the mine openings to the surface. Current projections indicate Mines #2 and #4, when flooded at closure will fill to an approximate elevation of 8,500 feet which is below both the Swens Canyon Vent Shaft (elev. 8,710-ft) and the Mine portals (elev. 8,573-ft). The Mine #3 workings (both ‘Old Mine #3 and current) will fill to elevations of approximately 8,200 feet and 8,100 feet, respectively which is below both the Winter Quarters and Mine site portals. Based on these projections the flooding of the mine workings with Star Point Sandstone water will have minimal impact to the pre-mining flow path and surface hydrology. Moreover, with the inactive groundwater zone having no communication with the surface hydrology, no impacts to water quality are anticipated.

Also in conjunction with acquiring the Flat Canyon lease, the numeric groundwater modeling exercise that was initially conducted in 2002 through 2004 was reevaluated in 2016 (PHC Addendum Volume 2 – Appendix R). As a preface to the numeric groundwater model update, Appendix Q provides a general outline of the purpose, scope, and qualifiers of the more detailed numeric model that follows. The purpose of the initial modeling exercise was to determine whether all of the groundwater being encountered in the mine during that time could be sourced from the Star Point Sandstone. A primary caveat being that a typical numeric groundwater model initially creates a ‘pre-inflow’ steady-state conceptual model based on a well-defined aquifer, then models the transient model based on drawdown (or inflow data). Although drawdown/inflow was actively happening during the conceptual phase, the modeling exercise determined it was possible for all the inflow being encountered to be sourced from the underlying Star Point Sandstone; although the results were considered non-unique. From 2003 through 2015 significant portions of Mine #2 were allowed to flood to elevations of 160-300 feet above major mine inflow locations. During that time, in conjunction with the inundation of the mine workings, mine inflows decreased from approximately 4,000 gpm to less than 2,000 gpm, and the monitoring wells in the Star Point Sandstone showed some recovery. Using the original conceptual model with updated inflow and well data, the July 2016 update of the groundwater flow model (PHC Appendix R), was recalibrated. Although the model was updated with approximately another decade-worth of data, the ability to define a complex, hydrologic system with a limited number of monitoring locations is difficult. The 2016 model update suggests part of the observed recovery of the Star Point Sandstone is generated from a near-surface source. Two (2) scenarios for the recharge source are suggested: 1) water originating from the ‘vertical recharge through the South Gooseberry fault from the shallow groundwater system’, or; 2) water from ‘Electric Lake, via a splay of the Diagonal Fault’. Ultimately, the source of the recharge and its mechanism is not clear. The modeling conclusions suggested the transient calibrations of both scenarios calibrated equally as well, and a combination of the two sources may be the most likely scenario.
No springs or water production wells in the mine permit or adjacent areas have reportedly been negatively impacted by the large mine inflows. There has been some concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As stated previously, this is discussed at length within the July 2002 Addendum to the PHC.

Water encountered in the mine is either utilized underground as processed water or is pumped from the mine. Procedures for handling of mine water are discussed in detail in Section 3.2. Indigenous water associated with the coal will be removed from the area. This, however, will represent only a small fraction compared to the water flowing from the Wasatch Plateau. The water pumped from the mine is added to the flow of Eccles Creek and into Electric Lake and has a positive effect on the aquatic flow systems.

The construction of surface facilities utilized in conjunction with the Skyline Mines (yard areas, roads, conveyor lines, etc.) resulted in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control measures be provided for all areas of surface disturbance, concentrations of suspended material were significantly reduced. Minimization efforts, however, met with varying degrees of success.

Sediment control structures such as sediment ponds, Alternate Sediment Control Areas (ASCAs), and Special Exemption Areas (SEAs) are discussed in detail in Section 3.2 - Components of Operations, subsections 3.2.1 and 3.2.12, respectively. Following construction, areas such as extensive outcrops of roads and ponds, sediment control will be managed by temporary devices such as silt fences, straw bales, wattles, or vegetative matting until vegetation is established. Implementing the sediment control structures listed above, minimal to no adverse effects to the hydrologic balance are anticipated with the construction of the Swens Canyon Ventilation facility.

Over long periods of time, groundwater in the Wasatch Plateau can be expected to flow towards the lowlands if not removed, passing through saline shales and emerging to augment streamflow with a dissolved solids content that significantly exceeds the concentrations found in the headwaters area. Because the Skyline Mines will act as interceptor drains, the groundwater that is brought to the surface from the mines has a much lower dissolved solids content than would have existed if the water was to continue its downward movement through shaley layers. Thus, the mines will have some beneficial impact on the chemical quality of water in the region.

The increased stream flow resulting from mine discharges, particularly during the summer low flow period, appears to benefit the Eccles Creek fishery by creating flow and temperature stabilization. The increased flows to Scofield Reservoir most likely benefitted the fish population in the lake by maintaining a sufficient level of dissolved oxygen to avoid a general fish kill that frequently occurs in the lake during periods of drought periods, such as has been occurring in the mine area since 2000. The mine has also been discharging large volumes of water since August 2002 with TDS concentrations only slightly higher than background levels. This good quality water flows to and is...
stored in Scofield Reservoir. The water stored in Scofield Reservoir is used for culinary and irrigation purposes in Helper, Price, and Wellington, Utah. The State Engineers office in Price, Utah indicated that without the additional discharge from Skyline Mine to the Price River drainage, the reservoir would have been at a dead pool level in late August of 2002, thus cutting short the irrigation season downstream.

Similarly, discharges to Electric Lake will be an overall benefit to the water users on Huntington Creek. The discharge of high quality water from mine dewatering wells JC-1 and JC-3 will increase the volume of water in Electric Lake, provide additional cooling water for the Huntington Power Plant, and provide additional irrigation water for agricultural uses in Emery County. Without the additional discharge of water to Electric Lake from the James Canyon wells, it is possible that in the summer and fall of 2003, the Huntington Power Plant would need to significantly scale back the production of electrical power due to insufficient cooling water. A reduction in power generation from the plant would have significant economic impacts on Carbon and Emery Counties from the loss of jobs and an increase in power rates for consumers of power generated by PacifiCorp.

The completion and operation of JC-3 will not result in an overall increase of mine water discharge from the Skyline Mine. Operation of the well will decrease the amount of mine water discharged to Eccles Creek and result in additional water discharged to Electric Lake.

The large volume of ground water inflow to the mine has resulted in the mine discharging significantly greater volume of water than were initially anticipated when the mine was planned and opened. The current mine UPDES permit was written when flows were expected to be less than 1000 gpm and limits on total dissolved solids (TDS) were created based on this volume of flow. A 7.1 ton/day limit of TDS was assigned to the mine with a maximum TDS concentration of 1310 mg/l TDS. It was not unusual for the mine, prior to March 1999, to discharge water with 1000 mg/l TDS. However, after the large inflows into the mine were encountered in March 1999, the volume of water discharged increased steadily and the concentration of TDS decreased. Also at that time, the mine began to have trouble passing the chronic Ceriodaphnia dubia toxicity test required by the UPDES permit. It was determined through extensive testing that the toxicity test was failed due to a slight increase in the nickel concentration in the water. The toxic limit of dissolved nickel concentration appeared to be 15 ug/l or greater and the water discharged from the mine in late 1999 until the end of 2001 contained a maximum of 42 ug/l dissolved nickel. These concentrations of dissolved nickel are well below drinking water standards. The significant inflow to the mine from the 10 Left area and changes of how water was handled underground resulted in a decline in TDS and dissolved nickel over time. As a result,
day limit or the mine would discharge less than 7.1 tons per day of TDS if the water had a TDS concentration greater than 500 mg/l.

A UPDES permit was obtained by PacifiCorp to operate the JC-3 mine dewatering well in James Canyon. This well will discharge high quality mine water to Electric Lake. However, since it is mine water, Skyline will be obligated under SMCRA to assure the quality of the water discharged is within the UPDES permit limits assigned to JC-3. Skyline will submit the required DMRs to the Division as required in Section 2.3.7.

Periodically, due to difficult recovery conditions or roof collapse, mining equipment is abandoned underground. Prior to leaving equipment underground, hazardous materials and lubricating fluids are drained when possible. Since the equipment is steel and not too different compositionally from the roof support throughout the mine, contamination to ground water from abandoned equipment is not anticipated.

Mining equipment such as longwall mining machines, roof bolters, and continuous miners, is made of high quality steel containing chromium, and is highly resistant to corrosion. Calculations of the corrosion potential of the steel used in long wall mining machines have been performed by the University of Utah Metallurgy Department (BLM 1998s). They determined it would take thousands of years for the metal to corrode away. The University of Utah (BLM 1998a) report indicated that the general conditions required to hasten the corrosion of this metal do not exist in the Utah mining environment. A map illustrating the location of equipment left underground is provided as Drawing 2.5.2-1. The drawing includes a description of each piece of equipment.

Because of the high alkalinity and low acidity concentrations in the area (differing normally by two orders of magnitude), acid drainage problems do not occur as a result of mining. This is supported by the fact that coal in the area has a low sulphur content. The pyritic sulfur content within the coal is approximately 0.10 percent. Approximately 0.931 pounds of Iron are taken out of the ground for each ton of coal that is produced. Assuming Skyline produces 3 million tons of coal per year, approximately 1,400 tons of Iron is extracted from the formation each year with the mining of the coal. On typical year, metal roof support associated with mining – on the order of 1,300 tons per year – is left underground. Over 25 years of water monitoring of the natural waters surrounding the Mine does not show any degradation in water quality.

Skyline Mine anticipates potentially discharging approximately 2,800 gpm of mine water to Eccles Creek after the completion of mining and subsequent abandonment of the 11 Left, 12 Left A and B, and 6 Left B panels in 2004. However, this rate may vary with changes in the operation of JC-3 and because of the steady decline in potentiometric head within the aquifer discharging into Mine #2. Assumptions used in developing the discharge amount can be found in July 2002 Addendum to the PHC in Appendix F.

The JC-3 well pumped water from the Mine from August 2003 through June 2004, and then October 2007. The pumping of the well was discontinued due to an inability of the discharge to meet the water quality standards in Electric Lake (255 mg/l, TDS). Skyline began discharging water from Mine #2 into Eccles Creek beginning in September 2004. From 2003 into 2014.
discharges from Mine #2 have significantly declined from more than 8,000 gpm to approximately 2,000 gpm.

PHC Addendum Volume 2 Appendix O assesses the groundwater conditions in Star Point Sandstone discussing impacts on the aquifer since significant inflows and pumping began in 1999. The observations include: 1) the drawdowns noted in the monitoring wells are consistent with removal of substantial quantities of groundwater from storage; 2) potentiometric levels in the Star Point Sandstone recovered significantly in mid-2003 in response to flooding the southwest portions of the mine to the 8,300 feet elevation; 3) water levels of wells completed in the Star Point Sandstone respond to pump-rate variability at JC-1 demonstrating a hydraulic interconnectedness between the two; 4) discharge rates at CS-14 (mine discharge from the flooded portion of the mine) suggest pumping variability at JC-1 impacts discharge rates at CS-14, (but not at equal rates) with CS-14 needing to increase pumping less; 5) discharge rates from CS-14 have declined substantially, reflecting a local lowering of the hydraulic head in the Star Point Sandstone; and 6) most monitoring wells have recovered substantially as water from the Star Point continues to be pumped from JC-1 and CS-14 suggest there is still a large quantity of water in the system. Based on the observations noted, it is anticipated that mining in the Flat Canyon lease will intercept water-bearing faults or fractures with considerable inflows. Moreover, the Star Point system has likely not been dewatered or depressurized sufficiently to expect appreciably reduced inflow rates or durations. Although the groundwater inflow complicates mining it is anticipated to have minimal affects to the long-term hydrologic balance of the Star Point Sandstone aquifer.

Revised: 12-30-16

The water consumed in operating underground equipment, dust suppression, and evaporation is obtained from ground water sources within the mine. These underground water sources are not connected to the surface waters in
The water consumed in operating underground equipment, dust suppression, and evaporation is obtained from ground water sources within the mine. These underground water sources are not connected to the surface waters in the area. Extensive research has been performed by the mine to verify that water currently entering the mine is not coming from the surface or depleting surface waters. The recent July 2002 Addendum to the PHC presents data supporting this statement. The data suggests the water intercepted underground is at least 4,000 to 25,000 years old and, based on the results of tritium analyses from most of the mine waters, does not typically contain water that has been exposed to the atmosphere in the past 50 years. Additionally, the steady rate of decline in ground water levels in monitoring wells within the permit area and the results of age-dating the ground water inflows to the mine indicating the water is not getting appreciably younger, suggests that the aquifer is not receiving significant recharge of “young” surface waters... Continued monitoring by the mine of the surface waters and seeps and springs flows in the permit and adjacent areas have shown no discernable impacts due to the increased mine inflows that were encountered in March 1999 and have continued through November 2002. It is the operator’s position that the water consumed in operating Skyline Mine is not depleting surface water sources. In fact, there is an overall net gain to local river systems discharging to the Colorado River as a result of Skyline Mine discharge.

In anticipation of the Winter Quarters Ventilation Facility being constructed, a discharge point (004) was added to accommodate both storm water and mine discharge into Winter Quarters Creek in 2008. A numeric model study conducted by Earthfax Engineering (Appendix A-1, Volume 2) indicates Winter Quarters Creek can receive a maximum discharge of 6,200 gpm while not being erosive to the creek. In the event discharge from Outfall 004 routinely exceeds 6,200 gpm additional armoring to the outfall location and investigation of the impacts to Winter Quarters creek will be initiated.

A pond was added at the Swens Canyon Ventilation Facility, but not as a sediment control structure for the pad. The sole intent of the pond is to collect the drill cuttings from the shaft. Once construction of the shaft is complete, the pond will only collect water from immediately above the pond.

As mining progressed north of Winter Quarters Canyon, the longwall panel orientation was rotated 90 degrees to maximize the coal recovery. This rotation increased mining in an easterly direction into an area of thinner overburden. The study conducted by Apagito Associates indicates longwall mining can be conducted in areas with overburden down to 475 feet. In Panel 11 Left Woods Canyon creek overlies the center of the panel with overburden ranging from approximately 1000 feet to 500 feet. Water monitoring of the creek, shallow groundwater in the creek bottom, macroinvertebrate, fish and vegetation monitoring of the stream corridor will all be studied to monitor any impacts to the creek. The combination of geology, cover, the panel located in the center of the creek, and the minimal aquatic habitat available in Woods Canyon Creek all support that there will be minimal probable hydrologic consequences to mining further east in Woods Canyon. Detailed discussions of water monitoring are discussed in Sections 2.3 and 2.4, the aquatic wildlife resources are discussed in Section 2.8, and the subsidence control plan discussed in Section 4.17 of this M&RP.

The following information is supplied as required by the Windy Gap process as it applies to existing coal mines in the Upper Colorado River basin:

**Mine Consumption:** (culinary well - Water Right 91-5010) =41.69 ac-ft (2004 consumption)

**Ventilation Consumption / Evaporation:**
(assumes 70 deg. F, 60 total days annually, 20% humidity air intake, 95% humidity air out-take; air density difference of 0.001 lbs/ft )

\[
(353,312 \text{ cu-ft/min}) \times (0.001)(0.1198) = 42 \text{ gal/min.}
\]

\[
= 11.21 \text{ ac-ft annually}
\]

**Coal Producing Consumption / Coal Moisture Loss:**
- 6.1% Inherent moisture
- 8.54 % run-of-mine moisture
- 2.44% moisture added to coal by cutting (8.54-6.1)

Projected 2005 Tonnage 237, 500 tons
Projected 5 yr Average 1,898,672 tons
Revised: 5-27-16
Tons water/year = (1,898,672)(0.0244)= 46,328 tons water/year

---

**INTEGRATED**

**JUL 19 2010**

**Div. of Oil, Gas & Mining**
Lbs water/year = 92,656,000
Gallons/year = 92,556,000 (0.1198) = 11,100,189 gallons/year
= 34.06 ac-ft annually

Sediment Pond Evaporation:
Evaporation estimate calculation uses evaporation data from Pacificorp evaporation pan located at Electric Lake spillway. Data was from 1998 through 2003.

Pond 001 (Mine Site) - 0.39 acre (surface area)
  - 0.15 ac-ft/month (ET)
  - 228,096 gallons/year
  - 0.70 ac-ft/yr

Pond 002 (Rail Loadout) - 0.44 acre (surface area)
  - 0.15 ac-ft/month (ET)
  - 257,422 gallons/year
  - 0.79 ac-ft/yr

Pond 003 (Refuse Pile) - 0.27 acre (surface area)
  - 0.15 ac-ft/month (ET)
  - 159,667 gallons/year
  - 0.49 ac-ft/yr

Pond 004 (Winter Quarters) - 0.036 acre (surface area)
  - 0.15 ac-ft/month (ET)
  - 19,551 gallons/year
  - 0.06 ac-ft/yr Swens Canyon (drill cuttings pond) = 1.08 ac

Total Annual Pond Evaporation = 3.98 ac-ft

Springs and Seeps Effects From Subsidence - Not Applicable to this calculation

Alluvial Aquifer Abstractions into Mine - Not Applicable

Deep Aquifer Pumpage - Not Applicable

Postmining Inflow - (0)

Direct Diversions - Not Applicable

Dust Suppression - 5,000 gallons/truck load. Data based on 2003 use; last fully active year. = 3.7 ac-ft/yr

Mine Discharge - last 6 month average = 3,757 gpm

Using the Windy Gap Process at the Mine site, water depletions include Mine Consumption, Ventilation Consumption, Coal Producing Consumption, Sediment Pond Evaporation, and Dust Suppression totaling approximately 94 acre-feet per year. The only addition to the system, as defined by the Windy Gap process is the mine discharge which is currently averaging approximately 6,060 acre-feet per year, indicating the Skyline Mine has a net gain of approximately 5,966 acre-feet year to the Colorado River drainage system.

2.5.3 Alternative Water Supply

OSM Regulation 30 CFR 783.17 requires that alternative sources of water supply be identified if mining impacts will result in the contamination, diminution, or interruption of existing sources.

Because no significant adverse hydrologic impacts are expected as a result of mining in the Skyline permit area, no individual or collective source of alternative water supply has been identified.
However, the Permittee presently owns approximately 556 acre-feet of water rights in the Scofield Reservoir. Of these water rights, water sufficient for the Permittee's needs has been exchanged for rights from wells located near the mine site and at the mouth of Eccles Canyon for use in culinary and dust suppression water systems. Of this 556 acre-feet, a 148 acre-foot exchange has already been approved by the State Engineer of Utah.

It is recognized that seeps and springs are important to wildlife, particularly to small, less mobile species, and that flow reduction could potentially negatively impact these species. While flow reduction from mining related activities, including subsidence, is not expected to cause a problem, however, should such a loss be documented, mitigation measures will be taken after consultation with the Division of Oil, Gas and Mining and the Division of Wildlife Resources.

The Permittee will replace the water supply of any land owner if such a water supply proves to be contaminated, diminished or interrupted as a result of the Skyline mining operations. First, a determination will be made by the Division in accordance with R645 - 301 - 731.800 as to whether or not material damage has occurred. Then, in accordance with Regulation R645-301-525.510, Skyline will correct any material damage resulting from subsidence caused to surface lands (which includes water rights), to the extent technologically and economically feasible, by restoring the land to a condition capable of maintaining the value and reasonably foreseeable uses that it was capable of supporting before subsidence damage. Negotiations will be held immediately with the impacted party to determine the appropriate mitigation activities. The restoration of water flows to impacted sources will be accomplished using the Best Technology Currently Available (BTCA). These activities may include, but not necessarily be limited to: piping or trucking water to the location of the loss; sealing surface fractures to prevent further losses (i.e., stream floors on bed rock or in shallow alluvium), and; construction of a ground water well and the installation of pumps to restore flows. If the above efforts are not successful, then Skyline will explore the transferring water rights to the injured party in flow equal to the determined loss and/or monetary reimbursement for proven material damages.

Historically, the mining activities at Skyline Mine have not resulted in the loss of surface waters or significant changes in the discharge of seeps and springs within the permit area. While significant volumes of ground water have been encountered while mining in the west and southwest portions of the permit area, no impacts to surface discharges of seeps and springs, the flow of streams, or bodies of water have been found. Age-dating of samples of water obtained from the mine indicate the water has been in place for several thousands of years. This suggests that ground water is moving very slowly through the area strata and does not discharge at a significant rate down gradient of the mine.
Very little ground water was encountered while mining in the northern portion of the existing permit area prior to the addition of the North Lease. The same geologic and hydrogeologic conditions are anticipated to occur in the North Lease as occurred in the northern portion of the existing permit area (Mine 3). From 2005 through 2009 no significant water has been encountered in the North Lease. Therefore, no significant inflows of ground water are anticipated as mining progresses into the North Lease area. Selected surface discharges of ground water and stream flows in the areas that could be impacted by mining activities have been will be monitored. Mining related surface impacts include subsidence and the ventilation facility in Winter Quarters Canyon (WQVF) is the only surface impact anticipated since no new surface facilities are currently planned for the in the North Lease area. The WQVF will be permitted to encompass approximately 7.93 acres with the disturbance being treated with a sedimentation pond. The sole purpose of the facility will be to provide ventilation to the mine. If impacts to the waters within the permit area are determined to have occurred, mitigation will be implemented immediately using BTCA as described previously.

North of Winter Quarters Canyon, north of the Winter Quarters graben (NOG), the longwall panels were rotated 90 degrees to maximize coal recovery. This rotation accommodates coal recovery approximately 1/2-mile further to the east. A study conducted by Agapito Associates indicates mining can be safely conducted in areas with as little as 475 feet overburden without seeing adverse effects related to subsidence. A lease modification to the North Lease in 2013 extended mining slightly into the Fish Creek drainage. Approximately 690 acres of the 770 acre lease modification are being undermined in the Fish Creek drainage with overburden ranging from approximately 900-1300. Surface water drainages include Wife Creek, and two forks of Andrew Dairy Creek. All three (3) surface drainages are similar in that they are ephemeral in the reaches proposed for mining. An additional similarity they share for the majority of their entire length is springs in or very near the stream channel. These springs will flow a short distance in the stream channel prior to disappearing in the alluvium. The first such spring in Wife Canyon (S26-2) begins approximately 0.35 miles downstream of the area impacted by mining and runs approximately 50-100 feet before going subsurface. This spring is separated from the proposed mining by almost 800 feet of overburden above the coal seam. Only Wife Creek (CS-26) has demonstrated perennial flow as it enters Fish Creek, with such minimal flow (0.45 gpm) that there is only a minimal persistent groundwater-derived base flow component. Based on the elevation of the coal seam, both Wife and Andrew Dairy Creeks are above the coal seam their entire length. Water rights 91-3917 (Spring S26-1) and 91-1039 (Spring S25-32) are located within the proposed expansion area with overburden ranging from approximately 1,270 feet to 880 feet, respectively. Preliminary water quantity information for Spring S26-1 and S25-32 indicate flows of approximately 0.33 to 2.8 gpm and 3.5 to 12 gpm, respectively. Preliminary water quantity information for Stream CS-26 indicates flows from 0.45 to 40.4 gpm. Based on the amount of overburden separating the proposed mining from the surface hydrology, and the same Blackhawk formation containing shallow recharge sources that has been mined and monitored for over 30 years, there is minimal probability that the quantity of water within the Wife and Andrew Dairy drainages will be impacted by mining. Other sites identified during baseline water monitoring collected in 2012 and 2013 are located in PHC Addendum Appendix L.

The water quality in the same drainages has minimal probability of being adversely impacted due to the slightly alkaline nature of the Blackhawk formation, combining with the groundwaters that are generally near neutral to slightly alkaline which limits the solubility of metals such as total iron and total manganese into the groundwater system. Similarly, surface water quality is highly dependent on the overwhelming influence of the annual springtime snowmelt event on the surface-water discharge rates. A supplemental report located in Appendix A in by Petersen INCORPORATED.

Revised 10-1-13
Hydrologic summarizes the similarities between the groundwater and surface water systems in the Fish Creek drainage with surrounding hydrologic systems that have been undermined and monitored for over 30 years. The Seeps and Springs survey located in the same Appendix outlines and concurs with the similarities between the Fish Creek and Woods Canyon and Winter Quarters Canyon drainages. The portions of the Fish Creek drainage that are being undermined are solely within the Blackhawk Formation as predominately the entire Skyline lease areas have been.

In summary, the geology of the Blackhawk formation, the flow regime identified in the Wife and Andrew Dairy Creeks, the similarities in water quality of the baseline water monitoring sites with existing water monitoring sites, and the amount of overburden separating the coal to be mined from the surface hydrology support that no adverse impacts to the hydrology of these drainages are anticipated. This includes minimal likelihood of generation acid-forming or toxic-forming materials, changes to the sediment yield or stream flow alterations, and minimal potential to contaminate water supplies or water availability. Due to the minimal contribution of water Wife and Andrew Dairy Creek add to both Fish Creek and Scofield Reservoir, no adverse impacts to the hydrologic balance to these waters are anticipated.

There has been some concern that Electric Lake has been impacted by the inflows of groundwater to the Skyline Mine since 1998. As presented in the Addendum to the Probable Hydrologic Consequences, July 2002 and updated in October 2002, April 2003, and June 2004, a direct connection between the water in Electric Lake and the mine inflows cannot be found. However, the water flowing into the 10 Left area of the mine and discharging from the James Canyon JC-1 well contains a slight percentage of tritium. No other significant inflows of groundwater into the mine contained tritium levels that would suggest a modern component of recharge. As stated by Petersen (Appendix A, Addendum to the Probable Hydrologic Consequences, July 2002, Updated October 2002):

“It is calculated that the maximum modern component in the fault-related system could range from approximately 6.9 to 12.4 percent. It is also apparent that since routine sampling of the 10 Left groundwater system began in May 2002, the percentage of modern recharge in the groundwater system has not increased. Based on the potential modern recharge percentage calculations presented above, it is determined that of the total inflow to the 10 Left region (approximately 3,800 gpm), a maximum of approximately 262 to 471 gpm could have originated as modern recharge. Inasmuch as Canyon Fuel has been pumping approximately 2,200 gpm from the 10 Left groundwater system into Electric Lake since September 2001, the potential net impact to the Electric Lake watershed, were it occurring, would be completely mitigated by the current pumping. Additionally, groundwater that would not otherwise be available for use without the pumping activity is being added to the watershed. Since October 2002, PacifiCorp has increased the pumping rate at JC-1 to more than 4,000 gpm. Thus, currently, the amount of groundwater being pumped into Electric Lake from JC-1 represents...
a volume approximately one order of magnitude greater than that which could potentially be
derived from modern sources. It should be noted that there is currently no information that
would indicate that the potential modern component in the fault-related mine inflows is directly
or indirectly related to losses from Electric Lake."

Based on the above information and assuming the same percentages of modern versus ancient water
applies to the water pumped from the JC-1 well at a rate of 2,200 gpm, a maximum of approximately
152 gpm to 273 gpm could have originated as modern recharge. The maximum estimated volumes
of modern recharge water being discharged to the mine and from the James Canyon well would have
been 744 gallons. This volume is still less than the approximately 2,200 gpm that JC-1 discharged to

October 2002, PacifiCorp negotiated with Skyline Mine to install a higher capacity pump in JC-1 well.
The discharge after the new pump was installed was approximately 4,200 gpm. The rate of
discharge from JC-1 dropped to approximately 3,900 gpm in March of 2003 and should be sustained
at approximately that rate through 2004. The cause of the decline in the pumping rate is unknown but
may be related to changes in well or pump efficiency.

After the new pump was installed in JC-1, the tritium concentrations in the water discharged from the
well increased slightly. It appears that since January 7, 2003 the tritium concentration in the JC-1 well
water has slightly increased, ranging between 1.83 and 2.34 TU. This suggests that between 6 and
22 percent of the water now being pumped from the JC-1 well has a component of water that could
be considered younger than 50 years old (The percentages are based on a comparison of 2.34 TU
in the well water with tritium concentrations measured in water samples from area springs and Electric
Lake that range between 8.6 and 30 TU. Table 2 of Appendix G). Assuming the calculated range of
7.8 to 27.2 percent represents the portion of young water discharged from JC-1 when the well is
operated at a pumping rate of 3,900 gpm, the range of modern water discharged from JC-1 is between
304 gpm to 1,061 gpm.

The 10 Left area of the mine was sealed in October 2002 and additional uncontaminated samples of
the water inflows in that area can no longer be obtained. Calculations of the percentage of modern
water in the 10 Left inflows can no longer be based on actual sample data. If it is assumed the JC-1
water is representative of the 10 Left inflows, the JC-1 well water is not being "contaminated" with

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modern water from sources that do not normally flow into the mine, and the inflow rate of ground water to 10 Left is approximately 3,000 gpm (as estimated in March 2004), the inflow rate of modern water to 10 Left might be between 234 gpm and 816 gpm. Combining the calculated inflow rates of modern water from JC-1 and the 10 Left area results in a range of 538 gpm to 1,877 gpm of a total of 6,900 gpm of water removed from the ground from JC-1 and the mine.

JC-3 pumps water from the flooded portions of the mine that include the 6 Left through 12 Left A and B panel areas. Water from the 11 Left and 12 Left A and B areas do not appear to contain modern waters. Without the JC-3 well, the from these flooded portion of the mine would be pumped to Eccles Creek and not Electric Lake. The pumping of the JC-3 well could be considered to further mitigate for the maximum possible inflow of modern water to the mine. The JC-3 well is expected to be operated for at least several years or until the persistent drought conditions end.

If a determination were made that Skyline Mine impacted Electric Lake and upper Huntington Creek waters, the JC-1 and JC-3 wells would continue to be operated by the mine to discharge water into the Huntington Creek drainage. Thus, through the mine's effort to dewater the Star point Sandstone to allow for the continuation of mining in the southwest portions of Mine 2, specifically to maintain the West Mains, any potential mitigation for the loss of water has been and continues to be accomplished.

Revised 08-24-05

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DIV OF OIL GAS & MINING
EXHIBIT "A"

PROBABLE HYDROLOGIC CONSEQUENCES OF MINING AT THE SKYLINE MINES, CARBON AND EMERY COUNTIES, UTAH

UTAH FUEL COMPANY
Skyline Mines
Helper, Utah

Prepared by
EARTHFAX ENGINEERING, INC.
Salt Lake City, Utah

September 30, 1992

Modified by
Utah Fuel Company
February, 1993
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Utah Fuel Company
Skyline Mines
Probable Hydrologic Consequences
September 30, 1992

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PHC-iii
PROBABLE HYDROLOGIC CONSEQUENCES OF MINING
AT THE SKYLINE MINES,
CARBON AND EMERY COUNTIES, UTAH

1.0 INTRODUCTION

Utah Fuel Company submitted a mining and reclamation plan (M&RP) for the Skyline Mines in 1986 and updated this M&RP in 1987 and 1989. The purpose of this document is to present an assessment of the probable hydrologic consequences of operating and reclaiming the Skyline Mines. Where possible, the impacts from potential future expansions will be addressed.

This document is divided into five sections, including this introduction. Section 2.0 presents probable groundwater impacts and groundwater monitoring plans. A similar discussion of surface water is provided in Section 3.0. Conclusions and references are listed in Sections 4.0 and 5.0, respectively.
2.0 GROUNDWATER

2.1 Background Information

Detailed information on groundwater and the physical resources that effect groundwater in the permit and adjacent areas is found in Part 2 of the M&RP. This information is summarized herein for convenience. Part 2 of the M&RP should be consulted for more detail.

2.1.1 Climatology

The Skyline Mines are located in an area of subalpine climate. According to the monthly climatological data presented in Volume 4 of the M&RP, monthly average temperatures at the mine range, during the period of record, from 8.0°F to 74.4°F and total annual precipitation averages 23.88 inches for the years from 1985 to 1990. Most of the precipitation occurs during the months of October through April. Monthly average precipitation varies from a low of 1.14 inches in June to a high of 2.96 inches in February.

2.1.2 Hydrology

The rock units that outcrop within the permit area are the Castlegate Sandstone and the Blackhawk Formation. Just outside of the permit boundary, the Star Point Sandstone outcrops in Eccles Canyon and the South Fork of Eccles Canyon. The Star Point Sandstone underlies the entire permit area and overlies the Mancos Shale.

Castlegate Sandstone. The Castlegate Sandstone is the youngest rock unit in the permit area and is exposed in outcrops approximately 160 feet thick in the northwestern part of the permit (Figure 2.2-1 of the M&RP). It is a massive medium- to coarse-grained conglomeratic sandstone with a few thin interbedded mudstones or shales near the base. It forms steep, ledged slopes where it outcrops, and is well cemented with calcareous cement.
According to Danielson et al. (1981), the Castlegate Sandstone typically contains water. Data collected by Vaughn Hansen Associates (1979) indicate that only a few springs issue from the Castlegate Sandstone within the permit and adjacent areas. Most of these issue near the base of the sandstone, where mudstones and shales in the lower Castlegate and upper Blackhawk limit vertical groundwater movement and force horizontal flow to the surface.

Only one spring issuing from the Castlegate Sandstone is included in the Skyline groundwater monitoring program. According to the water quality data summarized in the Annual Reports, this spring typically has a low flow rate (with an average discharge of less than 4 gallons per minute). Flows vary seasonally, being highest in the spring and early summer as a result of snowmelt percolation.

**Blackhawk Formation and Star Point Sandstone.** The Blackhawk Formation consists of approximately 1,900 feet of interbedded sandstone, siltstone, shale, and coal (Figure 2.2-A of the M&RP). Within the permit and adjacent areas, the upper portion of the Blackhawk Formation is dominated by perched zones of water contained in thin lenses of sandstone, discontinuous coal (the McKinnon Seam), and siltstone.

The lower Blackhawk contains the more continuous and minable Upper O’Connor and Lower O’Connor (A and B) Coal Seams (Figure 2.2-A of the M&RP). At its base, the lower Blackhawk intertongues with several tongues of the Star Point Sandstone which are up to 70 feet thick. The Star Point Sandstone consists of well-consolidated, fine to medium-grained, sub-rounded to well-rounded, light-colored sandstones which intertongue with the Blackhawk Formation above and the Mancos Shale below (M&RP, Part 2 and Utah Fuel Company, 1991a). The lower portion of the Blackhawk Formation and the Star Point Sandstone are typically considered to be one continuous aquifer (Lines, 1985).

Data collected from pumping tests and laboratory core analyses from the Trail Mountain area (approximately 28 miles south-southwest of the Skyline Mines) indicate that the transmissivity
of the full thickness of the Blackhawk-Star Point aquifer probably ranges from about 20 to 200 ft\(^2\)/day (Lines, 1985). The aquifer is most permeable where it is fractured.

Typically, the hydraulic conductivity of the siltstones and shales of the Blackhawk Formation are three to six orders of magnitude lower than the hydraulic conductivity of the sandstones in both the Blackhawk Formation and the Star Point Sandstone (Lines, 1985). These lower permeability layers create the perched groundwater conditions in the upper Blackhawk Formation as discussed previously.

Faults within the permit area exhibit only minor vertical displacement. Past experience has indicated that most of the faults encountered in the Skyline Mines do not convey large volumes of water. This suggests that clays contained in the Blackhawk Formation swell when wetted, thus sealing zones of minor fracturing. In an early attempt to determine if swelling clays exist in the permit area, samples were selected from a claystone and two siltstones in the cores of two underground wells (UH3-16 and UH3-9, Plate 2.3.6-1). The X-ray diffraction analysis of the claystone from well UH3-16 show that it contain 58 percent montmorillonite (Chempet Research Corp., 1989), an effective sealing agent. Significant groundwater inflow to the mine is typically limited to areas that encounter paleochannels in water-saturated sandstones of the Blackhawk Formation or the underlying Star Point Sandstone. Sources of mine water inflow are found at the active faces and are typically short-lived, becoming dry within one or two months. Mine water discharge for the No. 1 and No. 3 mines (monitoring stations CS-14 and CS-12, respectively) average 190 gpm each (Annual Report, 1991).

Data presented in the M&RP (Plate 2.3.4-2, Plates 7, 11, and 12, Appendix Volume A-1) and in the 1990 Annual Report, show that the approximate potentiometric surface of the Blackhawk-Star Point aquifer follows the topographic relief, with the flow being to the west-southwest in the San Rafael Basin and to the east-northeast in the Price Basin. The hydraulic gradient of the approximate potentiometric surface is about 0.07 foot per foot on both sides of the divide. The August-September 1992 potentiometric surface (Plate 2.3.4-2) is similar to the 1980 surface (Plates 7, 11, and 12, Appendix Volume A-1). There is no evidence of
mine inflow impact on the potentiometric surface. Wells W22-2-2 and W14-2B have failed casings associated with subsidence. Well W22-2-1 is the shallow well paired with W22-2-2. At the time of the Vaughn Hansen Associates (1979) report, the deeper of these two wells had an artesian potentiometric head which rose to a level above the water level in the shallower well. By 1982 the water level in W22-2-2 had dropped below that of W22-2-1. This is probably due to both the drought and dewatering of the area by the mining operations.

There are only 3 deep wells with static water level data in the permit area at present. No data are available from the eastern wells used in the 1980 potentiometric surface. Due to the similarity of present water levels with the 1980 potentiometric surface, the 1980 water level data was used to represent the eastern side of the potentiometric surface presented in Plate 2.3.4-2.

Hydrographs of water levels in the nine monitoring wells drilled into the Blackhawk-Star Point aquifer are presented in the 1991 Annual Report. As indicated by these hydrographs, seasonal water-level fluctuations are typically less than 3 feet, but in some instances are as great as 15 feet. Due to the map scale and size of the contour interval of the potentiometric surface (Plate 2.3.4-2), fluctuations of this magnitude cannot adequately be depicted. The seasonal fluctuations correlate well with snowmelt and rainfall events, but in some cases there is a lag time of one to two months. The wells which show rapid changes or seasonal fluctuations to periods of high precipitation likely are completed so that they intersect faults or fractures. Wells with seasonal fluctuations are gradual and have lag times of one to two months are caused by completions which have no direct connection to fractures.

The long-term trend in the well hydrographs is a decrease in water levels. These water levels are declining at a rate typically less than 3 feet per year. This water level decline is considered to be the result of two factors. First, there has been an overall decline in precipitation in the last several years (see Volume 4 of the M&RP) thereby reducing recharge to the groundwater system. Second, the Skyline Mines intercept groundwater, thus, increasing groundwater discharge from the area. The result of both of these factors has been
a slight lowering of the approximate potentiometric surface in the Blackhawk-Star Point aquifer, with the lowering probably being greatest in the vicinity of the mines.

It should be noted that the approximate potentiometric surface presented in Plates 11 and 12 (Appendix Volume A-1) is lower in elevation than the springs in the permit area. Additionally, shallower monitoring wells tend to have water levels well above the water levels in the deeper wells. Thus, the shallow monitoring wells and the springs typically issue from the discontinuous perched Blackhawk aquifers while the deeper monitoring wells typically extend into the Blackhawk-Star Point aquifer.

Recharge occurs to the Blackhawk Formation directly from its surface outcrops and from the small areas of overlying Castlegate Sandstone. Even though the slopes are typically steep in the permit area, the vegetation is thick and a well-maintained soil of high organic content provides an adequate medium for recharge.

The upper perched aquifers of the Blackhawk Formation discharge naturally to springs and to unconsolidated alluvial and colluvial fill in the local canyons. The springs that issue from these perched aquifers, that are currently monitored, flow at a low rate (typically less than 10 gpm). Hydrographs of the monitored springs (Volume 4), including those in Burnout and Upper Huntington Creek drainages, exhibit a decreasing trend in flow rates throughout the period of record.

The only known discharge of the Blackhawk-Star Point aquifer within the permit and adjacent areas is to the underground mine workings and apparent baseflow and spring flow to Eccles Creek below the O’Connor Fault (Plate 6, Vaughn Hansen Associates, 1979). Mine-water inflow is assumed to be stored (not recent) water since Utah Fuel has isotopically dated the water flowing into the mine as "pre-atomic bomb" or, older than 45 years (Utah Fuel Company, 1991b). Discharges from mines 1 (Upper O’Connor Seam) and 3 (Lower O’Connor "A" Seam) each averaged 190 gpm for the year 1991.
Quaternary Alluvium. Unconsolidated Quaternary deposits are present in the canyons that dissect the permit and adjacent areas. These deposits predominantly consist of silts and sands, with some minor clay. Some of these deposits range in size from clay to boulders (Appendix A-3, M&RP). Recharge to these deposits occurs from the adjacent bedrock in the canyons, and discharge is to surface waters. Spring S22-11 discharges an average of 16 gpm from a colluvial deposit which is probably recharged by the adjacent upper perched aquifers of the Blackhawk Formation.

2.1.3 Groundwater Quality

Observation wells and springs that are monitored as part of the Utah Fuel Company hydrologic monitoring program are sampled three times per year. Due to the general inaccessibility of the sample points during the winter, no winter sampling occurs. A summary of water-quality analyses for groundwater samples (wells, springs and mine inflow) collected from the permit and adjacent areas is presented in the 1990 Annual Report.

Groundwater-quality samples are routinely collected in the permit and adjacent areas from:

- Springs that issue from the Castlegate Sandstone and the upper portion of the Blackhawk Formation,
- A monitoring well at the waste-rock disposal site, and
- Mine outflow that is collected from the Blackhawk Formation within the mines.

The general character of spring water from the upper perched aquifers of the Blackhawk is that of a calcium-bicarbonate water that is slightly alkaline and contains low concentrations of total dissolved solids (TDS), nutrients, and metals. TDS concentrations for the upper Blackhawk springs that are currently monitored by Utah Fuel are typically 240 mg/l (Volume 4). The pH averages 7.1 and the alkalinity is typically more than 25 times the measured acidity. The total and dissolved iron concentrations of these springs are typically 0.39 and...
0.10 mg/l, respectively. Total and dissolved manganese concentrations are both typically 0.02 mg/l. Total iron and manganese concentrations correlate directly to flow rates.

The one Castlegate Sandstone spring (S10-1) that is currently monitored has had an average TDS concentration of 88 mg/l during the period of record. This spring also produces calcium-bicarbonate water that is low in nutrients and metals. The pH is neutral to slightly alkaline, averaging from 7.1 pH units. Alkalinity is typically 25 times acidity. Total and dissolved iron concentrations average 0.20 and 0.04 mg/l, respectively. Total and dissolved manganese concentrations average 0.011 and 0.01 mg/l, respectively.

A new monitoring well was installed at the wasterock disposal site in September, 1992. As the monitoring well at the waste rock disposal site is relatively new, no water quality data are available at present.

Mine-water is discharged from both the No. 1 and No. 3 mines (monitoring stations CS-14 and CS-12, respectively). These waters are calcium-bicarbonate waters that have increased in average sulfate and TDS concentrations from 159 and 260 mg/l in 1984 to 620 and 1100 mg/l in 1991, respectively. This increase will be further discussed in Section 2.2.2 of this PHC. Alkalinity is typically more than 40 times acidity and pH averages 7.4. Concentrations of nutrients and metals are low in the discharge waters. Total and dissolved iron concentrations average 1.4 and 0.02 mg/l, respectively. Total and dissolved manganese concentrations average 0.3 and 0.07 mg/l (CS-12) and 0.07 and 0.04 mg/l (CS-14), respectively.

As a point of comparison, groundwater quality analyses (Volume 4 of the M&RP) were compared to the primary drinking water standards (40 CFR 141) and the secondary drinking water standards (40 CFR 143). Although none of these standards apply directly to the spring water (since it is not used for culinary water purposes), there are no exceedences of primary or secondary drinking water standards.
2.2 Potential Groundwater Impacts

Potential groundwater impacts from mining and reclamation operations at the Skyline Mines include:

- Contamination from acid- or toxic-forming materials;
- Impacts to groundwater quantity; and
- Impacts to groundwater quality:
  - Contamination due to rock dust usage,
  - Contamination due to the usage of hydrocarbons, and
  - Contamination from road salting.

2.2.1 Potential Contamination from Acid- and Toxic-Forming Materials

Information on acid- or toxic-forming material monitoring is presented in Part 2.2 of this M&RP. These data show that there have been only 3 borderline boron occurrences in more than ten years. The data do not suggest a pattern of occurrence. It is possible that data suggesting the presence of acid- and toxic-forming materials are the result of contamination or lab error (Utah Fuel Company, 1992c). The infrequent and isolated nature of these occurrences make source identification unlikely. In addition, as noted in Section 2.1.3 of this PHC, the alkalinity of the groundwater in the area is at least 25 times the acidity. The alkalinity of the mine discharge water is typically more than 40 times the acidity.

Given past experience at the mines, the probability of acid- and/or toxic-forming materials being found in the future is very low. However, if any of these materials are discovered in the future through the on-going monitoring plan, these materials will be disposed of within the guidelines set down in R614-301-731.300 and in Part 3.2.8 of this M&RP.
2.2.2 Groundwater Quantity Impact

Mining will remove groundwater both from formations adjacent to the coal seams and from the coal itself. The removal of water from the surrounding formations occurs when groundwater flows into the underground mine workings as the coal is removed. Drainage of water from paleochannels produces the largest volume of water flowing into the mine. Fractures tend to be tightly sealed with clay.

As noted in Section 2.1.2, the elevation of the approximate potentiometric surface of the Blackhawk-Star Point aquifer is significantly lower than the discharge point for springs in the permit and adjacent areas. Thus, mine dewatering will not impact the upper perched zones in the Blackhawk which feed the springs in the permit and adjacent areas.

The approximate potentiometric surface of the permit and adjacent areas (Plates 11 and 12, Appendix Volume A-1) indicates the presence of a groundwater divide that bisects the mine permit area between the Price Basin and the San Rafael Basin. Groundwater intercepted by the mines comes from both sides of the divide. However, some of the mine inflow water is reused in the mine for dust suppression or is retained underground in sumps. Water used in dust suppression typically adds 2 to 3 percent moisture to the coal. Water that does not leave the mine in the coal or is not discharged from the mines is therefore returned to the groundwater system.

All water pumped from the mines is discharged to Eccles Creek (in the Price Basin). The part of this discharge that originates on the San Rafael Basin side of the groundwater divide was estimated using the mine water discharge values from Volume 4 of the M&RP, the corresponding maps of actual acreage mined, and the map of the approximate potentiometric surface. This analysis is summarized in Table 1. Based on the acreages mined, the current
TABLE 1
ESTIMATED DIVERSION OF GROUNDWATER FROM SAN RAFAEL BASIN SIDE OF GROUNDWATER DIVIDE TO PRICE BASIN

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Mine Discharge (gpm)</th>
<th>Annual Mine Production (tons)</th>
<th>Total Acres Mined</th>
<th>Percent Acreage in Price Basin</th>
<th>Percent Acreage in San Rafael Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>260</td>
<td>1,822,613</td>
<td>380</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>1988</td>
<td>290</td>
<td>2,263,581</td>
<td>630</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>1989</td>
<td>530</td>
<td>2,969,087</td>
<td>850</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>1990</td>
<td>340</td>
<td>3,704,866</td>
<td>1100</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>1991</td>
<td>380</td>
<td>4,719,000</td>
<td>1400</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Projected Future(a)</td>
<td></td>
<td>4836</td>
<td></td>
<td>32</td>
<td>68</td>
</tr>
</tbody>
</table>

(a) See Figure 1, based on final probable mine workings.
Approximate Groundwater Divide Between Huntington and Eccles Basins

Projected Final Extent of Mine Workings

Potential Reserves That May Be Mined Based on Future Exploration (Not Included in Calculations)

Figure 1. Approximate Groundwater Divide Between Huntington and Eccles Basins
Utah Fuel Company  
Skyline Mines  

Probable Hydrologic Consequences  
September 30, 1992  

diversion of groundwater from the San Rafael Basin to the Price Basin is estimated at 25% of the mine water discharge (or 95 gpm of the 380 gpm combined current average discharge from the mines).

A comparison of historical and projected maximum mine-water discharge and coal production rates is provided in Figure 2. As indicated, mine-water discharge rates tended to increase in a manner similar to the coal production through 1988. In 1989, when Mine No. 1 began discharging mine-water, discharge rates increased greatly. Mine-water discharge then decreased in 1990, when the reuse of mine-water underground increased greatly. The direct proportionality between mine-water discharge and coal production rates returned in 1991. As indicated in Part 3 of the M&RP, coal production from the Skyline Mines is expected to reach 6.5 million tons per year in 1994. This production rate is expected to continue through the life of the mine. Projecting this production rate and the mine discharge rate on Figure 2 into the future, it is estimated that long-term discharge of groundwater from the mines will average approximately 550 gpm. This represents an increase of 170 gpm over the current average mine discharge.

It should be noted that this is a maximum possible increase in average mine discharge. As mining of multiple seams progresses below Mine No. 1 (the mine highest in elevation), less groundwater will be intercepted since overlying areas will have been previously dewatered. As a result, the rate of mine-water discharge should decrease. Based on the data presented in Table 1, 68 percent of the total flow measured over the life of the mine is expected to originate within the San Rafael basin and 32 percent is anticipated to originate within the Price basin.

As noted, the maximum rate of mine-water discharge from the Skyline Mines is anticipated to be approximately 550 gpm. However, the following three factors indicate that the decrease in groundwater availability downgradient from the Skyline Mines will be significantly less than this rate:
According to Freeze (1971), as groundwater is withdrawn from storage in an aquifer (such as is occurring at the Skyline Mines), the unsaturated zone is induced to deliver greater recharge to the water table under the influence of higher gradients in the saturated zone. As a result of this phenomenon, changes in withdrawal do not translate into equivalent (or, in some cases, even perceptible) changes in downgradient groundwater availability.

The time lag for groundwater to flow naturally from the mine area to downgradient water users is great. To calculate this time lag, natural groundwater flow rates in the area were determined according to the modified Darcy equation (Freeze and Cherry, 1979):

\[ V = \frac{K}{n}(dh/dl) \]  

(2.1)

where

- \( V \) = average linear groundwater velocity (ft/day)
- \( K \) = hydraulic conductivity (ft/day)
- \( n \) = porosity (fraction)
- \( dh/dl \) = hydraulic gradient (ft/ft)

The hydraulic conductivity required for the solution of Equation 2.1 was determined from data provided by Vaughn Hansen Associates (1979) and Lines (1985). Aquifer tests performed by Vaughn Hansen Associates (1979) in monitoring wells within the permit area indicate that the hydraulic conductivity of the Blackhawk Formation is approximately 0.01 foot per day (assuming that the indicated depths are equal to the actual saturated thicknesses). Laboratory data reported by Lines (1985) indicate that horizontal hydraulic conductivities of the Star Point Sandstone and sandstone lenses in the Blackhawk Formation vary from about 0.01 to 0.03 foot per day. Based on these data, an average hydraulic conductivity of 0.02 foot per day was assumed for the Blackhawk-Star Point aquifer.

Data reported by Lines (1985) indicate that the porosity of the Star Point Sandstone and the sandstone lenses in the Blackhawk Formation averages about 14 percent. The hydraulic gradient downgradient from the permit area was assumed to be equal to that within the permit area (approximately 0.07 ft/ft - see Section 2.1.2). Based on the above data, the average liner velocity of groundwater flowing beneath the permit area is 0.01 foot per day (3.7 feet per year).
As previously noted, groundwater that is intercepted in the mines is derived from the Blackhawk-Star Point aquifer. Since no water wells exit in the permit and adjacent areas, groundwater in this aquifer first becomes available for use either as discharge to a spring or as discharge to a stream. This natural discharge will occur near the Star Point-Mancos Shale contact where groundwater is forced to the surface by its inability to flow vertically through the relatively impermeable, underlying Mancos Shale.

A review of geologic data provided by Waddell et al. (1981) indicates that the Mancos Shale outcrops closest to the permit area within Huntington Canyon, approximately one mile upstream from the confluence of Huntington Creek and the Left Fork of Huntington Creek. A review of pending and existing water rights in Huntington Canyon near this point (according to the files of the Utah Division of Water Rights) indicates that the source closest to the permit boundary with a diversion right in excess of 5 gpm is Huntington Canyon Campground Spring (right 93-1055, with a diversion point in Sec. 5, T. 15 S., R. 7 E. approximately 7.9 miles downgradient from the southern boundary of the permit area). Based on the groundwater flow rate noted above, the time required for groundwater to flow naturally from the southern boundary of the permit area to Huntington Canyon Campground Spring is approximately 11,200 years.

The great time lag in the flow of groundwater downgradient from the permit area to potential water users causes the impacts of mine-water discharges to be lessened through routing. Comparing the time of groundwater flow with the time frame during which water may be discharged from the mine (33 year projected life of mine), discharges from the mine are anticipated to have no significant impact on the availability of groundwater to downgradient users.

It should be emphasized that even though the impact is estimated to be minimal, the above calculations represent a conservatively high estimate of the potential impact. The assumption that the hydraulic gradient is the same downgradient from the permit area as it is within the permit area is probably over conservative. Gradients normally decrease as groundwater flows from upland areas (such as the permit area) to canyon areas. This decrease in gradient proportionally decreases the groundwater velocity, thus increasing the time required for groundwater to flow from one area to another and increasing the damping effect of flow routing.

Following the completion of mining, the mine workings will fill with water up to the top of the potentiometric surface. Due to the increased void space in the mine workings as compared with the in-place rock, the volume of groundwater beneath the permit area will increase. This will increase recharge to downgradient areas, thus further minimizing the downgradient impacts of mine dewatering.
As noted above, aquifer tests performed by Vaughn Hansen Associates (1979) indicate that the hydraulic conductivity of the coal zone and the base of the Blackhawk Formation is 0.01 feet per day. This hydraulic conductivity is equal to the hydraulic conductivity used by Lines (1985) to model the groundwater impacts of coal mining at Trail Mountain, approximately 28 miles south-southwest of the Skyline Mines. As a result of this similarity in hydraulic conditions, the conclusions drawn by the dewatering model of Lines (1985) are considered appropriate for estimating the probable drawdown effects due to the discharge of water encountered in the Skyline Mines.

Figure 3 (Lines, 1985) depicts drawdown expected at distances measured along the long ($D_x$) axis and the short ($D_y$) axis of the mine. Based on a mine life of 33 years (see Part 3 of this M&RP), the maximum expected lateral limits of the cone of depression caused by dewatering of the Skyline Mines would be approximately 10,000 feet (1.9 miles) from the mine boundary in the north and south directions and 15,000 feet (2.8 miles) from the mine boundary in the east-west directions.

With the exception of the Utah Fuel water supply wells shown on Plate 2.3.6-1, there are no water supply wells located in the permit and adjacent areas.

As indicated in the baseline data discussed in Vaughn Hansen Associates (1979, Volume A-1), the only springs issuing from the Blackhawk-Star Point aquifer located within these limits lie below the O'Connor Fault in Eccles Canyon. All other known springs in the permit and adjacent areas flow from the upper perched aquifers of the Blackhawk.

Vaughn Hansen Associates (1979) infer that baseflow and spring flow from the Blackhawk Star Point aquifer occurs in Eccles Creek beginning approximately one mile downstream from the mine permit boundary. This area is within the projected cone of depression, but lies below the elevation of the mine workings. The drawdown of the water table within the cone of depression will cause the hydraulic gradient to decrease, slowing the rate at which the
FIGURE 3. PREDICTED DRAWDOWN AS A FUNCTION OF DISTANCE (LINES, 1985)

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groundwater adjacent to the mine recharges the downgradient strata. The present hydraulic gradient produces a linear velocity of 3.7 feet per year, indicating that the impact of a reduced recharge rate would reach a discharge point one mile away approximately 1,400 years later. As stated above in parts 2 and 3 of the factors involved in the decrease in groundwater availability, the 33 year mine life is so small compared to the travel time involved that the impact to the groundwater will be minimized through routing and the recovery of the potentiometric surface when the mine fills with water.

The approximate in situ moisture content of coal mined by the Skyline Mines is 6.5 percent water by weight (this does not include moisture added from dust suppression). Two percent of this water is chemically bonded with organic compounds in the coal. The remaining 4.5 percent would normally be available to the groundwater system (Utah Fuel Company, 1991a). This water leaves the mine in the coal as part of the mining process. Using an extraction rate of 4.72 million tons of coal for 1991, approximately 160 acre-feet of water will thus be extracted from the groundwater system annually. Based on a long-term coal production rate of 6.5 million tons per year, approximately 220 acre-feet of water per year will be extracted from the groundwater system.

Discharge of groundwater from the underground workings and removal of groundwater in the coal is expected to continue through the life of the mining operation. To date, no negative impact to seeps or springs has been noted. The springs which issue from the perched aquifers will probably remain unaffected by the dewatering. In addition, as noted above, impacts to groundwater availability from the Blackhawk-Star Point aquifer in downgradient areas is estimated to be minimal.

Burnout Canyon will be subsided as part of a subsidence study which is being directed by the U.S.F.S. Water quantity impacts that could occur to springs in this area are loss or diminution of spring flow. It is expected that a subsidence induced flow change would occur rapidly and appear as a significant, distinct event. The present, gentle, decreasing trend in flow rates, as shown in monitoring data presented in the 1991 Annual Report, resulting from Allmantic
drought, should be readily distinguishable from a subsidence induced loss. Nine springs in this area are presently being monitored as a part of the U.S.F.S. study and current water monitoring program. This level of monitoring should be representative of springs in the area and should be sufficient to adequately identify any impacts. Should a spring be impacted by subsidence, Skyline commits to taking appropriate action to mitigate the impact.

2.2.3 Potential Groundwater Quality Impacts

Potential groundwater quality impacts include:
- Contamination due to rock dust usage;
- Contamination due to usage of hydrocarbons; and
- Contamination from road salting.
- Subsidence Impacts to the Burnout Canyon Area

Rock Dust Usage Impact. The practice of using rock dust for the suppression of coal dust in the mines may potentially impact the groundwater flowing through the mine by dissolution of the rock dust constituents into the water. Typical of many mines in Utah, until 1990, Utah Fuel Company used a rock dust that contained 40% gypsum. The dissolution of this gypsum has impacted the groundwater that accumulates in a large underground sump in Mine No. 3 by a four-fold increase sulfate and TDS concentrations above background levels established in mine-water discharge analyses in the earlier years of mining (see Section 2.1.3 of this PHC).

These high sulfate and TDS concentrations found in the sump in Mine No. 3 are presently being mitigated by discontinuing use of gypsum-bearing rock dust, consumption of as much of this water as feasible within the mine, and by diluting the remaining high sulfate-TDS water with other mine inflow water in Mine No. 3 which is low in sulfate and TDS. The chemistry that is presented in Volume 4 (of the M&RP) for Mine No. 3 are for the mixed high and low sulfate-TDS waters. Additionally, the water from Mine numbers 1 and 3 are mixed together prior to being discharged to the sedimentation pond.

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The high sulfate and TDS impact of using gypsum rock dust has occurred. However, active discontinuation of gypsum use has been implemented and all shipments of rock dust delivered to the site are now monitored carefully for gypsum. Therefore, no further gypsum contamination should occur from this source.

**Impact of Usage of Hydrocarbons.** Hydrocarbons (in the form of fuels, greases, and oils) are stored and used in the permit area. Groundwater contamination could result from spillage of hydrocarbon products during maintenance of equipment during operations, filling of storage tanks and vehicle tanks, or from tank leakage due to the rupture of tanks.

The probable future extent of the contamination caused by diesel and oil spillage is expected to be small for five reasons.

- First, all above ground storage tanks are enclosed in accordance with the Spill Prevention Control and Countermeasure Plan (SPCC).
- Second, no underground storage tanks exist at the site.
- Third, because the tanks are located above ground, leakage from the tanks can be readily detected and repaired.
- Fourth, spillage during filling of the storage or vehicle tanks is minimized to avoid loss of an economically valuable product.
- Finally, the SPCC Plan provides (and Utah Fuel Company has implemented) inspection, training, and operation measures to minimize the extent of contamination resulting from the use of hydrocarbons at the site.

The potential for hydrocarbon contamination of the groundwater associated with the operation and maintenance of the overland conveyor are limited to:

- A 5 gallon gas tank on the maintenance cart, mounted above the conveyor,
- The oil in the engine of the maintenance cart (approximately two quarts), and
The yearly lubrication of the conveyor.

The potential impact of leaks or spills from these sources will be prevented and mitigated through the SPCC plan (1991).

Road Salting Impact. Utah Fuel does not salt the roads within or adjacent to the permit. These roads are maintained by the State. Therefore, the probability of these mining operations impacting the hydrologic balance through road salting is non-existent.

Subsidence Impacts to the Burnout Canyon Area. The subsidence of the Burnout Canyon area may impact spring water quality. Subsidence impacts would be expected to increase for a short duration the TDS and TSS concentrations of the spring water by increasing the amount of fractured rock available to dissolution in the subsurface. Therefore, the effect would be expected to be a distinct event. Once rock fines became either washed out of the subsidence fractures or dissolved, water quality would likely return to previous levels. Thus, the elevated TDS and TSS concentrations would be relatively short-lived. As discussed in Section 2.2.2 of this PHC, the springs in the Burnout and Upper Huntington Canyons are presently being monitored as part of a U.S.F.S.-directed subsidence study and are a part of the ongoing groundwater monitoring program. Utah Fuel commits to performing appropriate mitigation and remediation should the quality of the spring water be affected.
3.0 SURFACE WATER

3.1 Background Information

Detailed information on surface water and the physical resources that effect surface water is found in Part 2 of the M&RP. This information is summarized herein for convenience. Part 2 of the M&RP should be consulted for more detail.

3.1.1 Hydrology

The Skyline Mines are located in the headwaters of the Price and San Rafael River Basins. Perennial streams that drain the permit area include Eccles Canyon, Green Canyon, Winter Quarters Canyon (tributaries of the Price River), and upper Huntington Creek (a tributary of the San Rafael River). Scofield Reservoir lies downstream of the permit area within the Price River Basin, and Electric Lake overlaps the southwest corner of the permit area on Huntington Creek.

All streams in the permit and adjacent areas are classified by the Utah Department of Health as follows:

- 1C Protected for domestic use with prior treatment processes,
- 3A Protected for cold water aquatic life, and
- 4 Protected for agricultural uses including stock watering.

Electric Lake, a storage facility for water used at coal-fired power plants, is owned and operated by Utah Power and Light and is classified as 3A and 4. Scofield Reservoir, in addition to the protection classifications above, is also classified 2B (protected for recreational use, excluding swimming).
The primary source of water for the streams in the area is snowmelt. Hence, peak flows occur generally in the late spring and early summer. Flow volumes per unit area are high in the headwaters and low near the mouths of the two drainage basins. Average annual watershed yields for Eccles Creek and Huntington Creek drainages within the permit boundary are approximated at 13.5 and 16 inches per year, respectively (Vaughn Hansen Associates, 1979).

Seasonal variations in perennial streamflow currently monitored in Huntington Creek above Electric Lake range from less than 20 gpm to 40,000 gpm, averaging 3800 gpm. Variations in perennial streamflow measured in Eccles Creek above Pleasant Valley Creek range from less than 1 gpm to 30,000 gpm, averaging 1500 gpm (Volume 4 of the M&RP). These extremes in flow rates are typical of western high elevation locations and are graphically displayed in the 1990 Annual Report.

The four surface water monitoring points at the waste rock disposal site have been dry since installation (Volume 4 of this M&RP). There are no flow data available for these monitoring points.

3.1.2 Water Quality

Sediment Yield. The estimated average annual sediment yield for the Skyline Mines area is approximately 0.44 acre-feet per square mile per year or a total annual yield of 1.25 acre-feet of sediment to the Price River Basin and 3.07 acre-feet of sediment to the San Rafael River Basin. The majority of this sediment occurs as suspended sediment, with only a minor percentage carried as bedload (Vaughn Hansen Associates, 1979).

Chemical Quality. Surface water quality samples are routinely collected in the permit area from stations located on Eccles Creek, Huntington Creek, Burnout Creek, Electric Lake, and at the four surface water monitoring points at the waste rock disposal site. Analytical data
from these sources are summarized in Volume 4 of the M&RP. Locations of these monitoring points are presented on Plate 2.3.6-1 of the M&RP.

Dissolved solids content in the surface water ranges from less than 125 milligrams per liter in the headwaters near the Skyline permit area to approximately 4,000 milligrams per liter near the confluence of the Price and San Rafael Rivers. As the surface water flows over rock formations such as the Mancos Shale that have large amounts of available alkaline salts, the total dissolved solids concentrations increase significantly.

Chemical analyses presented in Volume 4 of the M&RP indicate that surface water monitored by Utah Fuel is typically a calcium-bicarbonate water that is neutral to slightly alkaline. Total suspended solids (TSS) concentrations average approximately 60 mg/l and total dissolved solids (TDS) concentrations average about 320 mg/l. Alkalinity is typically more than 35 times the acidity.

Surface water quality deteriorates generally as it moves downstream. TSS concentrations measured in the headwaters of Eccles Creek at CS-3 and CS-11 are typically 14 and 59 mg/l, respectively. TDS concentrations measured at CS-3 and CS-11 are typically 256 and 182 mg/l, respectively. TSS and TDS concentrations measured at the mouth of Eccles Creek are typically 117 and 395 mg/l, respectively. This deterioration in quality is the result of streamflow through loosely consolidated sediments and mine-water discharge.

TSS concentrations tend to vary in direct relationship to streamflow. During the snowmelt runoff season, concentrations are also naturally higher in Eccles Canyon than in Huntington Canyon. Although channel erosion is relatively low throughout the area, it appears to be more extensive in the steeper Eccles Canyon than in the Huntington Creek Basin. Infrequent mudslides contribute greatly to the suspended solids concentration.

Total iron concentrations in the streams vary widely throughout the area, with the potential source being the iron contained in Blackhawk Formation cementing agents. Total iron
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Concentrations have ranged from 0.01 to 45.10 mg/l during the period of record (Volume 4 of the M&RP). The larger total iron concentrations correlate to high TSS concentrations. Dissolved iron occurs in lower, more consistent concentrations.

Total manganese concentrations in the permit area are typically low, ranging normally from 0.01 to 0.34 mg/l. No distinct trends in variation were noted.

A comparison of the surface water quality data presented in Volume 4 of the M&RP with the primary and secondary drinking water standards indicates that the chemical quality of local surface water is typically within the drinking water standards.

There were, however, some minor exceedances of these standards. These exceedances make up a small percentage of the population sampled (copper-5%, lead-5%, sulfate-3%, TDS-9% and chloride-less than 1%). Some of these copper and lead exceedances may be due to other mining operations in the area. The copper and lead exceedances occur at monitoring station CS-6 from September of 1982 through June of 1983 and at CS-9 in May and June of 1986. No copper or lead exceedances have occurred since. Therefore, no further exceedances of these parameters are expected. Sulfate and TDS concentration exceedances are likely due to mine water discharge and are further discussed under Section 3.2 of this PHC.

The four surface water monitoring points at the waste rock disposal site have been dry since installation (Volume 4 of this M&RP). No water quality data are available for these monitoring points.

3.2 Potential Surface Water Impacts

The surface water potential impacts that could result from mining and reclamation operations at the Skyline Mines includes:

- Contamination from acid- or toxic-forming materials
Increased sediment yield from disturbed areas;
Flooding or streamflow alteration;
Impacts to the chemical quality of surface water;
Impact to surface water quantity; and
Reduction in Burnout Creek fishery habitat value by subsidence.

3.2.1 Potential Contamination from Acid- or Toxic-Forming Materials

As noted in Section 2.2.1 of this PHC, isolated material samples showing a tendency toward being acid- or toxic-forming have been identified. Alkalinity of the mine water discharge is typically 40 times the acidity. Due to the naturally alkaline nature of the ground and surface waters in the area, and the very infrequent occurrence of acid- or toxic- forming materials, the probability of an impact from this source is minimal.

3.2.2 Potential Increase in Sediment Yield

The potential impact of mining activities on sediment yield may be an increase in sediment yield downstream of the disturbed areas. An increase in sediment load could inhibit biologic activity in Eccles Creek. Sedimentation control measures (such as sedimentation ponds, diversions, etc.) have been installed to minimize this impact. These facilities are regularly inspected (see Part 3 of this M&RP) and maintained.

Ecosystems Research Institute (1992) states that biologic activity has decreased in Eccles Creek below the mine. Studies performed by Ecosystems Research Institute (1992) indicate that this reduced biological activity is a result of a higher percentage of medium grained sediments in the creek below the mine than above the mine and that these sediments have filled in the gravels in the bed of the creek.

Current monitoring indicates that no significant increase of TSS concentrations occurs from CS-11 (23 mg/l), upstream of the mine discharge, to CS-2 (20 mg/l), downstream of the mine.
discharge. Thus, controls at the mine are effective at controlling sediment yields before discharging to the surface water along with other sedimentation controls.

The change in sediment size distribution in the creek below the mine may be due to scouring of sediments at the discharge point which are subsequently deposited downstream of the mine, rather than sediment discharges from the disturbed areas. This scouring and deposition would create the embedded nature of the stream bed found in Eccles Creek by Ecosystems Research Institute (1992). As a result of ongoing inspection and maintenance of the sediment-control facilities, there is a very low probability that sediment yield will increase due to mining activities.

3.2.3 Potential for Flooding or Streamflow Alteration

Runoff from all disturbed areas flows through sedimentation ponds or other sediment-control devices prior to discharge to adjacent undisturbed drainages. Three factors indicate that these sediment-control devices minimize or preclude flooding impacts to downstream areas as a result of mining operations:

1. The sediment-control facilities have been designed and constructed to be geotechnically stable. Thus, the potential is minimized for breaches of the sediment-control devices to occur that could cause downstream flooding.

2. The flow routing that occurs through these sediment-control devices reduces peak flows from the disturbed areas. This precludes flooding impacts to downstream areas.

3. By retaining sediment on site in the sediment-control devices, the bottom elevations of stream channels downstream from the disturbed areas are not artificially raised. Thus, the hydraulic capacity of the streams channels is not altered.

Following reclamation, stream channels will be returned to a stable state (see Part 4 of this M&RP). The reclamation channels have been designed to safely pass the peak flow resulting from the 10-year, 24-hour storm. Thus, flooding in the reclaimed areas will be precluded.
Interim sediment-control measures and maintenance of the reclaimed areas during the post-mining period will preclude deposition of significant amounts of sediment in downstream channels following reclamation, thus maintaining the hydraulic capacity of the channels and precluding adverse flooding impacts.

The mine has been designed to preclude subsidence of perennial streams identified in Part 4 of this M&RP. Thus, no alteration of perennial streamflow patterns is anticipated.

Subsidence will occur beneath Burnout Canyon. The effects of the subsidence on the streams in Burnout Canyon will be documented as part of a U.S.F.S.-directed study of stream subsidence. This is a five year study that began during the summer of 1992. No data are available at present. Utah Fuel commits to remediate and mitigate the subsidence study area using appropriate measures. However, until the mode of failure has been determined through the subsidence study, the appropriate measures will not be known.

Subsidence will occur in areas occupied by ephemeral and intermittent stream channels. Although surface cracks that result from subsidence in the permit area tend to heal with time (DeGraff, 1978 and the 1990 Annual Report), ephemeral streamflows may be partially intercepted prior to completion of the healing process. In addition, the broad depressions created by subsidence may locally retain runoff that would normally discharge from an area. However, the following factors indicate that the impact of subsidence on ephemeral streamflow will be minimal:

1. Ephemeral streamflow in the area is sporadic, allowing significant periods of time for surface cracks to heal between flow events. As the cracks heal, the potential for interception of streamflow is minimized.

2. Ephemeral streamflow typically carries a high sediment load. This sediment will fill remaining cracks, thus accelerating the healing process and minimizing streamflow interception.

3. The depressions created by subsidence are generally sufficiently broad that changes in slope are not typically of an ample magnitude to cause ponding in
anything other than local areas. This is especially true in the steep terrain which is typical of the permit and adjacent areas.

4. Alluvial and colluvial deposits in the stream channels are unconsolidated and will fill subsidence cracks that may occur.

Streamflow volume is increased by the discharge of mine water to Eccles Creek. At present, the average combined discharge from the No. 1 and No. 3 mines is 380 gpm. Thus, the mining activities presently increase surface water flow in Eccles Creek. This increased flow will cease when mining ceases. The mine will be sealed and no further discharges will be made to Eccles Creek.

As discussed previously, Ecosystems Research Institute (1992) has determined that the decrease in biologic activity in Eccles Creek may be a result of the highly embedded sediments in the creek bed below the mine. The higher flow rates from the combined streamflow and mine discharge have eroded sediments immediately below the mine. These sediments are then conveyed downstream till the stream gradient reduces where they then are dropped out of the stream flow and fill in the alluvial gravels.

3.2.4 Potential Chemical Quality Impacts

Potential impacts to the chemical quality of surface water in the permit and adjacent areas include:

- Increased acidity, total suspended solids, and total dissolved solids;
- Contamination from hydrocarbon usage;
- Contamination from rock dust usage;
- Contamination from road salt; and
- Contamination from coal haulage.

<table>
<thead>
<tr>
<th>CHANGE TO:</th>
<th>TEXT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 3.2.3</td>
<td>Section 3.2.3 Page PHC3-8</td>
</tr>
</tbody>
</table>

PHC3-8
Acidity, Total Suspended Solids, and Total Dissolved Solids Impact. As indicated in Sections 3.2.1 and 2.2.1 of this PHC, no significant impacts are expected to occur to the acidity of surface water in the permit and adjacent areas as a result of Skyline mining and reclamation operations. Likewise, no significant impacts are expected to occur to TSS concentrations in the permit and adjacent areas (see Sections 3.2.2 and 3.2.3 of this PHC).

TDS concentrations are elevated in the mine water discharge due to the use of gypsum-bearing rock dust. This impact is discussed in greater detail in the Rock Dust discussion of this section. Naturally occurring changes in TDS also occur in the permit and adjacent areas (see Plate 3 Appendix Volume A-1).

Hydrocarbon Usage Impact. The potential impacts of hydrocarbon usage are contamination of soils and surface water resulting from spillage of hydrocarbon based products during maintenance of equipment or from tank leakage due to rupture of the tank. These potential impacts are presently being prevented and mitigated through the Skyline Mines SPCC Plan (1991). These mitigations have been discussed in greater detail in Section 2.2 of this PHC. As a result of the implementation of this SPCC plan, the probability of spills and leaks of hydrocarbons contaminating the soil or surface water is low.

Rock Dust Usage Impact. Mine water discharge from Skyline Mines is high in sulfate and TDS concentrations due to the past usage of rock dust containing 40% gypsum. This high sulfate-TDS water from the underground workings is discharged to the surface water downstream of the mine portal facility. However, this effect becomes increasingly diluted with increased distance from the mine portal (see Table 2).

Elevated TDS concentrations in the mine discharge water may cause a decrease in biologic activity in Eccles Creek. However, the invertebrate study performed by Ecosystems Research Institute (1992) concludes that the elevated TDS concentrations in Eccles Creek due to the discharge of mine water are not acutely toxic to invertebrates. Chronic or long term toxicity has not been determined. In association with this invertebrate study, a dissolution study was
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TABLE 2
SULFATE AND TDS CONCENTRATIONS DOWNSTREAM OF THE MINE DISCHARGE

<table>
<thead>
<tr>
<th>Monitoring Point Number</th>
<th>Sulfate Concentration</th>
<th>TDS Concentration</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS-3</td>
<td>19.5</td>
<td>278</td>
<td>Upstream of Mine Discharge</td>
</tr>
<tr>
<td>CS-2</td>
<td>639</td>
<td>1246</td>
<td>Immediately Downstream of Mine Discharge</td>
</tr>
<tr>
<td>CS-6</td>
<td>405</td>
<td>860</td>
<td>Upstream of the RR Loadout</td>
</tr>
<tr>
<td>VC-9</td>
<td>385</td>
<td>860</td>
<td>Eccles Creek, Upstream of Confluence with Pleasant Valley Creek</td>
</tr>
</tbody>
</table>

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conducted to determine the potential yield of sulfate and TDS concentrations from the underground sump in the Skyline Mines and to predict how long the elevated concentrations may occur in the discharge water.

Calculations of total TDS concentration yield from rock dust were relatively consistent throughout the study, yielding 0.4 gram TDS concentration from one gram of rock dust. Assuming 75 million gallons have been discharged from the mine area to date, and an average TDS concentration of 1,200 mg/l in the discharge, approximately 625 tons of TDS concentration have been discharged from the mine. Subtracting background concentrations of 94 tons of TDS concentration yields 531 tons of TDS concentration which is equivalent to approximately 1,330 tons of rock dust. Skyline Mines estimates that between 1200 and 2,400 tons of rock dust were applied to the underground sump area of the mines. This suggests that in a worst case, half of the TDS concentration potential from rock dust has already been discharged. Thus, the elevated sulfate and TDS concentrations in the mine water will eventually decrease without further remediation efforts. Assuming that dissolution began when the mine sump began to fill in 1989, after a maximum of three years, sulfate and TDS concentrations will decrease and return to pre-sump concentration levels.

According to Ecosystems Research Institute (1992), discharge TDS concentrations will probably remain relatively constant until most of the TDS concentration has been leached from the rock dust. Sulfate concentrations will follow the same trend.

Use of gypsum-bearing rock dust has been discontinued and rock dust is monitored for gypsum.

It should be noted that no sulfate discharge standard has been promulgated in the Utah Department of Health Wastewater Disposal Regulations for any of the four surface water quality classifications in the permit and adjacent areas (1C domestic use with prior treatment, 3A cold water aquatic life, 4 agricultural uses, and 2B recreational use, excluding swimming). The only TDS standard is for Class 4 water, with a discharge limitation of 1200 mg/l.
Currently, only CS-12 slightly exceeds this standard. Since the standards are generally met, the impact from the additional input of these constituents to local streams from the mine water is considered low.

Road Salting Impact. Skyline Mines does not salt the roads on or adjacent to the permit area. Therefore, there is no road salting impact due to Skyline Mines operations.

Coal Haulage Impact. Coal is presently hauled along State Route 264 from the mine portal to the Railroad Loadout. Truck accidents along this road could spill coal onto the surface and any residual coal from the spill could wash down into Eccles Creek, increasing TSS concentrations and turbidity. Any spillages that do occur will be mitigated by swift and thorough cleaning of the spill.

Although experience here has indicated that the potential is low that such a spill would occur, the potential impact will be further minimized through the construction of an overland coal conveyor from the mine area to the railroad load out. This conveyor is planned to be completed by the end of 1992. After this conveyor is installed, approximately 5% of all of the coal produced will be hauled from the permit area by truck.

In addition to spills, wind may carry coal dust or small pieces of coal from the open top of the coal truck into creeks near the road. The potential impact from fugitive coal dust is considered to be insignificant due to the small amounts lost during haulage in the permit and adjacent areas. This potential impact will also be further minimized with the installation of the covered coal conveyor.

The overland conveyor is described in detail in the M&RP. This conveyor will be located north and uphill of the road above Eccles Creek. There is a small drainage ditch between the road and the conveyor. Small ephemeral streams cross under the conveyor and drain into the ditch or directly into the culverts. These drainage and ditch relief culverts flow under the road into Eccles Creek. If a rip occurred in the conveyor belt, coal could be spilled into the drainage...
ditch or across an ephemeral drainage. If this occurred during either a storm event or spring runoff, the fines could be carried into Eccles Creek, thus increasing TSS concentrations and turbidity.

The overland conveyor is covered on the top and sides throughout its length and is completely enclosed where it crosses the road and Eccles Creek near the Railroad Load Out. Thus, the potential for spill occurrence is minimized through the design of the conveyor.

In addition to the covered design of the conveyor, potential coal spills from the conveyor are prevented and minimized through:

- Daily inspection of the conveyor from the maintenance cart,
- Regular inspection of the conveyor by surface personnel traveling along the adjacent road,
- Magnetic removal of metal objects during processing that could potentially rip the conveyor,
- Electronic sensors for detection of conveyor failure which are located every 750 feet along the conveyor,
- Automatic shut-down of the system when failure is detected by the electronic sensors, and
- The implementation of the Coal Spill Mitigation Plan (1992).

In a worst-case coal spill scenario, the majority of the coal would be spilled across an ephemeral drainage during a storm event or spring runoff. According to the Coal Spill Mitigation Plan (1992), the maximum estimated coal spill would be 19 tons. This is based on assumptions of a maximum travel distance of 1,100 feet once a rip has occurred, a maximum load of 69 pounds of coal per foot of conveyor, and a 50 percent retention of coal along the ripped conveyor (at head of rip, belt fully unloaded; at tail of rip, belt essentially fully loaded).
Skyline’s response to this spill (Coal Spill Mitigation Plan, 1992) would occur within a maximum estimated time of 2 hours. Surface personnel would know that the belt was shut down due to a rip failure, as the rip location would be indicated on the monitor system. A crew would be dispatched to the affected area, and would determine the damage to the belt, and the extent of the coal spill. The first step to clean up the spill would be hand shoveling coal of sufficient depth. All remaining coal would be picked up using a portable "Guzzler" vacuum, owned by the mine.

First efforts will be concentrated in drainage ways. These critical areas will be cleaned up within a few hours of a spill, with the entire spill cleaned up within 24 hours. In winter, initial clean up will be done immediately. However, final clean up may have to be postponed until the snow leaves the area.

Potential impact from coal spills from the overland conveyor would be limited to small amounts of residual fines that reach Eccles Creek. Thus, the potential impact is low. The probability of occurrence of a coal spill from the overland conveyor is also low, due to design and preventative measures.

3.2.5 Potential Surface Water Quantity Impacts

Surface water availability may possibly be diminished through subsidence due to long-wall mining or through diversion from one drainage to another of groundwater that may feed the surface water further downstream. Surface water availability may also be increased in some streams due to mine-water discharges.

Subsidence is planned for Burnout Canyon. The effects of the subsidence on the streams in Burnout Canyon are being studied as part of a U.S.F.S. directed investigation of stream subsidence. It is planned that this will last for five years. It began during the summer of 1992 and as a result of the limited duration, no data are yet available. In the event that subsidence adversely impacts the Burnout Canyon drainage, Utah Division of Oil, Gas and Mining
3.2.6 Reduction in Burnout Creek Fishery Habitat Value by Subsidence

Any of the physical or chemical changes discussed in this section (3.2) could have an adverse effect on the value of the Burnout Creek fishery habitat. Of all of these possible failure modes, loss of flow would have the most serious and most immediate impact.

All consultant's estimates (see VHA Hydrology Report Vol. A-1) and all tests and observations made to date (see discussion in section 2.1.2 of this report) indicate that the high concentrations of montmorillonite quickly seal minor fracturing. Consequently, subsidence caused flow impacts to the fishery habitat should be minor to non-existent.

The potential for adverse chemical impacts from subsidence is also considered to be extremely low. This estimate is based on the absence of any known toxicants in any of the monitored surface or groundwater sources.
and mitigate the subsidence study area using appropriate measures. However, until the mode of failure has been determined through the subsidence study, the appropriate measures are unknown.

Utah Fuel Company has mined the permit area with longwall methods since 1986. Historically, there is no evidence of surface water loss or diminishment by subsidence (Volume 4 of the M&RP). When subsidence occurs, the subsidence cracks seal rapidly (DeGraff, 1978 and the 1990 Annual Report), preventing the deep percolation and subsequent loss of water previously destined for springs and other water sources. Therefore, with the exception of Burnout Canyon (discussed above), the probability of surface water availability being affected by the subsidence, is low (see also Section 3.2.3 of this PHC). Subsidence is adequately monitored under the subsidence monitoring plan (Part 4 of this M&RP).

As noted in Section 2.2.2 of this PHC, approximately 95 gpm of groundwater is currently diverted from the San Rafael Basin and discharged to the surface at Eccles Creek in the Price Basin. Long term, it is anticipated that approximately 370 gpm of groundwater will be diverted from the San Rafael Basin to the Price Basin. Although the Price Basin will experience an increase in flow, it is estimated that no significant decrease in the flow of streams in the San Rafael Basin will occur (for the reasons stated in Section 2.2.2 of this PHC).

As noted in Section 2.2.2 of this PHC, the effects of this groundwater diversion on springs that issue from the Blackhawk-Star Point aquifer to surface water will probably not occur for at least 11,000 years. The impact upon surface water in the area will be lessened in intensity due to the dampening effects of downgradient routing.
4.0 CONCLUSIONS

The potential impacts of these mining operations upon the hydrologic balance are summarized in Table 3. All of the potential impacts of mining on the hydrologic balance are being properly monitored and mitigation plans have been implemented.
<table>
<thead>
<tr>
<th>POTENTIAL IMPACT</th>
<th>POTENTIAL EFFECT</th>
<th>POTENTIAL MAGNITUDE OF IMPACT</th>
<th>PROBABILITY OF OCCURRENCE</th>
<th>MITIGATION MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaching of acid- or toxic-forming materials</td>
<td>Degradation of surface and groundwater quality.</td>
<td>Low (very infrequent and minor amounts of materials present)</td>
<td>Low</td>
<td>Monitoring materials handled in approved manner.</td>
</tr>
<tr>
<td>Groundwater availability</td>
<td>Decrease in spring flow due to subsidence</td>
<td>Low to moderate (depending on the spring)</td>
<td>Low (no history of impact)</td>
<td>Monitoring, monitoring</td>
</tr>
<tr>
<td>Groundwater availability</td>
<td>Interception of groundwater by mine workings</td>
<td>Low</td>
<td>High (ongoing)</td>
<td>Monitoring</td>
</tr>
<tr>
<td>Groundwater availability</td>
<td>Removal of water with coal</td>
<td>Low</td>
<td>High (ongoing)</td>
<td>Monitoring, discontinued use of gypsum rock dust, dilution</td>
</tr>
<tr>
<td>Groundwater quality</td>
<td>Decrease in quality due to leaching of rock dust</td>
<td>Low</td>
<td>High (ongoing)</td>
<td>Monitoring, SPCC plan, inspections and maintenance</td>
</tr>
<tr>
<td>Groundwater quality</td>
<td>Decrease in quality due to hydrocarbon usage</td>
<td>Low</td>
<td>Low</td>
<td>Monitoring, SPCC plan, inspections and maintenance</td>
</tr>
<tr>
<td>Sediment Yield</td>
<td>Increase in TSS</td>
<td>Moderate</td>
<td>Low</td>
<td>Sedimentation ponds, diversions, interior sediments, control, monitoring</td>
</tr>
<tr>
<td>Flooding</td>
<td>Damage to downstream areas</td>
<td>Moderate</td>
<td>Low</td>
<td>Sedimentation ponds, diversion, monitoring</td>
</tr>
<tr>
<td>Streamflow Alteration (Except Burnout Canyon, see below)</td>
<td>Damage to streams due to subsidence</td>
<td>Low</td>
<td>Low</td>
<td>Protection of perennial streams, monitoring</td>
</tr>
<tr>
<td>Streamflow Alteration</td>
<td>Short term increase in streamflow due to mine water discharge</td>
<td>High (ongoing)</td>
<td>High (ongoing)</td>
<td>Monitoring, limited duration</td>
</tr>
<tr>
<td>POTENTIAL IMPACT</td>
<td>POTENTIAL EFFECT</td>
<td>POTENTIAL MAGNITUDE OF IMPACT</td>
<td>PROBABILITY OF OCCURRENCE</td>
<td>MITIGATION MEASURES</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------------------------------------------</td>
<td>-------------------------------</td>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Streamflow Alteration</td>
<td>Damage to Burnout Creek due to subsidence</td>
<td>Unknown</td>
<td>High</td>
<td>U.S.F.S. directed study monitoring the effects of subsiding stream. Appropriate mitigation and remediation measures will be taken.</td>
</tr>
<tr>
<td>Surface water quality</td>
<td>Decrease in quality due to leaching of rock dust</td>
<td>Low to moderate</td>
<td>High (ongoing)</td>
<td>Monitoring, discontinued use of gypsum rock dust, dilution of inorganic rock dust</td>
</tr>
<tr>
<td>Surface water quality</td>
<td>Decrease in quality due to hydrocarbon usage</td>
<td>Low</td>
<td>Low</td>
<td>Monitoring, SPCC plan, inspections, maintenance</td>
</tr>
<tr>
<td>Surface water quality</td>
<td>Increase in TSS due to coal spills and wind blown coal dust</td>
<td>Low</td>
<td>Low</td>
<td>monitoring, safety measures, installation of covered conveyor</td>
</tr>
<tr>
<td>Surface water quality</td>
<td>Increase in flow of Eccles Creek due to mine discharge</td>
<td>Low</td>
<td>High (ongoing)</td>
<td>Monitoring, underground, ie., use of water</td>
</tr>
<tr>
<td>Surface water quality</td>
<td>Decrease in flow in San Rafael basin due to mine discharge</td>
<td>Low</td>
<td>High (ongoing)</td>
<td>Monitoring, underground, ie., use of water</td>
</tr>
</tbody>
</table>
5.0 REFERENCES


2.6 CLIMATE

The climate of the Skyline Mines area is typical of subalpine areas in the central region of Utah. In general, the summer season is short with maximum temperature readings (°F) in the 80's and minimum readings in the 40's. Fall and spring seasons are erratic in nature with snow precipitation occurring as early as September and as late as June. Winters are often severe, with recorded temperatures of -30°F or below. Snow frequently remains on the ground from November until June. Pre-construction meteorological studies performed for the Permittee show that the prevailing wind direction within the general area of the Skyline Mines site is south-southwest. Winds are generally parallel to the canyons except during storm periods. Seasonal wind direction variance is minimal.

At the minesite, a U.S. Weather Bureau station has been established and average monthly temperatures range from a low of 8°F in January to a high of 74°F in July. Extreme temperatures are about -30° and 86°F. Average annual precipitation is 22 to 26 inches, including 8 inches of rainfall from May to September. Potential evapotranspiration is less than 18 inches per year. Snowfalls generally occur during the months of October through May. During this period, snow accumulation averages 4.5 feet. Maximum snow depth to be expected is 9 feet. Although no site specific weather data is collected at the railroad loadout area and the waste rock disposal area, observations indicate that they receive less moisture than the minesite and therefore are assumed to receive less than 25 inches of moisture each year for bonding purposes.

2.6.1 Climatological and Air Quality Monitoring Program

To provide climatological and air quality information specific to the Skyline Mines site area, the Permittee contracted with Radian Corporation of Austin, Texas, to conduct an air monitoring program for a one-year period beginning January, 1979.
The monitoring program, designed to generate site specific data of the air quality and meteorological conditions of the Skyline area, involves three separate monitoring phases - preoperational, construction, and operational (life of the mines). The preoperational monitoring program included continuous meteorological monitoring of the Skyline site area for a 12 month period and 24-hour total suspended particulate (TSP) monitoring every third day for a period of six months (beginning May, 1979). Two locations, Boardinghouse Peak and Eccles Canyon, were selected as monitor station sites for the preoperational phase monitoring program.

On July 1, 1984, an approved NOAA weather station was placed in operation at the portal area. Operators were trained by the National Weather Service and are continuing to record temperature and precipitation data. These data are adding to the available baseline started by Radian Corporation. All climatological data obtained, including that taken at the mine, are published monthly by the National Climatic Data Center, Asheville, North Carolina. The climatological summaries presented in this document are taken from the NOAA reports of 1984 through October, 1991. A summary of these data is included in Volume 4. The complete Radian Corporation report may be found in the Air Quality Section of Appendix Volume A-1.

All equipment utilized by Radian in the performance of air quality and meteorological sampling was approved by the EPA for use in similar applications. Following are detailed discussions of the preoperational monitoring programs conducted at each site.

Boardinghouse Peak Monitoring Program

The lack of electrical power at the Skyline Mines site during the monitoring program required the selection of Boardinghouse Peak as the location of the continuous monitoring system. Boardinghouse Peak is 2 miles to the south of the Skyline portal site. On Boardinghouse Peak, an existing shelter with sufficient
electrical power was adapted to house the data acquisition systems. At the Boardinghouse Peak site, the monitoring program included:

- Continuous meteorological monitoring of wind speed, wind direction, and temperature at a ten meter level.
- Solar radiation and rainfall/snowfall are recorded continuously at ground level.
- A battery-powered mechanical weather station for redundancy and assuring data gathering in the event of power failure.
- Twenty-four hour high volume particulate samples collection every third day (beginning on or about May 1, 1979) with monitoring to continue for a six month period.
- Noise monitoring, performed twice, once in the spring and again in the fall of 1979. Each field sampling involved a three to four day sampling period.
- Upper air studies of wind speed, wind direction, temperature and air pressure performed once each month using a Radiosonde-type system.

Eccles Canyon Monitoring Program

To obtain data at the location of the Skyline portal site, Radian Corporation positioned a battery-powered mechanical weather station within the boundaries of this site. The mechanical weather station monitors wind speed, wind direction and temperature. The monitoring program in Eccles Canyon was designed to coincide with the monitoring periods of the Boardinghouse Peak program.

Radian Corporation also monitored TSP at various locations in Eccles Canyon to provide site specific data for the Skyline.
portals. Monitoring at the portal site location, which lacked continuous electrical power, required portable electrical generation and supervision for each 24-hour sample period. Ten samples were taken coinciding with sampling days at the Boardinghouse Peak facility. TSP samples were also collected on a three day basis at the mouth of Eccles Canyon, near Clear Creek, Utah, which is the location of the train load-out facilities for the Skyline facilities for the Skyline Mines.

2.6.2 Synopsis of Data

A summary discussion of the Radian Corporation report follows.

The results of the meteorological and air quality studies indicate that the air quality of the Skyline project area is very good to excellent. Air in Eccles Canyon during 1979 was of poorer quality due to an unpaved dirt road leading from the mouth of the canyon up past the proposed portal site. The Permittee, in conjunction with the State of Utah, through the Utah Resource Development Act, paved this road in 1982 to accommodate traffic, which resulted in a reduction of particulate emissions from road traffic.

Presented below is a summary of the monitoring program results from January 1, 1979 through December 31, 1979.

See Section 4.22 - Air Pollution Control Plan for current Air Quality permit.

Boardinghouse Peak - Monthly averages

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Speed (MPH)</td>
<td>11.7</td>
<td>17.1</td>
<td>14.7</td>
</tr>
<tr>
<td>Temperature (OF)</td>
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<td>57.6</td>
<td>37.3</td>
</tr>
<tr>
<td>Pyranometer (Langleys)</td>
<td>151.2</td>
<td>678.5</td>
<td>413.5</td>
</tr>
<tr>
<td>Net Radimeter (Langleys)</td>
<td>31.5</td>
<td>294.1</td>
<td>150.2</td>
</tr>
<tr>
<td>Total Suspended Particulates (ug/cu.m)</td>
<td>23.0</td>
<td>49.5</td>
<td>30.3</td>
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</table>

Revised: 12-30-16
Eccles Canyon - Monthly Averages

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Speed (MPH)</td>
<td>1.5</td>
<td>3.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Temperature (°F)</td>
<td>-1.4</td>
<td>63.2</td>
<td>35.5</td>
</tr>
</tbody>
</table>

Clear Creek

The TSP sampled at the Clear Creek monitoring station averaged 61.7 ug/cu.m.

Upper-Level Atmospheric Studies

During the upper-level atmospheric studies several different weather conditions occurred. The studies determined the relationship of the topographical features and temperature and wind flow effects. The findings were:

- Deep surface-based temperature inversions were detected in Eccles Canyon during several morning pilot balloon runs. These inversion layers ranged in depth from about 100 meters to 500 meters.

- During the July sampling period, solar radiation was found to result in large increases in temperatures near the surface of Eccles Canyon, while at the Boardinghouse Peak site, the daytime increase in temperature was relatively small.

- Most of the Eccles Canyon afternoon soundings during the July sampling period showed that, even at heights well above the tops of the canyon walls, temperatures were notably warmer than during the morning at the same levels, indicating that heating of the canyon floor on sunny days influenced temperatures at considerable heights above the canyon floor.

- Daytime up-valley winds in Eccles Canyon, which were typically east-northeasterly, were found to be quite shallow (generally less than 100 meters). With increasing height
above the canyon floor, wind directions quickly turned toward the direction of flow at levels above the canyon. While many of the soundings were conducted when daytime up-valley flows were occurring, only one sounding was conducted early enough in the morning for the nocturnal down-valley flows (generally westerly) to still be present. However, the sounding data showed that the down-valley flow was quite shallow, probably less than 100 meters.

- The daytime up-valley flows tended to be overridden by the large scale flow over the region and by channeling effects during cloudy conditions and/or when the large scale flow was relatively strong.

- Wind speeds generally increased with height above the floor of Eccles Canyon.
2.7 VEGETATION

2.7.1 General Description

Complete vegetative baseline data are in Appendix Volume A-2 and entitled, "Report of Vegetation, Plant, Community Analysis, Threatened and Endangered Plant Species, Soils and Reclamation Plans".

The Skyline project area and adjacent areas occur within an aspen-spruce-fir phase of the boreal forest brome, with representatives of cool desert shrub, riparian, and, to a lesser extent, the mountain brush community types present as significant, though minor, components.

The spruce-fir community, a type mainly on north-facing slopes, is dominated by Engelman spruce and subalpine fir, with variants supporting admixtures of aspen and wet meadow subtypes characterized by species of sedges and grasses. The forest floor is frequently subjected to dense shade.

The aspen community is a forb type with *Populus tremuloides* as the principal tree species. A small percentage of the project area is dominated singularly by aspen. South-facing slopes and ridges are the main localities of this community. It is transitional, however, to the aspen, grass, forb, elderberry community.

Species diversity in the aspen community is great. The main ground layer species are the same as those in the aspen, grass, forb, elderberry community with which the aspen community is transitional. More than 80 species of plants are present in the aspen community.

The environmental assessment for Whisky and Woods Canyons indicate the following vegetative communities:

"Much of the ridge top areas, and some of the canyon bottoms, are covered by the mountain grassland community. Mountain brome (*Bromus carinatus*) and slender wheatgrass (*Elymus trachycaulus*) are the dominant species. Other grasses, forbs, and

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browse species are common. Some of the slopes above riparian areas are covered by the upland sedge-grass community with Carex geyeri. The ridge tops also contain the sagebrush-grass community in some areas. The dominant species are Vasey sagebrush (Artemisia tridentata var. vaseyana), slender wheatgrass, and subalpine needlegrass (Stipa columbiana). Other common species in the sagebrush-grass community are low rabbitbrush (Chrysothamnus viscidiflorus), Louisiana sagewort (Artemisia ludoviciana), aster (Aster spp.), yarrow (Achillea millefolium), and Indian paintbrush (Castilleia spp.).

A few small meadows occur in the canyon. They are generally dominated by species of Poa with some sedges and carex intermixed. They are generally productive.

Riparian areas exist along streams and at seeps and springs. The vegetation along the water edge consists of species of Carex, Poa, and to a lesser extent sedges. Some willow is present along the streams.

Eccles Canyon is vegetated by similar plant communities as described for the rest of the project.

Plate 2.7.1-1 shows the locations of the various plant communities of the areas to be mined. The plant communities are in the soil and vegetation section of Volume A-2 along with other vegetative studies and maps. Plate 2.7.1-2 shows the location of the various vegetative reference areas. GPS coordinates are included on plate 2.7.1-2 to simplify navigation to each area for division personnel. Per request from division staff, a single reference area was chosen from Welsh 1980 to represent each plant community. This was done using aerial imagery, and was field verified by qualitative ocular methods during the summer of 2016. Should any of these reference areas prove unsatisfactory in the future, one of the original reference areas from Welsh 1980, or subsequent studies, will be evaluated by the mine and submitted for division approval as a new reference area for the affected plant community. Each reference area comprises at least 1 ac² from the GPS point up to the extent of the representative plant community as outline on plate 2.7.1-1. The limits of the surface disturbance are shown on Plates 3.2.1-1, 3.2.1-3, 3.2.3-3a thru 3.2.3-3h and 4.16.1-1B. A species list by plant community with a discussion of the methods used in the community analysis are presented in the Appendix Volume A-2.

2.7.2 Community Analysis - Results and Discussion

Greatest diversity of species was observed in the reference area transects occupied by aspen, and by the grass-forb-elderberry with which it is intergraded. Those two types includes from 23 to 32 plant species in transects and in the productivity plots. Spruce-fir transects yielded from 17 to 26 species of plants and the riparian communities 15 to 26 species. The community type with least diversity in the reference areas was the sagebrush community, ranging from 10 to 14 species.

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Sites in the reference areas differed in the production of herbage which can be eaten by livestock. Aspen and grass-forb-elderberry communities vary from 451.8 to 835.5 pounds per acre. Sagebrush exceeded that productivity with approximately 917.1 pounds per acre. Spruce-fir is assumed to be non-productive because of shading and poor representation of species in the forest floor. The riparian habitats measured in the reference areas yielded only 180.5 and 286 pounds.

The importance of the aspen and grass-forb-elderberry communities, which occupy approximately 42 percent of the permit area, is seen in the comparison of area occupied by that community and that occupied by other types.

The sagebrush-snowberry, sagebrush, and fringed sagebrush occupy only 13 percent of the project area. They occur mainly on shallow soils. Collectively they are diverse, with approximately 90 species of vascular plants. Fringed sagebrush occurs on only one percent of the area and is confined to ridge crests at high elevations. Only 16 species were noted in this type area.

The riparian community type consists of continuous strips of vegetation along the major drainages, as in the valley bottoms of Huntington Creek, Eccles Creek, and other minor tributaries. The community also occupies spring lines, seeps, and perennial channels down slope from minor springs, as in the valley of Huntington Creek. Dominant species on the wet lands are red top, silver sagebrush, sedge species, grasses, and numerous forbs.

Despite the importance of spruce-fir and spruce-fir-aspen community in the total vegetative cover of the permit area, these types are of little value in forage production. They are of value, however, in the protection of both wildlife and livestock. The dense shade provides cool bedgrounds and wildlife cover, while main grazing areas are in adjacent aspen and grass-forb-elderberry communities.

Wood production of aspen is equaled by spruce and fir species. All types produced an annual growth increment averaging 4.2 mm per year. Aspen occurs in a density of only one-third the number of trees per acre when compared to spruce and fir. Spruce and fir production is most significant as a timber source, and historically has contributed substantially to lumber production.

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in the permit area and in Eccles Canyon, where scars of drag roads provide evidence of lumbering operations.

Sagebrush and snowberry-sagebrush communities are productive (917.1 pounds per acre) and extensive, representing approximately 13 percent of the permit area. Despite the relatively small area occupied, the type is of much importance to grazing and browsing animals.

Relative vitality of tree stands indicates that aspen sites are composed of different size classes: young, moderate, and old. This seems to assure the continuity of the aspen community. Where aspen grows in an admixture with spruce and fir, it appears that the woodland is successional with trends towards dominance by the coniferous species. In more xeric sites, the stand of aspen is composed of trees of all age and size classes. In that site, there is a substantial understory of chokeberry which is subordinate to the aspen overstory.

The composition of the spruce-fir community at the portal-yard area indicates a climax forest dominated by spruce, with young, intermediate, and old trees being represented. Fir trees are represented by a large number of seedlings, but the lack of trees of intermediate and older ages suggests that fir is not successful in dominating the forest type.

Total productivity of the areas to be disturbed is 519 animal unit days. This area will be lost to production during the active period of mine operation. Assuming a grazing period of three months (July, August and September), the reduction is then equivalent to the loss of thirteen cow-calf unit months.

2.7.3 Threatened and Endangered Plant Species

Passage of the Endangered Species Act of 1973 provided the legal basis for establishment of lists of endangered and threatened plant species. Such lists were prepared under direction of the Smithsonian Institution, and were published subsequently in the Federal Register (40:27824-27924. 1975; and 41:24524-24572. 1976). United States Fish and Wildlife Service and the United States Forest Service lists of threatened, endangered and sensitive species are listed in Tables 2.9-4 and

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2.9-6. Work on endangered and threatened plants of Utah has been reviewed by Welsh, Atwood, and Reveal (1975), Welsh (1978), and reevaluated by the Utah Division of Wildlife Resources (1999) Table 2.9-5. The region under investigation was included in a report on threatened and endangered species of the Central Coal Lands of Utah (Welsh, 1976).

A survey of the literature has failed to indicate the presence of any of the proposed endangered or threatened plant species in the area. This lack of critical or unique species is supported by the field surveys of the lease areas during initial investigation.

The region was searched on a quarter section by quarter section basis, with each community type within each quarter section being traversed. All community types were systematically searched by study teams walking parallel transects through the larger communities, and by individual search in the smaller vegetative types. No threatened or endangered species were encountered in either the permit area or surrounding areas.

2.7.4 Potential for Reestablishing Vegetation

Disturbed areas were present in the original proposed permit area, due to a small underground mine in Eccles Canyon which was abandoned long ago. The area had been slightly treated to reclamation procedures.

Crested wheatgrass, intermediate wheatgrass, smooth brome, orchard grass, tall oatgrass, bulbous wheatgrass, and bluegrass are introduced species which are now naturalized in the area. Numerous examples of natural re-establishment exist in the portal area and along Mountain Fuel Company pipeline corridor which transverses the ridge dividing Huntington Creek and Clear Creek drainage. Native species noted in the disturbed areas include yarrow, Artemisia species, aster, sedge, rabbitbrush, thistle, penstemon, bluegrass, cinquefoil, western coneflower, red elderberry and horsebrush.

Sparingly-vegetated sandstone ledges occupy approximately one percent of the project area. Species present on the ledges include serviceberry, aster, sedge, ferns, and others which are uncommon in the more densely-vegetated communities.

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Revegetation efforts on slopes over 60 percent at the mine site have been disappointing. On these steep slopes at the mine site several different techniques have been used on different occasions with very little success. These techniques have included burlap netting, hydromulching, hand seeding and transplanting of shrubs and seedlings. Revegetation on these slopes may have to be postponed until final reclamation when the slope angle will be altered making successful revegetation much more probable.

2.7.5 U. P. & L. Tract

The general vegetation community mapping was done using existing U. S. Forest Service vegetative type maps prepared by the Manti-LaSal National Forest, Price, Utah, aerial photography, and limited ground truthing. These vegetative communities are shown on Dwg. 2.7.1-1a.

There are four vegetative communities within the tract. They are the sagebrush/grass, riparian, conifer-timber and the aspen vegetative community. The following table presents the approximate number of acres associated with each vegetative community.

<table>
<thead>
<tr>
<th>Vegetative Community</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagebrush/grass</td>
<td>103</td>
</tr>
<tr>
<td>Riparian</td>
<td>13</td>
</tr>
<tr>
<td>Conifer-timber</td>
<td>103</td>
</tr>
<tr>
<td>Aspen</td>
<td>240</td>
</tr>
</tbody>
</table>

Sagebrush/grass communities are dominated by two species of sagebrush, Mountain Bigsage (Artemisia tridentata var. vaseyana), and Silver Sage (Artemisia cana). Grass species include Slender wheatgrass (Agropyron trachycaulum), subalpine needlegrass (Stipa lettermannii), and Sandbury blue greass (Poa secunda). Other common species in the community are low rabbitbrush (Chrysothamnus viscidiflorus), Lousiana sagewort (Artemisia ludoviciana), aster (Aster spp.), yarrow (Achillea millefolium), and Indian paintbrush (Castilleja spp.), Western coneflower (Rudbeckia occidentalis), Sweet Cicely (Osmorhiza occidentalis), and Lovage (Ligusticum porteri).

The riparian communities are immediately adjacent to the creek beds and vary from only one to two feet on either side of the stream channel to several feet wide. The drier areas of the riparian

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community are comprised of species such as Kentucky bluegrass (Poa pratensis), bentgrass (Agrostis alba) and Ross sedge (Carex rossii). The wet portions would include species such as Water sedge (Carex aquatilis), Nebraska sedge (Carex nebraskensis), Baltic rush (Juncus balticus), and Hairgrass (Deshampsia caespitosa).

Conifer-timber lands are dominated by Englemann spruce (Picea englemanni), and subalpine fir (Abies lasiocarpa). Since the overstory of conifers is quite often very dense the understory varies from relatively little to moderate ground cover, and is often comprised of Gooseberry (Ribes montigenum), Arnica (Arnica cordifolia), Groundsel (Senecio serra), and Lupine (Lupinus alpestris).

The Aspen community is the most common community in the tract area. Aspen (Populus tremuloides), is the dominant overstory species. Depending on the area and environmental variables, Snowberry (Symporicarpos oreophilis), Red elderberry (Sambucus racemosa), Oregon grape (Mahonia repens), Western coneflower (Rudbeckia occidentalis), Groundsel (Senecio serra), Needle and Threadgrass (Stipa columbiana), and Kentucky bluegrass (Poa pratensis) are the dominant understory species.

Within the proposed tract there are no existing farmlands, prime or unique rangelands.

Since there are no surface facilities planned in the tract, the potential for disturbance is limited to that caused by subsidence. Subsidence monitoring on areas already mined indicates that subsidence damage is minimal.

James Canyon Area

In August, 2001, the permittee placed a pipeline and buried power line in James Canyon in an abandoned county road. The pipeline originated at a drill pad located in the SW1/4SW1/4, Section 35, T13S, R6E. Refer to Sections 2-11 and 4-20 for additional information.

The buried power line originated at the Questar property at the head of Boardinghouse Canyon and continued along the Monument Peak Road to the head of James Canyon where the power line

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continued down James Canyon to the drill pad. Vegetation, consisting of grasses, rabbit brush, and sagebrush had encroached upon the abandoned road since its closure. The road was reportedly reseeded in the early 1970's but the exact seed mix used is not known at this time.

No permanent significant modifications to the current land surface are anticipated to occur. No work will occur outside the boundaries of the abandoned county road. Vegetation that is present in the area of the excavation will be removed and redistributed with the topsoil.

The pipeline and power line were reclaimed immediately after construction. The power line trench has been compacted and regraded. The pipeline surface was deep gouged and left in a roughened condition. The area disturbed was reseeded with a seed mix based on the results of vegetation study of the area conducted in September of 2001 (refer to seed mix listed below).

A vegetation study was conducted by Mt. Nebo Scientific in the James Canyon area in September of 2001 with the report completed in October of 2001. The study was performed on an area approximately one acre in size located adjacent to the disturbed road. The study area is to be used as the “Reference Area” for determining final revegetation success. Refer to Drawing 2.7-1-1(a) for the location of the reference area.

The data obtained from the study show the understory cover to be 58.13% and the overstory cover as 6.36%. The mean total living combined cover is 64.50%. The most common overstory species is aspen (Populus tremuloides). The aspen overstory cover was 5.88%. The vegetation report is incorporated in Appendix A-2.

White fir (Abies concolor) and subalpine fire (Abies lasiocarpa) are in the immediate area.

The woody species density in the “Reference Area” was a total of 47 individuals per acre with the aspen comprising most of the density at nearly 43 individuals per acre. The most common understory specie is slender wheatgrass (Elymus Trachycaulus) the next common specie was Western coneflower (Rudbeckia occidentalis).

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Seed Mix

A list of plant species suggested to be used for a seed mix for revegetation at final reclamation has been provided below. This list was formulated based on the sample data from the study previously described of the native plant communities in the area, and communications with biologists from the State of Utah, Division of Oil, Gas & Mining, the USDA Forest Service, as well as seed vendors for consideration of seed availability at the proposed seeding dates. Slight alterations to the list may still be necessary when the seed mixtures are prepared. These alterations will be approved by the Division and Forest Service prior to implementation.

The vegetative survey described above was performed by Dr. Patrick D. Collins, Mt. Nebo Scientific in accordance with guideline supplied by the State of Utah, Division of Oil, Gas & Mining. The report can be found in Appendix A-2.

Revegetation Standards for James Canyon Road

A representative of the NRCS informed the permittee that the US Forest Service had jurisdiction over forest lands and would need to make the productivity determination for the reference area. Rod Player of the US Forest Service was contacted and agreed to determine the productivity of the general area, in conjunction with the productivity of the reference area.

Since the area of disturbance related to the James Canyon project was previously disturbed, the vegetation on the redisturbed area was not representative of the native/natural vegetation. We must therefore use the "estimates for similar sites" mentioned in R645-301-321.200, and use the data collected for the reference area as revegetation success standards, since there is not available data for the site prior to disturbance.

The success standards for revegetation in James Canyon will be based on the reference area described in the report called "Vegetation Reference Area in James Canyon" (Mt. Nebo Scientific, Inc., October 2001, Appendix A-2). Bond release will be based on the total cover, woody species density, and annual biomass productivity of the reclaimed areas. These parameters will be evaluated with the reference area by comparing quantitative data of the final 2 consecutive years.

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of the 'responsibility period'. To meet the objectives for final revegetation success and bond release, these parameters in the reclaimed areas must be equal or exceed 90 percent of the reference area. Additionally, the reclaimed areas will be compared with the reference area for diversity by appropriate diversity indices.

The reference area chosen in James Canyon (see report: "Vegetation Reference Area in James Canyon", October 2001, by Mt. Nebo Scientific, Inc., Appendix A-2) will be used to determine final revegetation standards for cover productivity, woody species density, effectiveness, seasonality, and diversity. Cover and woody species densities are shown in the Mt. Nebo report. Diversity, seasonality and other parameters can also be established from that report or when final quantitative sampling is done for bond release. Current biomass productivity estimates have been made by the USDA Forest Service (see letter to Vicky Miller dated August 12, 2002). Production measurements of the reference area and reclaimed areas will also be performed and compared during sampling for final bond release.

In the report "Vegetation Reference Area in James Canyon", October 2001, prepared by Mt. Nebo Scientific, Inc., there were 47 woody species per acre inventoried in the reference area in September 2001. To enhance the reclamation of the road and drill pad area, 100 seedlings will be planted during reclamation of the area. The 100 seedlings will include 45 snowberry bushes (Symphoricarpos oreophilus), 35 quaking aspen (Populus tremuloides), and 20 white fir (Abies concolor).

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<table>
<thead>
<tr>
<th>Final Revegetation Seed Mix for the Aspen/Mountain Herblands in James Canyon</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SHRUBS</strong>^2</td>
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<tr>
<td>----------------</td>
</tr>
<tr>
<td>Artemisia tridentata var.</td>
</tr>
<tr>
<td>Sambucus racemosa</td>
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<tr>
<td>Symphoricarpos oreophilus</td>
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<tr>
<td><strong>FORBS</strong>^2</td>
</tr>
<tr>
<td>Achillea millefolium</td>
</tr>
<tr>
<td>Linum Lewisii</td>
</tr>
<tr>
<td>Lupinus alpestris</td>
</tr>
</tbody>
</table>

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2-61b
2.7.6 VEGETATION OF THE NORTH LEASE TRACT AREA

The North Lease Tract Area is located adjacent to the northernmost boundaries of the current Skyline Mine permit area. Much of this area is located within and adjacent to Winter Quarters Canyon.

The Winter Quarters Ventilation Facility (WQVF) is the only surface disturbance in the North Lease. A review of the existing information and data of the North Lease Tract and adjacent areas was done as the North Lease was permitted. Subsequently, a detailed vegetation survey has been conducted in Winter Quarters Canyon in the vicinity of the WQVF.

During August 2002 aerial photographs, collecting both infrared and black and white images, were taken of the North Lease Tract area to provide baseline vegetation data. Aerial photographs are taken annually, and will continue to be taken to detected variances from the baseline. Annual photographs will be interpreted by a qualified person and a report prepared for inclusion in the annual report.

PLANT COMMUNITIES
A report was prepared earlier by Mt. Nebo Scientific, Inc. (Collins 1992) of the vegetation of the Winter

<table>
<thead>
<tr>
<th>Plant Species</th>
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<th>Live Seed Seed</th>
<th>Acre</th>
<th>Square Feet</th>
</tr>
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<td>Osmorhiza occidentalis</td>
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<td>Penstemon strictus</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Viguiera multiflora</td>
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<td>3.63</td>
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<tr>
<td><strong>GRASSES</strong></td>
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</tr>
<tr>
<td>Bromus carinatus</td>
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<td></td>
</tr>
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<td>Elymus trachycaulus</td>
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1. Broadcast Rate
2. Species changes may be made by a qualified botanist based on availability.
PLS = Pure Live Seed
AC = Acre
FT² = Square Feet

Revised: 9-16-10

INCORPORATED

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Div. of Oil, Gas & Mining
Quarters Canyon area (North Lease Tract Area). This report was submitted to the USDA Forest Service. The report has been included in Appendix A-2.

Methodologies for this previous study relied on general vegetation mapping done by using existing information and limited ground-truthing techniques. Most of the mapping was done using existing maps and data from range analyses prepared by the USDA Forest Service (Manti-LaSal National Forest, Price, Utah).

Plant community named in the aforementioned study were revised to be consistent with the existing vegetation map of the permit area (Drawing 2.7.1-1a). The existing vegetation map of the area was revised using both black and white and color aerial photography. No field work or ground-truthing methods were implemented.

In October 2002 the vegetation at specific sites along the perennial streams within the North Lease was ground-truthed. This information is included in Appendix A-2 titled, "Riparian Plant Community Survey near Scofield, Utah - Winter Quarters and Woods Canyon 2002". Also in Appendix A-2 is "Biological Studies in Winter Quarters Canyon Creek and Woods Canyon Creek - A Study Plan" dated April 2005. The Study Plan outlines the method to be used to collect both qualitative and quantitative data to delineate areas of riparian vegetation. Using USFS Level III protocol transect lines will be established perpendicular to the stream channel at approximately 800-foot intervals for a baseline vegetation survey. Two years prior to longwall undermining any section of perennial streams, the transect interval will be increased to approximately 400-feet and surveyed each subsequent year through two years after mining has been completed for each longwall panel. The combined increase in transect interval and surveying the transects on an annual basis will provide adequate monitoring of the riparian areas. In addition, since riparian vegetation is closely related to the available flow in the perennial sections of the stream, additional flow monitoring sites have been established in the perennial sections of the stream that correspond to the longwall panels and areas of possible subsidence (See section 2.4.4 for monitoring plan details, Figure 2.3.6-2 for locations). Subsequent to the data collection outlined in the "Biological Studies Plan" in 2005, the baseline information will be submitted to the Division, to be included in Appendix A-2. All additional information will be submitted on an annual basis or as the information becomes available. The survey was expanded in 2010 to include additional portions of Woods Canyon Creek.

The North Lease area was expanded in 2013 to include a small area north of Woods Canyon in the Fish Creek drainage. Although not significantly different, an additional vegetation evaluation was conducted by Mt. Nebo Scientific, Inc., which confirmed the vegetation in the expansion is not significantly different from the rest of North Lease (See Appendix A-2) INCORPORATED JAN 03 2014

Aspen
The Aspen community was the most common vegetation type of the Winter Quarters Tract Area.

Revised: 10-1-13 2-61d
Aspen (Populus tremuloides) was the dominant overstory species, whereas, depending on the area and environmental variables, snowberry (Symphoricarpos oreohiphus) or Oregon grape (Mahonia repens) were the dominate understory species.

**Conifer Timber**

Also important by relative number of acres, these communities were dominated by Engelmann spruce (Picea engelmannii) and subalpine fir (Abies lasiocarpa). Understory varied from relatively little to moderate ground cover, and often was comprised of gooseberry currant (Ribes montigenum).

**Sagebrush**

The Sagebrush communities that were mapped were dominated by Vasey sagebrush (Artemisia tridentata var. vaseyana) and various grass species i.e. slender wheatgrass (Elymus trachycaulus) and subalpine needlegrass (Stipa columbiana). Other common species of the community were low rabbitbrush (Chrysothamnus viscidiflorus), Louisiana sagewort (Artemisia ludoviciana), aster (Aster spp.), yarrow (Achillea millefolium) and Indian paintbrush (Castilleja spp.).

Although surface disturbances are not planned and the submittal of quantitative data was not necessary for the North Lease Tract Area, baseline quantitative data of many of the same communities located near the Skyline Mine site have been taken for previous studies. These additional data sets have also been included in Appendix Volume A-2 of the Skyline Mine MRP.

**THREATENED & ENDANGERED PLANT SPECIES**

Per personnel communication with Bob Thompson, USFS Botanist on November 1, 2002, “none of the currently listed USFS threatened, endangered or sensitive species are found in the Winter Quarter’s Lease area”. In addition to their being no species of concern in the USGFS Winter Quarter’s Lease area, no surface disturbance is planned for the area.

An additional review was conducted by Mt. Nebo Scientific, Inc. in 2012 for the North Lease extension. No threatened, endangered or sensitive species were added or found in the area (See Appendix A-2).

**HABITAT LOSS**

In the unlikely event it is determined that mining-related subsidence causes material damage or a loss.
of riparian habitat, the Permittee commits to using the best technology currently available (BTCA) to mitigate the damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and USFS personnel. Repairs related to disruption of a water supply are addressed in Section 2.5.3.

2.7.7 VEGETATION OF THE SCOFIELD WASTE ROCK SITE

The Scofield Waste Rock site was expanded in 2007 into areas (approximately 5.13 acres) that were previously undisturbed by mining activities. In the 1990s the northern and eastern portions of the area were disturbed with logging activities. Soils and Vegetation information that was collected in 1981-82 was updated in 2007 with information specific to the Refuse pile expansion. The 2007 information is grouped into two (2) separate reports, the first report summarizing the preliminary qualitative vegetation data with the second compiling the remaining qualitative and quantitative data. Quantitative data was not collected during the preliminary report due to the season of data collection (late Fall 2006). The 2007 reports focused on baseline information for reclamation and identification of threatened and endangered species. No threatened or endangered species were identified. The 1981-82 information is located in Appendix Volume A-2, with the 2007 reports being located in Appendix Volume A-2, Volume 2, respectively.

Vegetation resources are protected and enhanced at the Waste Rock site through contemporaneous reclamation of the site as it is being filled. The 2007 vegetation study established a reference area for a reclamation standard and also insured no sensitive, threatened or endangered species exist at the site. For additional information on revegetation of the site, see Sections 3.2.8 - Plan for Disposal of Waste Rock, and 4.7 - Revegetation Plan of the M&RP.

2.7.8 WINTER QUARTERS VENTILATION FACILITY

The Winter Quarters Ventilation Facility (WQVF) was necessary to provide ventilation for underground mining located north of Winter Quarters Canyon. Both Soils and Vegetation information specific to the WQVF site were collected in 2008 with a second revised report drafted in 2009. Plate 2.7.1-1a was qualitatively updated in 2007. In 2008, a site-specific report focused on acquiring baseline vegetation information for reclamation and identification of threatened and endangered species for the WQVF. The revised report drafted in 2009 was necessary due to changes in the pad design that eliminated impacts to the riparian areas. The modified pad design minimizes affects to the riparian areas by keeping the disturbed area a minimum of two stream widths from the stream bank (approximately 24 feet). In general, the WQVF pad site encompasses a sagebrush and mountain brush south-facing hillside, and minimal riparian areas that have had significant detrimental affects due to heavy livestock use and noxious week infestation. Conversations with vegetation consultant Dr. Patrick Collins suggest successful revegetation of the riparian areas is very likely due to the combination of vegetation species and available water. No threatened or endangered species were identified. The vegetation report is located in Appendix A-2, Volume 2. The vegetation report focused on the riparian areas is available on request. The existing Winter Quarters Canyon road was improved with additional road base, gravel, and drainage, but no vegetation was affected because the improvements remained within the footprint of the existing road.
2.7.9 North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft is constructed to provide adequate ventilation for completion of the North of Graben mining district. The shaft was necessary due to encountered geologic conditions that required turning two (2) separate mining districts into one (1). The facility will include one (1) 5-foot diameter, unlined shaft. The area permitted for the bleeder shaft is approximately 3.0 acres, with a disturbed area of approximately 1.7 acres. Both soils and vegetation information specific to the site were collected in 2014 prior to construction. In general the NOG Bleeder Shaft site encompasses a mix of musk thistle, cheatgrass, bluebunch wheatgrass, and aspen on south-facing hillside located approximately 200 feet downhill from the existing Granger Ridge USFS road. A portion of the new access road will be constructed in an area that had been disturbed previously by other activities, and appears to have been later re-seeded. Attempts were made to minimize the size of the pad utilizing the existing flat areas adjacent to the USFS road, but geologic conditions prohibited placing the shaft on the road. No threatened or endangered species were identified. The vegetation report is located in Appendix A-2, Volume 2 (Vegetation of the NOG Ventilation Site 2014, Mt Nebo Scientific).

2.7.9 Swens Canyon Ventilation Facility

The Swens Canyon Ventilation Facility (SCVF) was necessary to provide both ventilation and power for underground mining in the Flat Canyon Lease - Southwest Reserves portion of the mine. Both soils and vegetation information specific to the SCVF site were collected in 2014 prior to construction. In general, the SCVF pad site encompasses a sagebrush and mountain brush south-facing hillside. The existing access road up Swens Canyon was modified slightly, moving it closer to the creek to better utilize a generally flat portion of the valley upland area to minimize the disturbance of constructing the SCVF access road. No riparian vegetation was disturbed. No threatened or endangered species were identified. The vegetation report is located in Appendix A-2, Volume 2 (Vegetation of the Powerline Corridor & Swens Canyon Pad 2014, Mt. Nebo Scientific).

2.7.10 Flat Canyon Lease Area

The Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) in 2002 determined there were no threatened and endangered, or sensitive species present in the lease area. In February 2013, Allen Rowley, Acting Forest Supervisor for the Manti LaSal National Forest determined the 2002 EIS was current and did not need additional updating. As described in the EIS the area is comprised of approximately 2.5% grasslands, 2% meadows/wetlands, 24% sagebrush/grass, 27.5% conifer-timber, and 44% aspen (Flat Canyon Coal Lease Tract – Final Environmental Impact Statement (FEIS), January 2002, (Section3.17 pg. 3-25. Included as Figure 2.7.9-1 (pg. 2-63b) is FEIS Figure 3.5 Vegetation Types which illustrates and broadly defines the location of vegetation communities. The EIS considered surface disturbance, there is no surface disturbance currently proposed in the Southwest Reserve Flat Canyon lease area and no impacts to the existing vegetation are Mine Vegetative Analysis of Seven Proposed Drill Sites and Seven Reference Site” is included in Appendix A-2, Volume 2. The report not only provides reference areas spread throughout the area, it also includes federally listed threatened, endangered, Candidate, and Sensitive Species for Emery and Sanpete County indicating none of the species listed are found within the project area.

Revised: 12-30-16
To address Special Stipulations for Coal Lease UTU-77114 #'s 8, and 27, the following vegetation monitoring program will be initiated while mining in the Flat Canyon Lease area. The vegetation community potentially impacted adversely by mining are primarily riparian areas. The only mining scenario potentially impacting the riparian areas would be where subsidence of the creeks, through longwall mining, significantly reduced the surface flow to the creek. Any significant decrease in flow will be documented through the water monitoring program outlined in Section 2.3 or the Subsidence monitoring and Stream gradient monitoring outlined in Section 2.17 of this M&RP. Since established riparian areas naturally react slowly to seasonal climatic variations, a reduction in flow potentially due to mining would elicit a similar response. Baseline riparian vegetation evaluations will be collected prior to undermining the various creeks (See Figure 2.7.9-2 (page 2-63c for baseline vegetation evaluation locations). If quarterly water monitoring flow measurements fall below the recorded historic low-flow values (not associated or explained by climatic seasonal variation) additional monitoring will continue on an annual basis until the cause of the lower flows is determined. A comparison of seasonal low-flow versus historic low-flow data observed on the creeks in the Flat Canyon area, will be included in the Annual Report. No follow up vegetation monitoring will be conducted following the baseline survey unless historic low flows are observed during mining activities. The vegetation monitoring method will follow techniques outlined by Winward (2000) incorporating data such as the Greenline Successional Status, Riparian Successional Status, and Greenline Bank Stability (see Appendix A-2, Volume 2 for detailed vegetation monitoring methods). Following the collection of the baseline data, the vegetation monitoring will continue annually until conditions improve or the need for mitigation is determined. In the unlikely event it is determined that mining-related subsidence causes material damage or a loss of riparian habitat, the Permittee commits to using the best technology currently available (BTCA) to mitigate the damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and USFS personnel.

In Eccles Creek an opposite situation may occur with mine water discharges possibly increasing to volumes found to be erosive. A study of the geomorphology of the stream has been conducted multiple years from 2002 through 2006 where the creek appeared to be stable. This study was re-established in 2015 and will be conducted again annually if mine discharges are consistently greater than 7,500 gpm (see section 2.5 of M&RP for details). Riparian vegetation along Eccles Creek was evaluated in the baseline vegetation study conducted by Welch & Murdock in 1980, (see Appendix A-2, Vol 1). In order to make this baseline data comparable to current and future data, this data will be evaluated using the Winward (2000) criteria to determine the baseline successional state for future comparison. An interim riparian vegetation study was conducted in 2016 to evaluate the current riparian successional status. Follow up vegetation surveys will be conducted if warranted by the geomorphic studies. In the event it is determined that mining-related discharge flows cause material damage or loss of riparian habitat, the Permittee may use BTCA to mitigate any damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and DWR personnel. It is anticipated that at the cessation of mining, stream-flow will return to the pre-mining condition, with the riparian vegetation showing a similar transition within a short time.
Approximate Riparian Vegetation Evaluation Area

- Proposed Mine Workings
- Previously Mined Areas

CONTOUR INTERVAL: 80 Feet

Figure 2.7.9-2
Riparian Vegetation Evaluation

Canyon Fuel Company, LLC
Skyline Mines

Figure 2.7.9-2
Pg. 2-63c
BIBLIOGRAPHY
(of Literature available at Skyline Mine Office)

VEGETATION


Thompson, Bob 2002. Personal communication with Vicky Miller on November 1, 2002, 8:30 am.


Data Adequacy Study Flat Canyon Tract, Volume III, Chapter 8, July 1999

Revised: 11/04/02
SECTION 2.7 - VEGETATION

ATTACHMENT 1

CONDITION AND PRODUCTION JAMES CANYON REFERENCE AREA
Dear Vicky:

Here is the report of the condition and production of the James Canyon reference area. The data is from a study in the head of Coal Canyon in the same vegetation type. Robert Thompson, our Forest Botanist, feels that the Coal Canyon study is representative of the grass/forb community type found in the James Canyon reference area. As you will note the site has a very high production rate.

<table>
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<td>Grass/forb</td>
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<td>3,000 lb</td>
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</table>

Sincerely,

ELAINE J. ZIEROTH
Forest Supervisor
Introduction

Both Huntington Creek and Eccles Creek flow through the project area and both provide habitat for reproducing resident populations of cutthroat trout. Cutthroat trout from Electric Lake use upper Huntington Creek for spawning and nursery activities. Scofield Reservoir, although stocked with rainbow trout exclusively, has numerous cutthroat trout which have been produced in Eccles Creek and other tributary streams such as Winter Quarters, Woods Creek, Lost Creek, Fish Creek, Pondtown Creek, Pleasant Valley Creek and possibly Boardinghouse Creek.

Eccles Creek

Eccles Creek is a small mountain stream draining west to east into Pleasant Valley Creek which flows north approximately 3 miles where it empties into Scofield Reservoir. Discharges in Eccles Creek are frequently as low as 2 cfs during late summer, fall and winter months; and high flows seldom exceed 50 cfs, even at the creek mouth. Water temperatures of streams such as Eccles Creek fluctuate because of turbulence from the rough channels. During November to March, water temperatures remain between 0-2° C. In the summer, water temperatures often fluctuate from 12-15° C daily although high temperatures seldom exceed 20° C.

Through natural erosion of mudstone, sandstone and shale deposits, Eccles Creek has periods of high total suspended solids (sedimentation). This occurs, however, during periods of high runoff when the stream waters have sufficient energy (velocity) to carry the fine sediments out of the canyon rather than depositing them on the coarser substrate materials. During normal runoff years, there are numerous clean trout spawning gravel beds in Eccles Creek. During low runoff years, fine sediments may not be flushed from the spawning grounds. Maintenance of this resource is dependent upon a continuation of flow, adequate substrate, food base and water quality conditions.

The existing aquatic species of Eccles Creek, fish and macroinvertebrates, have adapted to tolerate natural temperature fluctuations and sediment loads. The macroinvertebrate communities of Eccles Creek have a high diversity of species representing all major trophic groups. There are

Revised: 08-24-05  2-65
species found only in high quality water streams indicating the high water quality of Eccles Creek. There are also environmentally resistant taxa present. This high diversity represents a resiliency to environmental change, especially short term changes.

Upper Eccles Creek above the White Oak Mine Road (at sampling stations ECO3, ECO2, UPMF, UPSF, Figure 2.8-A), have numerous taxa of macroinvertebrates found only in high quality waters and stable habitats. Lower Eccles Creek (Stations ECO4 and ECO5) has a more tolerant macroinvertebrate community with taxa tolerant to sedimentation dominating the community.

Cutthroat trout have historically maintained naturally reproducing populations in Eccles Creek from the National Forest boundary downstream to the creek mouth. Recent migrations, however, have been impeded by obstacles unrelated to mining, such as, irrigation diversions, and numerous beaver dams. There are no fish in the upper forks of Eccles Creek.

Construction activities caused sufficient sediment loading into Eccles Creek resulting in a significant reduction in fish populations. Cooperative efforts with DWR, however, resulted in habitat improvement by 1986 sufficient for near recovery of these populations. (See DWR report, "Recovery of the Cutthroat Trout (Salmo Clarki) Fishery in Eccles Creek, Utah From Coal Mining Impacts", Donaldson & Dalton, Volume A-3, under Aquatic Wildlife.)

Huntington Creek

Huntington Creek above Electric Lake is a small mountain stream draining north to south into Electric Lake. Discharges are frequently as low as 1.5 cfs, with spring high flows sometimes reaching 100 cfs. Water temperatures fluctuate during summer months, although daily highs seldom exceed 20°C. During winter months water temperatures seldom exceed 2°C and the stream is nearly completely iced over.

Through natural erosion of existing stream channel geological formations and adjoining hillsides, Huntington Creek waters have high loads of fine sediments during runoff periods. This occurs when runoff is high and these sediments are carried into Electric Lake rather than being deposited on spawning gravels or other coarse substrate materials. Huntington Creek has numerous clean trout spawning gravel beds and the amount of fine sediments is not high enough to hinder spawning.

Revised: 08-24-05 2-66
Huntington Creek has a diverse aquatic community with macroinvertebrate taxa representing all trophic levels. The successful cutthroat trout spawning and high number of resident trout evidence the high quality waters and habitat of Huntington Creek plus the ability of the macroinvertebrate community to support quality fisheries. Cutthroat trout, Tiger trout, and Kokonee salmon according to Utah Division of Wildlife Resources (UDWR) surveys, are increasing in numbers in Huntington Creek above Electric Lake. Tributaries to Upper Huntington Creek include Boulger, Burnout, Swens, and Little Swens canyons which contribute in various degrees to the habitat, with Boulger Creek providing the most suitable amount of habitat. Trout produced in Huntington Creek provide an important part of the total number of fish in Electric Lake.

Winter Quarters Canyon Creek

As indicated in the 1995 environmental assessment prepared by the Forest Service and the Bureau of Land Management Winters Quarters Canyon Creek has a moderate population of macroinvertebrates. Perennial flow in the canyon has produced Stonefly larvae as far up as Box and Bob=s Canyons. Mayfly nymphs were also found present in waters tested. Cutthroat trout were found within the creek east of the Forest Boundary on June 7, 1994 indicating fish are likely within perennial sections of the creek containing significant flows. A survey conducted in Winter Quarters Canyon Creek in October 2002 indicated similar conditions and species (See Appendix Volume A-3, Volume 2). The Winter Quarters Ventilation Facility pad was specifically designed to minimized any potential impacts to the stream. The pad was designed to stay a minimum of two(2) stream widths from the stream, ( or approximately 24 feet), thus maintaining a buffer zone and avoiding impacts to both the stream and riparian areas. The macroinvertebrates are monitored on a scheduled basis to insure the health of the stream (see Plate 2.8.1-1 for locations, Table 2.8-1a for monitoring frequency). Refer to Section2.4.3 - sediment yield and next section for measures implemented to construct in the stream buffer zone.

Woods Canyon Creek

As indicated in the 1995 Environmental Assessment, Mayfly nymphs were found within the upper portions of Woods Canyon Creek in higher quantities than those found within Winter Quarters Canyon. Stonefly larvae were also found as high as the fork in the stream near the center of Section 34 (T 12 S, R 6 E). No fish were seen during the 1994 field survey although some may have been present. A survey conducted in Woods Canyon Creek in October 2002 indicated similar conditions (See Appendix Volume A-3, Volume 2). Another fish survey was conducted in 2010 to serve as baseline information for expanded mining located approximately ½ mile east and further downstream than previously conducted. Similar with the earlier surveys the stream is relatively shallow and does not provided ideal fish habitat, however a total of eight (8) fish were identified. An addition of both a macroinvertebrate and a fish monitoring location were set up to insure monitoring stations are established downstream of mining activities to fully evaluate any impacts from mining. Details are outlined later in this section.

Fish Creek

The North Lease area was extended in 2013 to include approximately 770 acres in the Fish Creek drainage.
No perennial streams are being undermined. Wife Canyon has various springs that day-light in or near the stream channel, that run on the surface a short distance prior to disappearing into the alluvium. Both the East and West Forks of Andrew Dairy Canyon shows the same characteristics in short reaches. Approximately 900-1300 feet of overburden exist in the area being undermined, further minimizing any impacts. Andrew Dairy Spring, which exists immediately outside the area to be mined is being monitored as Spring S25-32. Water Right 91-3917 is a Spring located above the area to be mined and will be monitored S26-1. No monitoring of aquatic resources is necessary in these drainages.

UP Canyon - Scofield Waste Rock site

The Scofield Waste Rock site is located in UP Canyon at the confluence of two ephemeral unnamed drainages. No aquatic wildlife habitat has been noted in either drainage.

Project Impacts on Fisheries Resources

The surface facility disturbances in the portal area encroached on sections of all three upper Eccles Creek forks. In order to reduce sedimentation of these stream segments and the main stream, the tributaries and a section of Eccles Creek proper immediately below the tributary confluences were diverted into closed culverts. This modified approximately 4,200 feet of total stream habitat but did not reduce available fish habitat since fish were not found above the U.S. Forest boundary, prior to the diversion. Downstream drift of macroinvertebrates from the upper reaches of these forks still occurs as before.

At the coal loadout facilities near the mouth of the canyon (Station EC05), approximately 600 feet of stream was moved to the north into a new channel. The new channel is 100 feet shorter but has nearly the same gradient (3 feet additional vertical drop/1,000 feet horizontal channel).

Degradation of Eccles Creek between the National Forest boundary and the coal loadout facilities should continue to be minimal since road and conveyor plans were developed and are being implemented to minimize effects on the stream.

Water being discharged from the mine is augmenting the Eccles Creek stream flow. This increased stream flow is especially beneficial during summer months when normal stream flows are low. Water temperatures are also moderated by this increased flow.

There should be little impact on Huntington Creek above Electric Lake. Impacts to date have been associated only with the construction of a new UDOT highway. Sediment control measures minimized the impact during the construction activity.

Prior to construction of the Winter Quarters Ventilation Facility (WQVF) silt fencing or similar best management practice will be installed along the entire length of the construction zone to minimize sediment and debris from entering the creek. Once construction is complete and other sediment controls are installed, these situation structures will be removed. During the life of the WQVF pad, long term sediment control will be implemented thorough a sediment pond (UPDES discharge point 004).

At this point in time there are believed to be no other potential impacts on either Winter Quarters or Woods Canyon Creeks.

Prior to construction of the Swens Canyon Ventilation Facility (SCVF) silt fencing or similar best management practice will be installed along the section of road to be modified adjacent to minimized sediment and debris from entering Swens Canyon Creek. Once construction is complete, these sediment structures will be removed. The SCVF is a minimum of 350 feet north of the creek with a minimal potential of impacting the creek. An associated power line bringing power to the SCVF from the mine site runs overland a majority of the distance. Following recommendations from Manti-LaSal US Forest Service personnel, the power line will be buried from the SCVF under Huntington Creek to the east side of the Huntington Creek basin. It is anticipated this will be achieved using horizontal drilling.

Revised: 5-27-16
Figure 2.8-A. Eccles Creek and Huntington Creek, Carbon and Emery Counties, Utah, shown in relation to the Skyline Project, Coastal States Energy Company. Study stations are shown with the station codes used in the report.
2.8.1 Aquatic Monitoring Program

An aquatic monitoring program has been conducted to meet the intent of the requirements of R614-301-311. The main purpose of the monitoring program is to gain sufficient knowledge to prevent and/or minimize impacts through wise project planning. Monitoring has: (1) described existing resources; (2) detected existing perturbations; and (3) provided the basis for wise project planning, operation and resource restoration.

The biological (macroinvertebrate and fish) and habitat (sediment and channel surveys) monitoring stations on Eccles Creek are shown in Figure 2.8-A. Sampling dates are limited by weather, but June and late October samplings are usually possible. Two seasonal sampling dates per year are required to differentiate natural seasonal intrastand variance from impact induced changes. Samples were taken annually through the project planning and early development. The biological sampling has been performed in conjunction with normal stream water monitoring so that comparative analysis is possible.

Seven stations on Eccles Creek were selected in relation to impact areas, UDWR fish sampling stations, existing macroinvertebrate and sediment stations, and water quality monitoring stations. At each station on the scheduled sample date (Table 2.8-1), four macroinvertebrate samples were taken from selected optimal substrates with a modified Surber Sampler. Three sediment samples were taken from potential spawning grounds. Replicate samples were taken to enable an analysis of variance between samples.

Habitat surveys, following methodologies used by USBLM and USDFS fisheries habitat specialists, were made annually throughout construction at critical Eccles Creek stations (Table 2.8.1). Measurements included: stream bank stability, channel substrate composition; stream gradient; riparian vegetation (type, relative cover); water width, depth and velocity at various discharges (Q) and channel width and tortuosity.

Fish surveys are usually made in August so year class I fish will be large enough to sample and young-of-year fish are large enough to observe. Fish are measured as to total length and weight, counted and then released. These data are compared with earlier UDWR collection records, thus illustrating present fish population conditions compared with years past.

Table 2.8-2 summarizes the stream monitoring data. A summary of the sediment composition data, taken in accordance with the schedule on Table 2.8-1, is shown on Table 2.8-3. The UDWR reports have been added to the Aquatic Wildlife section of Volume A-3.

Macroinvertebrate and fish monitoring was conducted by independent contractors from 2000 through 2013. The program was evaluated in detail with consultation with DOGM, USFS, UDWR, and CFC personnel with modifications being initiated in 2015. As discussed later in this section, for each creek individually, Eccles Creek the macroinvertebrate sampling frequency was modified while both the macroinvertebrate and fish monitoring surveys were discontinued in both Winter Quarters and Woods Creek.

Revised: 12-30-16
James and Burnout Creeks

A fish and macroinvertebrate monitoring program for James and Burnout Creeks were implemented prior to undermining the lower portion of James Canyon. The fish survey consisted of multi-pass electro fishing to estimate fish populations in the streams for one year and then every third year thereafter. The fish surveys were performed in the fall of each third year on or about the same date, and were continue through a minimum of two (2) years following active subsidence. The fish survey was initiated on October 16, 2000 and completed in 2007.

A macroinvertebrate survey of Burnout Creek was performed twice a year for two consecutive years and then every three years thereafter. This survey was performed in the fall and spring of each year, with the fall macroinvertebrate survey being performed in conjunction with the fall fish survey. The macroinvertebrate survey was initiated on October 16, 2000 and completed in 2008.

A macroinvertebrate survey of James Creek initiated on October 16, 2000 was performed twice a year for two consecutive years and then every three years thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM, USFS and the DWR, to be long enough to provide data to establish population trends. This survey will be performed in the fall and spring of each year on or about the same date. The fall macroinvertebrate survey will be performed in conjunction with the fall fish survey. (See Table 2.8-1a for Sampling Scheduled).

The following methods have been used previously on this creek and will continue to be used for future macroinvertebrate sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Three benthic sites will be sampled. They will be located beginning approximately 162 meters (528 feet) above the reservoir. Refer to Plate 2.8.1-1 for all macroinvertebrate sample site locations. Note that macroinvertebrate sites sample reaches of a stream - site locations are plotted at the approximate mid-point of the reach of the sample site.

Quantitative samples will be taken with a modified box sampler. The three samples taken will be field preserved in 70% ethyl alcohol and returned to the laboratory for processing. The samples will be sorted and invertebrates identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). Those of questionable identity will be further examined and identified under magnification. The mean, standard deviation, density per square meter, and standing crop will be calculated and estimated using the same methods as in previous analysis.

Calculations of the USFS Biotic Condition Index (Winget and Mangum 1979) will be completed using the abundances of the benthic taxa to generate the dominance weighted community tolerant quotient (CTQd). The predicted community tolerant quotient (CTQp) will be calculated using water chemistry data provided in Winget (1972) for the Huntington Creek drainage.

Cluster analysis will be run using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm.
Boulger, Swens, and Little Swens Canyon Creeks

As indicated in the 2002 Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) all three (3) creeks are considered third order streams providing varying contributions to the aquatic habitat. Both Swens and Little Swens provide little habitat for fish due to the shallow pools and predominance of riffles in the reaches potentially affected by undermining. Based on the combination of minimal habitat and minimal reaches being undermined, only Boulger Creek will be monitored for fish. A fish monitoring program for Boulger Creek will be implemented prior to undermining the lower portion of the creek. The electro fish survey will estimate the fish populations in the stream for one year and every third year thereafter. The fish survey will begin one year prior to undermining any portion of the creek. Unless otherwise noted, sampling methods will be consistent with surveys conducted previously on James, Burnout, Eccles, Woods, and Winter Quarters creeks.

Boulger Reservoir is an artificial, man-made fishery that is restocked with fish on a regular basis throughout the fishing season. In the event Boulger Reservoir is undermined additional permitting will outline the mitigation of possibly draining the reservoir. All necessary regulatory agencies concerns will be addressed prior to undermining.

Winter Quarters Canyon and Woods Canyon Creeks

From Fall of 2002 through early Summer of 2004 fish and baseline macroinvertebrate data for the perennial reaches within Winter Quarters Canyon and Woods Canyon Creeks in the North Lease area were gathered. Copies of the reports are included in Appendix Volume A-3, Volume 2.

A macroinvertebrate survey of portions of Winter Quarters Canyon and Woods Canyon Creeks was performed twice a year for two consecutive years and then every third year thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM, USFS, and the DWR, to be long enough to provide data to establish population trends. This survey was performed in the fall and spring of each year on or about the same date and completed in 2011.

Based on adequate data being collected, and the completion of longwall mining in Winter Quarters Canyon, macroinvertebrate surveys were terminated in both Winter Quarters and Woods Canyon creeks in concurrence with the various regulatory agencies in 2015. No impacts to the macroinvertebrate community based on mining were observed. Information supporting the ending of the surveys is available in Appendix A-3 (Skyline memo) and the individual macroinvertebrate reports located in the Annual Reports. Monitoring in either creek could be re-established should conditions related to mining change.

In 2010 the Winter Quarters Ventilation Facility (WQVF) was added to the permit area approximately 2 mile downstream of the existing macroinvertebrate monitoring stations. Consultation with Dr. Shiozawa who directs the Skyline macroinvertebrate monitoring program, indicated the portion of stream in the vicinity of the WQVF pad is not conducive to a macroinvertebrate study due to low gradient and inundation of fine sediment. He recommended a electro-fishing monitoring program which is outlined later in this section.

As mining progressed north of Winter Quarters Canyon, the longwall panel orientation was rotated 90 degrees to maximize coal recovery. The rotation expanded mining approximately ½ mile to the east. To accommodate the modification, an additional macroinvertebrate station and fish monitoring station were set up in Woods Canyon to insure monitoring stations are established downstream of mining activities to fully evaluate any impacts from mining. The additional electro-fishing monitoring station was added to Woods Canyon creek in 2010 although the stream is marginal fish habitat due to the shallow nature. Sampling frequency will continue every 3rd year unless future sampling confirms
the habitat is unsuitable to sustain a viable fish population. See Appendix Volume A-3, Volume 2 for 2010 fish density report.

The following methods have been and will be used for macroinvertebrate sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Three benthic sites will be sampled in each creek. Following the first survey a map with these stations will be prepared and submitted with the next sample report (included in the following year=s annual report). Quantitative samples will be taken with a modified box sampler. The samples taken will be field preserved in 70% ethyl alcohol and returned to the laboratory for processing. The samples will be sorted and invertebrates identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). Those of questionable identity will be further examined and identified under magnification. The mean, standard deviation, density per square meter, and standing crop will be calculated and estimated.

Calculations of the USFS Biotic Condition Index (Winget and Mangum 1979) will be completed using the abundances of the benthic taxa to generate the dominance weighted community tolerant quotient (CTQd). The predicted community tolerant quotient (CTQp) will be calculated using water chemistry data provided in Winget (1972) for the Huntington Creek drainage.

Cluster analysis will be run using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm.

An electro fishing study was conducted in 2002 to examine 1) the species present in Winter Quarters Canyon; 2) determine if fish were present in Woods Canyon; and 3) determine how far upstream fish extended into either canyon. The one-time survey was conducted on request by the U.S. Forest Service (See Appendix A-3, Volume 2 for report).

Based on the addition of the Winter Quarters Ventilation Facility, beginning in 2010 two (2) electro fishing sites were established Winter Quarters Creek. Two sampling runs (150 meters in length), one upstream and one downstream of the WQVF pad, will be tested on an tri-year basis to monitor the general aquatic health of Winter Quarters Creek. Sampling is minimized to every third year to reduce the stress on the fish population. The fish studies were terminated after the 2013 survey due to adequate baseline information being collected, and the minimal impact from the Winter Quarters site. Electro fishing surveys could resume should conditions change, such as adding mine water discharge to the creek. Information supporting the ending of the surveys is available in Appendix A-3 (Skyline memo) and the individual fish reports located in the Annual Reports.

In the event mining causes quantifiable damages to fish populations, stream flows, or other negative impacts on fish or wildlife habitat, the mine will identify, research and implement measures sufficient to correct the problemsAreas where there is potential for habitat loss from subsidence are shown on Plate 4.17.3-1a. The consumption rate of water from mining activities is provided in Section 2.5.2.

Future aquatic monitoring is planned only on an as needed basis. Need will be established in conjunction with DOGM, USFS, UDWR, and Skyline personnel and will be required only in case of a major perturbation in fish populations or other anomalous conditions. Monitoring data will be reviewed for mining related impacts, and, if found, a mitigation plan will be developed in conjunction with UDWR and UDOGM personnel. The Permittee will cooperate with UDWR in the investigation of any such conditions. This approach to future monitoring is consistent with the requirements recommended by the UDWR, Price office.
Eccles Creek

To determine the impacts to Eccles Creek, if any, related to discharge of mine water, semi-annual macroinvertebrate studies will be conducted. The studies will start in the spring of 2002 and will continue for three (3) consecutive years or for a period determined by Canyon Fuel Company, LLC, DOGM and the DWR, to be long enough to provide data to establish population trends.

The following methods have been used previously on this creek and will be used for future sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Four samples will be taken at intervals separated by approximately 20 to 30 m. Samples will continue to be taken from three stations on the stream, with five replicates per station. These stations on Eccles Creek are located above South Fork (site 1), Eccles Creek at Whisky Canyon (site 2), and Lower Eccles Creek (site 3). A map with these stations has been added to the Aquatic Wildlife section of Volume A-3.

A box sampler will be used to collect the samples. Samples will be taken in areas with rubble or cobble substrates to insure that similar habitats are examined. When possible, samples will be taken from parts of the stream channel that had been submerged continuously throughout the year. The substrate will be stirred to a depth of approximately 5 cm. Rocks within the area of the sampler will be removed and washed to insure quantitative assessment of the invertebrates. The box sampler will have a net mesh of approximately 250 microns. The samples will be concentrated on a screen with a mesh of approximately 64 microns and field preserved in ethyl alcohol.

In the laboratory the samples will be sorted in a pan illuminated from below. All invertebrates will be removed and identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). The mean density and standard deviation per sample will be calculated for each taxon and the mean values will be used to determine the density per square meter.

The collected samples will be compared to the previous data collected in 1979 through 1983 and included in Appendix A-3, Volume 2. After comparing historical data with data obtained in the three year study starting in 2002, a determination would be made if the macroinvertebrate in Eccles Creek are impacted by the mine water discharge. If impacts are found, the significance of the impacts will be determined and appropriate mitigation will be performed if necessary.
Upon completion of the 2011 data collection, a full evaluation of the sampling program was conducted with consultation of DOGM, USFS, DWR, Div. of Water Quality (DWQ), and CFC personnel. It was determined sufficient data had been collected to determine a habitat evolution had taken place due to an increase in mine water discharge beginning in 2002. Although changes have occurred, they have been predictable due to the consistent, good quality water being added to the system. However due to the combination of seasonal variations, the limited amount of data, and consultation with DWQ personnel, modifications to the macroinvertebrate sampling program were initiated. Modifications include 1) conducting the study only in the Fall while both the species and stream flows are most stable and less susceptible to high Spring snowmelt; 2) modify the frequency from every third year to 2-years of collecting samples followed by 2-years off frequency that will essentially double the number of comparable data sets; 3) hired a new contractor who's committed to a timeframe of having a report available prior to the next season; and 4) the report by the contractor will include both the Hilsenhoff Biotic Index and the USFS Community Tolerance Quotient for indicators for the health of the biotic community. See Appendix A-3 for information summarizing the established trends (Skyline memo) and Annual Reports for the specific macroinvertebrate studies.

Fish studies were conducted on Eccles Creek beginning 2003. The fish study consists of multi-pass electro fishing to estimate fish populations in the stream for one year and then every third year thereafter. The fish studies will be performed in the fall of each year. Results from sampling will be compared with all available historic studies done on this creek.

Aquatic Monitoring Summary

Aquatic monitoring data have been accumulated for a period of six years. Summaries of these data are presented in Tables 2.8.2 and 2.8.3. Backup data for these summaries, including the consultants original report and subsequent summary reports, may be found in Appendix Volume A-3, Aquatic Wildlife.

During a 23 year time span macro-invertebrate data was collect on 24 site visits to Eccles Creek and compiled into a report entitled "A Compilation and Comparison of Eccles Creek Macro-Invertebrate Data for the Period of 1979 - 2002" prepared by Dennis Shiozawa, Ph.D., Professor of Fisheries Biology at Brigham Young University, Provo, Utah. The report documents that Eccles Creek has undergone changes in the benthic community structure through the years of study and demonstrates the resilience and adaptability of the creek to disturbance by multiple sources. Burnout, James, Eccles, Winter Quarters, and Woods canyon creeks have continued Aquatic monitoring reports that are submitted to the Division of Oil, Gas, and Mining in the required Annual Report when the information is compiled. These reports are available for review at the Division of Oil, Gas and Mining public library.
TABLE 2.8-1

STREAM RESOURCE MONITORING SCHEDULE FOR ECCLES CREEK

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**Key:**
- C = completed
- X = scheduled
- ND = no end date
- F = Fall
- RC = requirements completed

* (will re-initiate monitoring if conditions change significantly)

Reports located in the Annual Submitted to the Division of Oil, Gas, and Mining.

Revised: 12/30/2016
TABLE 2.8-2

DESCRIPTORS OF THE BENTHIC COMMUNITIES AT SEVEN STATIONS ON ECCLES CREEK AND ITS MAJOR TRIBUTARIES, CARBON COUNTY, UTAH

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<td>Standard Deviation</td>
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SEDIMENT COMPOSITION OF GRAVEL BEDS
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FOR SEDIMENTS PASSING THROUGH SIX USGS
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SEDIMENT COMPOSITION OF GRAVEL BEDS
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FOR SEDIMENTS PASSING THROUGH SIX USGS
STANDARD SOIL SIEVE SIZES

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Revised: 10/04/02
2.9 TERRESTRIAL WILDLIFE

INTRODUCTION

Prior to any disturbance of the environment it is required that each Permittee conduct a study of the wildlife and their habitats in the mine plan area (R614-301-311). This section summarizes the results of that study. An unabridged copy of the consultants report can be found in Appendix Volume A-2.

Impacts to terrestrial wildlife found within the North Lease area were discussed within the 1995 Environmental Assessment completed by the Forest Service and BLM. Within this assessment it was indicated that alteration of stream flow could alter riparian zones, which in turn could alter watering, foraging, cover, and calving / fawning opportunities for wildlife. Under stipulations #2, 3, 4, 7, 9, 14 and 17 identified, the assessment further states that there should be no unmitigated impacts to terrestrial wildlife.

Purpose of Study

Prior to the study and evaluation of the Skyline Project, the Utah Division of Oil, Gas and Mining in consultative deliberation with the Utah Division of Wildlife Resources and U. S. Forest Service determined the objectives were to: (1) determine habitation and use by moose and elk of the environs in and around the Skyline project, (2) estimate use by mule deer of the canyons to be traversed by the coal conveyor, (3) determine more accurately the presence of other species of mammals, amphibians and reptiles, (4) determine habitat affinities and time of utilization by mammals, amphibians and reptiles, and (5) ensure correct knowledge of the occurrence of any endangered or high-interest species on the area of the project.

Personnel

The study was done under the direction of Drs. Clyde L. Pritchett, Associate Professor in the Department of Zoology and Curator of Mammals at the Monte L. Bean Museum, and H. Duane Smith, Associate Professor and Coordinator of Wildlife and Range Resources in the Department of Zoology, at Brigham Young University, Provo, Utah.

Revised: 9/04/02
2.9.1 Species Status Lists

Literature and field data were summarized for all terrestrial vertebrates of concern, and the species categorized to determine habitat affinities and high-interest species status. These results are reported in tabular form (Tables 2.9-1 through 2.9-3). They are listed according to their various ecological classifications (Dalton et al. 1978 and 1990; Durrant 1952; Hall and Kelson 1959; Hayward 1967; and Hayward et al 1958). All species whose ranges appear to overlap any or all of the potential area of impact are listed. Generally speaking, the proposed project area could potentially be inhabited by about 57 mammalian, 6 amphibian and 15 reptilian species. Some of these are considered high interest species for the habitats and local area of concern and 48 percent are protected species.

Tables 2.9-1 through 2.9-3 contain listings of the vertebrate species most likely to be impacted by the mining activity and is not a listing of all area inhabitants. A more complete listing, including small birds, may be found in the Dalton et al 1978 reference copied in its entirely and located in Appendix Volume A-2.

Terms used in Tables 2.9-1 through 2.9-3 are defined as follows:

1. Plant communities (discussed in detail in another portion of this report): (a) spruce-fir; (b) aspen; (c) sage brush; (d) mixed shrubs and grasses; and (e) riparian habitat.

2. Resident species: (R) Any species that inhabits the area during reproduction activities.

3. Casual or Rare: (Ca) Any species that is only observed occasionally over a period of several years but whose status has not been determined as "threatened" or endangered.

4. High-interest: (X) Any species that is endangered, threatened, game or of economic or recreation value.

Revised: 9/04/02

INCORPORATED

DEC 02 2002
DIV OF OIL GAS & MINING
TABLE 2.9-1
SPECIES LIST AND CLASSIFICATION OF MAMMALS WHOSE PUBLISHED RANGES OVERLAP THE PROPOSED SKYLINE COAL MINE SITE

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ADDITION TO: TABLE 2.9-1 Page 2-82

TABLE 2.9-1 Page 2-82 Date 01/25/93

2-82
Table 2.9-1 (Continued)

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<th>Sagebrush</th>
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<th>Riparian</th>
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Table 2.9-1 (Continued)

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<td>Montane Vole Microtus montanus</td>
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ADDITION TO: TABLE 2.9-1 Page 2-84

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**INTEGRATED EFFECTIVE:**

MAR 23 1993

**UTES DIVISION OIL, GAS AND MINING**

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**TABLE 2.9-2**
TABLE 2.9-2

SPECIES LIST AND CLASSIFICATION OF AMPHIBIANS WHOSE PUBLISHED RANGES OVERLAP THE PROPOSED SKYLINE COAL MINE SITE

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<th>Sagebrush</th>
<th>Mixed Shrub &amp; Grass</th>
<th>Riparian</th>
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<th>High-Interest Species</th>
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<td>Great Basin Spadefoot Toad</td>
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<tr>
<td>Woodhouse's Toad</td>
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The table lists the species whose published ranges overlap the proposed Skyline Coal Mine site. The species are categorized based on their habitat preferences and presence at the site.
**TABLE 2.9-3**

SPECIES LIST AND CLASSIFICATION OF REPTILES WHOSE PUBLISHED RANGES OVERLAP THE PROPOSED SKYLINE COAL MINE SITE

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<td>Sagebrush Lizard</td>
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**ADDITION TO:**

| TABLE 2.9-3 Page 2-86 | TABLE 2.9-3 Page 2-86 | Date 01/25/93 |

**INTEGRATED EFFECTIVE:**

| MAR 23 1993 |

**Utah Division Oil, Gas and Mining**

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2-86
### TABLE 2.9-3 (Continued)

**SPECIES LIST AND CLASSIFICATION OF REPTILES WHOSE PUBLISHED RANGES OVERLAP THE PROPOSED SKYLINE COAL MINE SITE**

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<thead>
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<th>Species</th>
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<th>Aspen</th>
<th>Sagebrush</th>
<th>Mixed Shrub &amp; Grasses</th>
<th>Riparian</th>
<th>Observed on Site</th>
<th>High-Interest Species</th>
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<td><em>Crotalus viridus</em></td>
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**INTEGRATED EFFECTIVE:**

MAR 23 1993

**UTAH DIVISION OIL, GAS AND MINING**

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<td>TABLE 2.9-3 Page 2-86(a) Date 01/25/93</td>
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2.9.2 Project Impact Analysis by High-Interest Species

There are many published systems for ranking the importance for and use of habitat by wildlife. The one utilized herein was developed by the Southeastern Region of Utah Division of Wildlife Resources. Their system parallels but is not identical to the one developed by the U. S. Fish and Wildlife Service to rank wildlife values on coal lease lands in the western states. The Utah system lists critical wildlife habitats and use areas as most important followed in respective importance by high-priority, substantial value, and limited value habitats and use areas. It must be noted that the use of the word "critical" in this system is not the same as the legal definition used for "critical" in the Endangered Species Act.

Critical wildlife use areas are sensitive use areas necessary to sustain the existence and perpetuation of one or more species during critical periods in their life cycles. These areas are considered limited and lie within high-priority wildlife use areas. Biological intricacies dictate that significant disturbances cannot be tolerated by the members of an ecological assemblage on critical sites. The opinion of the Utah Division of Wildlife Resources is that disturbance to critical use areas or habitats will result in irreversible changes in species composition and/or biological productivity of the area so classified.

High-priority wildlife use areas are considered to be "intensive use areas" for one or more species of wildlife. High-priority use areas are not limited and in conjunction with limited value use areas form the substantial value distribution for a wildlife species.

Substantial value wildlife use areas are "existence areas" for one or more species of wildlife. These areas represent the distribution of a given herd or population and are formed by the merging of high-priority and limited value wildlife use areas for a species.
Limited value wildlife use areas are "occasional use areas" for one or more species of wildlife. Such areas are not limited and although they constitute part of the substantial value wildlife use area for a species, they are not essential.

Another important term used by Utah Division of Wildlife Resources is "crucial period." This refers to a time in the natural history of the species when disturbance will likely lead to serious decreases in the productivity and perpetuation of the species. Examples are the reproductive and over wintering periods. UDWR in recent years has modified the term "crucial-critical" in regard to relative biological value of wildlife habitats or use areas to just "critical". The term "crucial" now only relates to a time of animal use. The definition remains the same.

2.9.2.1 Mammals

The potential area of impact is inhabited by about 57 species of mammals (Table 2.9-1). Approximately 30 percent of these species are protected and considered of high-interest to the State of Utah Division of Wildlife Resources. As such, each was considered in relation to the potential perturbations, but only those likely to be negatively impacted are discussed.

Moose

The population of moose inhabiting the Wasatch Plateau is most numerous in and about the drainages of Scofield Reservoir and upper Huntington Canyon where the moose are dependent upon the riparian habitats that are all designated as critical habitat by Utah Division of Wildlife Resources. These riparian zones are utilized by some moose year long, whereas the higher elevation habitats adjacent to the riparian zones are only utilized during the summer and are considered as high-priority summer range. The entire Skyline Project lies within this high-priority summer range and is utilized by moose from May 16 to November 30.
Unlike other ungulates, moose do not mass migrate large distances to other altitudinally lower areas for winter but concentrate into the riparian areas from December 1 to May 15. Both high elevation and riparian habitats are used by moose as calving areas between May 15 and July 15.

During the field-work portion of the pre-operational study only one cow and a calf were observed in the environs of the mine lease site. This cow was easily identified by a blue collar previously put on the moose by personnel of Utah Division of Wildlife Resources. The cow and calf were sighted on the Huntington side of Eccles Canyon, not far from where the road is intersected by the pipeline road. These animals were observed by various people and according to personnel of Utah Division of Wildlife Resources, they spent most of the summer in the environs of the mining site. One other moose, a yearling female with an injured front leg, was observed in the vicinity of the general project area. She was seen on Highway 96 two miles from the Scofield turnoff from U. S. Highway 6/50.

Considerable fresh tracks and pellets were found around the beaver ponds in upper South Fork and along the ridge above South Fork, and many sets of tracks were also found near a small pond located across the ridge south of South Fork. Some of the willows along the beaver ponds in Eccles Canyon were browsed quite high, apparently by moose during the winter. Sheepherders in the general project area indicated they had seen no moose in 1979; however, one sheepish said a bull and cow inhabited James Canyon during most of 1978.

Both Eccles Canyon and South Fork have sufficient stands of willows and beaver ponds to facilitate moose populations, and since these specific sites are the focal points of moose sign in the project area care should be taken to minimize disturbance to and preserve this critical riparian habitat.
Elk

Elk on the mine site are from the Manti herd unit and occupy the high-priority summer range from mid-May through October each year. The known summer range of this herd is more extensive than the potentially impacted area but the entire area of the mine lease lies within this high-priority summer range. During the summer, calving and rearing of elk occurs within the summer range from mid-May to mid-July. Unlike moose, elk migrate altitudinally and from November 1 to May 15 occupy lower vegetation communities that are classified as high-priority, and critical winter ranges. These winter ranges are not within the potentially perturbed habitat but are on ranges to the east and southeast (Scott, 1977) (Figure 2.9.1-A).

During the field-work in 1979, elk sign (tracks and pellets) were commonly observed throughout the project area of concern, but actual sightings of elk were obviously less frequent, however, not unusual. In the early part of the summer, before traffic increased, elk were often sighted from the road in Eccles Canyon, but after human activity increased few animals were seen within the canyon. Animals were, however, still using the area because fresh sign was observed just above the portal site on and along the Eccles Canyon Road. It appears that the elk adjusted their daily behavior pattern to avoid disturbance from vehicles and man. They seem to seek refuge in South Fork and periodically utilize Eccles Canyon on a crepuscular or nocturnal basis.

Although elk were present throughout the project area, the environs of the South Fork drainage was occupied by the highest concentration. This drainage appears to be a calving ground, since many cow elk with very young calves were observed therein, however by the same criteria there are other calving areas in James, Coal and Burn Out Canyons. It is not known whether or not these canyons external to the Skyline Project Area are near saturation during calving or if they could absorb cows that might be displaced from the area of concern due to disturbance.
Fig. 2.9.1-A Winter range and migratory route of elk living in the environs of the Skyline lease area
The habitat in South Fork is conducive to elk habitation. The mountain is steep, has considerable cover and an abundance of good meadows that contain beaver ponds used for "elk wallows". The upper beaver ponds were used extensively as determined by the large number of tracks and bedding areas around them and elk traveled over the ridge from these ponds and less disturbed areas into Eccles Canyon.

The distribution of elk within and utilization of the Skyline Project Area has already been impacted by human activity as evidenced by the behavior pattern change in elk utilization of Eccles Canyon as human activity increases. The elk still utilize Eccles Canyon, but not for calving. It seems that they have sought more solitude for such activities in South Fork or other secluded places. Elk prefer large areas and it is known that 100 animals will do better on 500 acres than one elk on 5 or even 50 acres (Seton, 1927). Elk often traverse a 10-mile stretch during short periods of time, particularly when disturbed, in either summer or winter so disturbance sources and obstructions to movement should be minimized. Limits to elk populations will be determined by the extent man is willing to dedicate suitable range for this purpose (Rush, 1939). This range must include not only forage but sufficient security cover to allow the population to escape disturbance sources. This makes South Fork or the adjacent canyons important elk habit and they are significant to the stability of the elk herd in the potentially perturbed area. Underpasses are provided so that elk can cross the conveyor that will otherwise function as a barrier to movement. This is essential to elk that occupy or traverse to and from the South Fork area.

Mule Deer

Mule deer on the mine site are considered part of herd units 32 and 34 by Utah Division of Wildlife Resources. They utilize the entire mine lease and adjacent areas which are high-priority summer range from May 16 to October 31. Fawning and rearing of
young occur within this high-priority summer range from mid-May to mid-July. Unlike moose, deer migrate altitudinally and from early November to mid-May occupy lower vegetation communities that are classified as high-priority and critical winter ranges. Winter range for this population is not clearly defined but some deer likely move northeast in the environs of the Soldier Summit vicinity while others may migrate east to the Gordon Creek winter range. In either case, these winter ranges are not within the permit area (Figure 2.9.2-B).

Field work revealed that mule deer ranged over the entire project area, but were present in varying concentrations. In the mornings and evenings they were frequently sighted at the numerous salt licks in the area, especially South Fork. The ridge on the north of Pipe Spring Canyon had a good stand of manzanita and 25-35 deer were often observed in that area. There was also a herd at 20-30 deer in James Canyon. Deer frequented Eccles Canyon and were sighted from the mouth of the canyon to the top of the ridge. Fresh tracks were frequently observed on the road. Most draws coming into Eccles Canyon had deer trails in them, but the two just below the site of the proposed portal and one 1.6 miles from the top end of the conveyor, had heavily used trails.

No deer were observed with twin fawns in the environs of the proposed Skyline project but this is not surprising. According to Utah Division of Wildlife Resources records the deer population on this unit is below the carrying capacity of the excellent summer range and productivity is slightly below the state average. The amount of high-priority and critical winter range is the limiting factor for populations of deer in the potentially disturbed habitat. The Skyline project will not decrease the acreage of winter range that limits this population of mule deer, and, therefore, the impact will be less than if critical winter habitat were involved or if summer habitat were at carrying capacity.
Fig. 2.9.2-B Winter range and migratory route of mule deer living in the environs of the Skyline lease area.
Cougar

The entire Skyline project area provides substantial value, yearlong habitat for cougar which is a game species in Utah. The animals range throughout the area, but their movements are often dictated by migration patterns of mule deer and human disturbance. Although cougars are not overly abundant and are secretive, concern must be given them particularly when the females are accompanied by their young who are learning to hunt and survive. This is considered a crucial period for cougars by Utah Division of Wildlife Resources.

Bobcat

The mine plan and adjacent areas provide substantial value habitats for bobcats who are reputed to occupy all terrestrial habitats on the entire Skyline project area. Although little is known about the bobcat habits, crucial periods would be late February when parturition occurs and May and June when the young bobcats are not as secretive as cougar, and therefore, would be less likely to avoid the high human disturbance areas. They would therefore be vulnerable to open human harassment and illegal killing.

Black Bear

The entire potential area of concern provides substantial value, yearlong habitat for black bear. Although no black bear were observed the animals range throughout the entire lease area. They are not abundant nor are they active year round. The crucial periods for black bear are February and March when the cubs are born and when they accompany their mother on initial foraging expeditions during early summer. Since parturition occurs within the winter den this crucial period will be little impacted, but when the young are with the mother they will be susceptible to human activity, particularly harassment and illegal killing.
Cottontail Rabbit

The entire mine plan and adjacent areas provide substantial value, yearlong habitats for cottontail rabbits. The young are born between April and July which is considered crucial period, but the activities associated with mining operation will in all probability not seriously alter the reproductive potential of the population. There will be increased hunting both legal and illegal, but this will likely benefit cottontail populations since hunted populations are more healthy and stable than non-hunted populations. Disturbed vegetation leading to succession also enhances reproductive potential.

Snowshoe Hare

The snowshoe hare is present in and dependent upon the spruce-fir vegetation type as a yearlong habitat use area. This habitat type is in abundance over the entire proposed project and adjacent areas, but the operation will do little to harm the total acreage of the habitat type and the hare populations dependent upon it. Although the crucial period for reproduction is from April 1 to August 15, the snowshoe hare will not be severely impacted through time nor will the actions lead to the demise of the population. Subsidence will not harm the above ground dweller and the lost habitat is sufficiently small that it will do little to snowshoe populations. Hunting pressure, legal and illegal, will be the most detrimental action and it will be up to law enforcement and hunting regulations to control this impact.

Furbearers

Portions of the proposed mine lease and adjacent areas provide substantial value habitats for some furbearing species: beaver, marten, ermine, long-tailed weasel, mink, badger and the striped skunk. The muskrat, classified as a non-furbearing animal by Utah Division of Wildlife Resources because of its "pest" status, must also be considered. The breeding and rearing activities of
all of these non-migratory species occurs within the area of concern and their dens and lodges are of critical value to maintenance of their populations. It is doubtful if the proposed actions will seriously impact them. These species, with the exception of the marten, are widespread and highly adaptable to the activities of man. In fact, both beaver and muskrats are often controlled as pests. In the acres of actual habitat that is destroyed the faunal species will be lost, but this small acreage loss will be minimal compared to the total habitat available and the total impact on faunal populations will be little noticed.

2.9.2.2 Herpetofauna

Increasing elevation rapidly reduces the number and kind of reptiles and amphibians. Furthermore, in Utah the effects of the more northern latitude reduces numbers of herptiles in much the same way as does the increase in elevation.

These geographical and associated climatic factors have eliminated most desert species, leaving species that are adapted either to mountain habitats or montane type habitats developed in the more northern areas. Thus, the reptiles and amphibians of Utah, and particularly those inhabiting the areas under consideration, have arrived in Utah by means of dispersal lanes coming from the northeast and the southeast. With few exceptions the species listed have wide distributions and are versatile in their adaptive abilities.

Literature pertaining to the amphibians and reptiles is extensive; but much of it refers to species occurring in the desert areas and has only limited reference to forms inhabiting Utah mountains. Most of the publications dealing with species lists for the states are old. (V. Tanner, Amphibians, 1931; Woodbury, Reptiles, 1931; and Pack, Snakes, 1930). Perhaps the most up-to-date listings for the area under consideration are a checklist of Utah amphibians and reptiles (Tanner, 1975), and Utah Division publication No. 78-16 (Dalton, 1978).
Other recent literature pertinent to this report are: Schmidt (1953); Stebbins (1954 and 1966); W. Tanner (1953, 1957a and b, 1966-with Banta, 1969-with Morris, and 1972-with Fisher and Willis); and Woodbury (1952).

The area of concern in this report is located in the upper edges of sagebrush (*Artemisia*) and into the Aspen-Spruce-Fir plant communities.

**Amphibians**

Based on the extensive literature review and limited field work it was determined that probably four and potentially six species of amphibians (Table 2.9-3) inhabit the area of concern that provides substantial value habitat for all species listed. All amphibians are protected, but since the species listed are all widespread throughout the mountains of Utah, none are treated as high-interest species, and, therefore, are not individually discussed. It is doubtful if the development action would seriously impact populations but rather localized individuals in the areas of total habitat destruction. An exception to this would result if subsidence interrupted underground aquifers and caused drying of present wet or riparian habitats essential to reproduction.

Amphibian surveys, focusing on locating the Spotted Frog and Boreal Toad, will be conducted in Spring and Summer 2005 depending on the appropriate survey time. The survey for the Spotted Frog will only focus on areas that will be longwall undermined in 2005, additional surveys will be conducted as longwall mining advances, if necessary. The entire survey for the Boreal Toad will be conducted in both Winter Quarters Canyon and Woods Canyon in 2005. During the Boreal Toad survey, an assessment will be made whether suitable Spotted Frog habitat exists in the two drainages and whether additional Spotted Frog surveys are necessary. A detailed description of the Amphibian Studies outlining survey timing, optimum season, and methods is located in Appendix A-2, "Biological Studies in Winter Quarters Canyon Creek and Woods Canyon Creek - A Study Plan". In the event either or both of the amphibians are encountered, the Permittee commits to implementing suitable protection methods, in consultation with the appropriate regulatory agencies (DOGM, USFS, DWR, etc.).
Reptiles

Based on the literature search and limited field work it was determined that probably 10 and potentially 15 species of reptiles (Table 2.9.3) occupy the mine land area that is considered as substantial value habitat for all 15 species. All reptiles are protected, but since the species listed are all widespread throughout montane habitats in Utah, none are treated as high-interest species and therefore, are not individually discussed. It is doubtful if the development action would seriously impact populations but it will destroy the habitat for individuals living in the areas of total habitat destruction surrounding the mine portal, conveyor, storage facilities and access roads.
2.9.3 Endangered and Threatened Species

Passage of the Endangered Species Act of 1973 (Public Law 23-205) provided a legal basis for establishment of lists of endangered and threatened plants and wildlife (Tables 2.9-4, 2.9-5, and 2.9-6). According to National Wildlife Federation (1977), Dalton (1978) and the Federal Register (1979), there are no endangered or threatened species of amphibians or reptiles, or any threatened mammals that inhabit the south-eastern region of Utah. Dalton (1978), however, indicates that one endangered species, the black-footed ferret, might be found in the Wasatch Plateau east of the Skyline Drive. Durrant (1952) reports that he knows "...of no occurrence of the black-footed ferret north of the Colorado River in Utah...". There are unconfirmed reports of black-footed ferret sightings east of Castle Dale and Ferron in Emery County, Utah. Many hours have been spent trying to verify the presence of these animals. Up to now these efforts have been unsuccessful. Observations on all of the Skyline lease and immediate surrounding areas show no signs of prairie dog colonies nor sufficient ground squirrel populations to support ferret populations (Fig. 2.9.3-A).

In recent decades, the bald eagle has recovered from the endangered status and is now listed as threatened. Despite the recovery, very few nests have been identified in Utah as of 2000. The golden eagle is quite common in Utah and is not listed as threatened or endangered. The Skyline Mine permit area was flown in 2005 by DWR and no nests were identified for either eagle.

Threatened and Endangered, and sensitive species were re-evaluated in 2012 as part of the North Lease modification which extended the area approved for mining into portions of the Fish Creek drainage. The lease modification encompasses approximately 770 acres. A pre-survey investigation determined only the Western Toad needed a survey. The survey for the Western Toad was conducted in 2013 and determined they were not in the area. See Appendix Volume A-2 for Alpine Ecological report.

In 2010, the Greater Sage grouse became a candidate species under the ESA. Figure 2.9.3-E shows Skyline Mine lease areas in relation to UDWR Sage Grouse Management Areas from 2014 data. These are areas where leks, brood rearing habitat, and winter habitat occur. Skyline Mine’s lease areas are located within the overall boundary of a Sage-Grouse Management Area, but do not overlap any nesting/brood-rearing habitat or winter habitat (see Figure 2.9.3-E).

2.9.4 Impact Analysis and Protection of Wildlife

Numerous precautions were taken during construction of Skyline Mine to protect the wildlife resources. While the disturbances during the operational phase are greatly reduced, the following concerns have been and are still being considered: (1) surface disturbance, (2) loss of habitat, (3) noise, (4) human activity and (5) air pollution. Any one, all or a combination of the above perturbations can impact terrestrial vertebrates.
Surface Disturbance

Surface disturbance during construction was a major concern. Development radically modified the acreage (Portal Area, South Fork breakout and water tank pad) of National Forest and of private surface. The surface contours were leveled, filled or cut to construct roads, conveyors, waste disposal site and portal and loadout facilities necessary to the project. These cut and fill operations altered land forms and surface areas to conform to needs and modify natural surface drainage patterns. Much of the area will to be undermined via underground techniques with portions being subsided. (Final EIS on Development of Coal Resources in Central Utah, 1979).

In the summer and fall of 2001, the abandoned James Canyon county road was reopened to allow for the construction of two ground water wells. A 16-inch pipeline was buried from the wells to Electric Lake to transport ground water from the wells to the lake. The James Canyon road will remain open to pick-up or similar vehicular traffic from its intersection with the Monument Peak road to the drill holes for useful life of the wells. The wells may be operated for the life of the mine. The section of the road in which the pipeline is buried has been reclaimed and closed to traffic. The wells will be accessed periodically for inspections as needed. The James Canyon road is gated and locked, thus restricting access to the general public. Skyline Mine and Forest personnel have copies of the keys to the gate.

Effects on wildlife will be minimized by limiting access to the wells. No further construction in this area is planned at this time. Future construction will be timed to minimize disturbance to wildlife. Runoff from the road and well pad is treated through silt fences and/or a sediment pond to eliminate off site impacts to the critical Yellowstone Cutthroat Trout habit found in James Creek and Electric Lake. Water discharged from the wells is of similar quality found in James Creek and thus will not adversely impact either the lake or stream.

Habitat Loss

The immediate area of the mine portal, access routes, coal conveyor corridor and loadout facilities have been lost as habitat for wildlife, but the total acreage loss is small compared to that available. Minimal critical habitat was disturbed. Revegetation of road cuts and fill areas was initiated as soon

Revised: 11/02
Figure 2.9.3-A

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program “Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report” by William R. Bosworth, III December 2003. Publication Number 03-45

Utah prairie-dog *Cynomys parvidens*

The distribution of records of the Utah prairie-dog (*Cynomys parvidens*). Red circles represent records since 1983, inclusive, and yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.

Revised 2-2015

Div. of Oil, Gas & Mining
Figure 2.9.3-B

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program "Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report" by William R. Bosworth, III December 2003. Publication Number 03-45

*Gray wolf Canis lupus*

Figure 2.9.3-C

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program “Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report” by William R. Bosworth, III December 2003. Publication Number 03-45

Grizzly bear *Ursus arctos*

The distribution of records of the Grizzly bear (*Ursus arctos*). Yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.

Revised 2-2015
Figure 2.9.3-D

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program “Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report” by William R. Bosworth, III December 2003. Publication Number 03-45

Canada lynx *Lynx canadensis*

The distribution of historical records of the Canada Lynx (*Lynx canadensis*). Yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.
Greater Sage-grouse Winter Habitat*  Nesting and Brood Rearing Habitat*
Flat Canyon Lease area  Greater Sage-grouse Management Area*

*Data from Utah Division of Wildlife Resources SGMA Threat Analysis Management Map
(http://utahdnr.maps.arcgis.com/apps/Viewers/index.html?appid=0ed5494214cc4ea98b614a72477f67b)

Figure 2.9.3-8
Sage Grouse Management Areas Relative to Skyline Mine
as was practical with concern given to revegetation with plant species that not only benefit, but promote wildlife.

Subsidence

Surface disturbance associated with certain mining operations and techniques can be extremely detrimental to terrestrial and aquatic vertebrates, but the mining technique proposed for use in the Skyline Project minimizes much of the impact. Since no over burden is removed with underground mining, the only potential problem is surface subsidence. The acres that will be in part undermined will be subject to subsidence up to 70 percent of the thickness of the mined coal, however, similarly mined areas in comparable habitats in New Mexico have experienced less than 12 percent subsidence with little or no visible surface disturbance. This was substantiated on a personal inspection tour by Dr. Smith. It is probable that the integrity of the above ground terrestrial communities will generally remain status quo, with occurrence of occasional fractures and minor slippages that will not be detrimental to vegetation or wildlife. Since subsidence will occur systematically and in small areas at a given time as panels are mined, the impact will be lessened. Only localized populations will be impacted and only for a short while. Existing reproductive potential coupled with dispersal will facilitate almost immediate recovery and negate the temporary population reduction.

Overland Coal Conveyor

One of the major surface disturbance impacts of concern to terrestrial wildlife was the construction of an overland coal conveyor that due to necessity acted as a partial barrier to normal wildlife movement patterns in, along and across Eccles Canyon.

The overland coal conveyor extends 2.1 miles down Eccles Canyon from the portal to the storage facilities at the railroad loading area, and represents a barrier to normal big game movements in the area. The potential impact of the conveyor as a barrier is now well understood by wildlife specialists. A detailed design of the conveyor system showing the big game crossings has been designed and approved by UDWR. Design and location of Big Game passageways are shown on

Revised: 11/02
maps 3.2.3-3a thru 3.2.3-3h. To assure that state-of-the-art knowledge concerning big game passage was implemented, the applicant has coordinated the detailed design with UDWR personnel.

Loss of Habitat

The area loss to wildlife because of surface disturbance is minimal in comparison to the habitat available adjacent to the disturbed areas. Refer to Plate 1.6-3 for the acreage for the disturbed area and the permit area.

Because no surface disturbance is planned for the North Lease area, little or no effect to the resident wildlife is expected. However, a review of the existing information and data of this and adjacent areas was conducted.

Once the mining operation is completed and the structures dismantled, the area will be revegetated to enhance the habitat for wildlife.

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Noise

Noise created from construction and operation of the mine and its facilities was initially of consequence, but for most species will become inconsequential. With the possible exception of cougar and elk, there are no wildlife species of concern that will be permanently impacted. Wildlife will be initially disturbed and reproductive success possibly impaired but habituation will occur thus allowing a return to normal.

Cougars do not readily habituate to noise, but they are usually in sufficiently low population numbers and have such extensive ranges that they avoid the source of disturbance. This has likely occurred already in the project area due to the high level of noise and activity already in Eccles Canyon. Elk and noise are still an enigma. It is generally thought that elk will habituate to noise and observations by Dr. Smith, during blasting for seismic studies on the Big Horn Ranch, Utah, substantiate this. The observations to date, however, have been on elk in wide open areas where they did not have to be in close contact with the noise. A concern is whether elk will habituate sufficiently to the noise of the overland conveyor to use the underpasses.

Human Activity

Increased human activity can possibly cause the greatest impact. More people are actively using and traversing the area on a work-day basis plus many are also utilizing the area for recreation. More road kills of wildlife could occur and many of those people traversing and utilizing the area may carry firearms in their vehicles and use them for target shooting of small mammals, carnivores and even game species whether legal or not. Such action could seriously impact the stability of many of our non-protected species but trophically the impact will not cause a "domino effect." Removal of the herbivores will not cause radical declines in populations of higher trophic level species, since the carnivores and raptors will also experience declines.

Game and protected species could also be impacted but hopefully the laws of protection will sufficiently deter such actions to minimize this impact.

Recreational use of the environs other than hunting will undoubtedly impact the wildlife of concern, and will occur in all seasons of the year. It is especially important that wildlife not be harassed.

Revised: 9/04/02
during crucial periods in their life history. During winter, wildlife are often in a delicate energy state. Unnecessary disturbance by man causes them to use up critical and limited energy reserves that often results in mortality. In less severe cases, the fetus being carried by gestating mammals may be aborted or absorbed thus reducing reproductive success and productivity of the population. Impact, however, is reduced by the small number of species wintering in the project area.

During breeding seasons, disturbance by man can negatively affect reproductive success by disrupting territorial selection or defense, interrupting courtship displays and disturbing mating animals. This could result in reduced reproductive success and ultimately in reduced population levels.

During parturition, lactation and early in the rearing process, the increased potential for disturbance of young animals could be determined. It is during this time that young animals gain the strength and ability to elude predators and man. Undisturbed habitats allow the young animals to develop in relatively unstressed situations and to utilize habitats that are secure from predators. Disturbance by man can compromise this situation and result in abandonment of the young by the female, increased accidents that result in mortality or increased natural predation.

Efforts are being made to educate employees associated with the mine operation in the Skyline project area to the intricate values of the wildlife resources associated with the mine plan area. Employees are advised not to unnecessarily harass or take wild-life. The Permittee has extended an invitation to UDWR personnel to participate in these training sessions as appropriate.

2.9.5 TERRESTRIAL WILDLIFE OF THE NORTH LEASE TRACT AREA

The North Lease Tract Area is located adjacent to the northernmost boundaries of the current Skyline Mine permit area. Much of this area lies within and adjacent to Winter Quarters Canyon.

Because no surface disturbance is planned for this area, little or no effect to the resident wildlife is expected. However, a review of the existing information and data of this and adjacent areas was conducted.

Revised: 11/02
Table 2.9-4  
County Lists for Carbon, Emery and Sanpete Counties  
of Federally Listed Threatened (T), Endangered (E), and Candidate Species

### Carbon County

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uinta Basin Hookless Cactus</td>
<td><em>Sclerocactus wetlandicus</em></td>
<td>T</td>
</tr>
<tr>
<td>Graham Beardtongue</td>
<td><em>Penstemon grahamii</em></td>
<td>T Proposed</td>
</tr>
<tr>
<td>Humpback Chub</td>
<td><em>Gila cypha</em></td>
<td>E</td>
</tr>
<tr>
<td>Bonytail</td>
<td><em>Gila elegans</em></td>
<td>E</td>
</tr>
<tr>
<td>Colorado Pikeminnow</td>
<td><em>Ptychocheilus lucius</em></td>
<td>E</td>
</tr>
<tr>
<td>Razorback Sucker</td>
<td><em>Xyrauchen texanus</em></td>
<td>E</td>
</tr>
<tr>
<td>Greater Sage-grouse</td>
<td><em>Centrocercus urophasianus</em></td>
<td>C</td>
</tr>
<tr>
<td>Black-footed Ferret</td>
<td><em>Mustela nigripes</em></td>
<td>E Extirpated</td>
</tr>
<tr>
<td>Gray Wolf</td>
<td><em>Canis lupus</em></td>
<td>E</td>
</tr>
</tbody>
</table>

### Emery County

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones Cycladenia</td>
<td><em>Cycladenia humilis var jonesii</em></td>
<td>T</td>
</tr>
<tr>
<td>Last Chance Townsendia</td>
<td><em>Townsendia aprica</em></td>
<td>T</td>
</tr>
<tr>
<td>Barneby Reed-mustard</td>
<td><em>Schoenocrambe barnebyi</em></td>
<td>E</td>
</tr>
<tr>
<td>San Rafael Cactus</td>
<td><em>Pediocactus despainii</em></td>
<td>E</td>
</tr>
<tr>
<td>Winkler Pincushion Cactus</td>
<td><em>Pediocactus winkleri</em></td>
<td>T</td>
</tr>
<tr>
<td>Wright Fishhook Cactus</td>
<td><em>Sclerocactus wrightiae</em></td>
<td>E</td>
</tr>
<tr>
<td>Humpback Chub</td>
<td><em>Gila cypha</em></td>
<td>E</td>
</tr>
<tr>
<td>Bonytail</td>
<td><em>Gila elegans</em></td>
<td>E</td>
</tr>
<tr>
<td>Colorado Pikeminnow</td>
<td><em>Ptychocheilus lucius</em></td>
<td>E</td>
</tr>
<tr>
<td>Razorback Sucker</td>
<td><em>Xyrauchen texanus</em></td>
<td>E</td>
</tr>
<tr>
<td>Greater Sage-grouse</td>
<td><em>Centrocercus urophasianus</em></td>
<td>C</td>
</tr>
<tr>
<td>Yellow-billed Cuckoo</td>
<td><em>Coccyzus americanus</em></td>
<td>T</td>
</tr>
<tr>
<td>Mexican Spotted Owl</td>
<td><em>Strix occidentalis lucida</em></td>
<td>T</td>
</tr>
<tr>
<td>Black-footed Ferret</td>
<td><em>Mustela nigripes</em></td>
<td>E Extirpated</td>
</tr>
<tr>
<td>Canada Lynx</td>
<td><em>Lynx canadensis</em></td>
<td>T</td>
</tr>
<tr>
<td>Gray Wolf</td>
<td><em>Canis lupus</em></td>
<td>E</td>
</tr>
</tbody>
</table>

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2-104(a)
Sanpete County

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heliotrope Milkvetch</td>
<td>Astragalus montii</td>
<td>T</td>
</tr>
<tr>
<td>Greater Sage-grouse</td>
<td>Centrocercus urophasianus</td>
<td>C</td>
</tr>
<tr>
<td>Utah Prairie-dog</td>
<td>Cynomys parvidens</td>
<td>T</td>
</tr>
<tr>
<td>Brown (Grizzly) Bear</td>
<td>Ursus arctos</td>
<td>T Extirpated</td>
</tr>
<tr>
<td>Canada Lynx</td>
<td>Lynx canadensis</td>
<td>T</td>
</tr>
</tbody>
</table>

Disclaimer: This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. (Last updated on January 12, 2012).

DEFINITIONS

**E**
A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the probability of worldwide extinction.

**E Experimental**
An "endangered" taxon that is considered by the U.S. Fish and Wildlife Service to be "experimental and non-essential" in its designated use areas in Utah.

**E, T, or C Extirpated**
An "endangered," "threatened," or "candidate" taxon that is "extirpated" and considered by the U.S. Fish and Wildlife Service to no longer occur in Utah.

**E or T Proposed**
A taxon "proposed" to be listed as "endangered" or "threatened" by the U.S. Fish and Wildlife Service.

**T**
A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered.

**C**
A taxon for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threats to justify it being a "candidate" for listing as endangered or threatened.

For additional information contact: U.S. Fish and Wildlife Service (801-975-3330)

Revised 7-2015
Utah Sensitive Species List

March 29, 2011

This list has been prepared pursuant to Utah Division of Wildlife Resources Administrative Rule R657-48. By rule, wildlife species that are federally listed, candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. The additional species on the Utah Sensitive Species List, “wildlife species of concern,” are those species for which there is credible scientific evidence to substantiate a threat to continued population viability. It is anticipated that wildlife species of concern designations will identify species for which conservation actions are needed, and that timely and appropriate conservation actions implemented on their behalf will preclude the need to list these species under the provisions of the federal Endangered Species Act. Please see Appendix A for the rationale behind each wildlife species of concern designation.
Utah Sensitive Species List

Fishes

Federal Candidate Species
Least Chub*  
Iotichthys phlegethontis

Federally Threatened Species
Lahontan Cutthroat Trout (introduced)  
Oncorhynchus clarkii henshawi

Federally Endangered Species
Humpback Chub  
Gila cypha  
Gila elegans  
Gila seminuda  
Ptychocheilus lucius  
Plagopterus argentissimus  
Chasmistes liorus  
Xyrauchen texanus
Virgin Chub  
Colorado Pikeminnow  
Woundfin  
June Sucker  
Razorback Sucker

Conservation Agreement Species*
Bonneville Cutthroat Trout  
Oncorhynchus clarkii utah  
Oncorhynchus clarkii pleuriticus  
Lepidomeda mollispinis mollispinis  
Gila robusta  
Catostomus discobolus  
Catostomus latipinnis
Colorado River Cutthroat Trout  
Virgin spinedace  
Roundtail Chub  
Bluehead Sucker  
Flannelmouth Sucker

Wildlife Species of Concern
Northern Leatherside Chub  
Lepidomeda copei  
Lepidomeda aliciae  
Catostomus clarkii  
Oncorhynchus clarkii bouvieri  
Prosopium abyssicola  
Prosopium gemmifer  
Prosopium spilonotus  
Cottus extensus
Southern Leatherside Chub  
Desert Sucker  
Yellowstone Cutthroat Trout  
Bear Lake Whitefish  
Bonneville Cisco  
Bonneville Whitefish  
Bear Lake Sculpin

*Least chub is a Federal Candidate Species and a Conservation Agreement Species.
See Appendix A for the rationale behind each wildlife species of concern designation.
Utah Sensitive Species List

Amphibians

Federal Candidate Species
Relict Leopard Frog (extirpated)  
*Rana onca*

Federally Threatened Species
(None)

Federally Endangered Species
(None)

Conservation Agreement Species
Columbia Spotted Frog  
*Rana luteiventris*

Wildlife Species of Concern
Western Toad  
*Bufo boreas*

Arizona Toad  
*Bufo microscaphus*

Great Plains Toad  
*Bufo cognatus*

See Appendix A for the rationale behind each wildlife species of concern designation.

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Utah Sensitive Species List

Reptiles

Federal Candidate Species
(None)

Federally Threatened Species
Desert Tortoise  
*Gopherus agassizii*

Federally Endangered Species
(None)

Conservation Agreement Species
(None)

Wildlife Species of Concern
Zebra-tailed Lizard  
*Callisaurus draconoides*
Western Banded Gecko  
*Coleonyx variegatus*
Desert Iguana  
*Dipsosaurus dorsalis*
Gila Monster  
*Heloderma suspectum*
Common Chuckwalla  
*Sauromalus ater*
Desert Night Lizard  
*Xantusia vigilis*
Sidewinder  
*Crotalus cerastes*
Speckled Rattlesnake  
*Crotalus mitchelli*
Mojave Rattlesnake  
*Crotalus scutulatus*
Cornsnake  
*Elaphe guttata*
Smooth Greensnake  
*Opheodrys vernalis*
Western Threadsnake  
*Leptotyphlops humilis*

See Appendix A for the rationale behind each wildlife species of concern designation.

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## Utah Sensitive Species List

### Birds

#### Federal Candidate Species
- Yellow-billed Cuckoo: *Coccyzus americanus*
- Greater Sage-grouse: *Centrocercus urophasianus*
- Gunnison Sage-grouse*: *Centrocercus minimus*

#### Federally Threatened Species
- Mexican Spotted Owl: *Strix occidentalis lucida*

#### Federally Endangered Species
- California Condor (experimental): *Gymnogyps californianus*
- Whooping Crane (extirpated): *Grus americana*
- Southwestern Willow Flycatcher: *Empidonax traillii extimus*

#### Conservation Agreement Species*
- Northern Goshawk: *Accipiter gentilis*

#### Wildlife Species of Concern
- Bald Eagle: *Haliaeetus leucocephalus*
- Grasshopper Sparrow: *Ammodramus savannarum*
- Short-eared Owl: *Asio flammeus*
- Burrowing Owl: *Athene cunicularia*
- Ferruginous Hawk: *Buteo regalis*
- Black Swift: *Cypseloides niger*
- Bobolink: *Dolichonyx oryzivorus*
- Lewis's Woodpecker: *Melanerpes lewis*
- Long-billed Curlew: *Numenius americanus*
- American White Pelican: *Pelecanus erythrorhynchus*
- Three-toed Woodpecker: *Picoides tridactylus*
- Sharp-tailed Grouse: *Tympanuchus phasianellus*
- Mountain Plover: *Charadrius montanus*

*Gunnison sage-grouse is a Federal Candidate Species and a Conservation Agreement Species. See Appendix A for the rationale behind each wildlife species of concern designation.*
Utah Sensitive Species List

Mammals

Federal Candidate Species
(None)

Federally Threatened Species
Utah Prairie-dog
Brown/Grizzly Bear (extirpated)
Canada Lynx

Federally Endangered Species
Utah Prairie-dog
Brown/Grizzly Bear (extirpated)
Canada Lynx

Conservation Agreement Species
(None)

Wildlife Species of Concern
Preble’s Shrew
Townsend’s Big-eared Bat
Spotted Bat
Allen’s Big-eared Bat
Western Red Bat
Fringed Myotis
Big Free-tailed Bat
Pygmy Rabbit
Gunnison’s Prairie-dog
White-tailed Prairie-dog
Silky Pocket Mouse
Dark kangaroo Mouse
Mexican Vole
Kit Fox

See Appendix A for the rationale behind each wildlife species of concern designation.

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Utah Sensitive Species List

Mollusks

Federal Candidate Species
(None)

Federally Threatened Species
(None)

Federally Endangered Species
Kanab Ambersnail

Conservation Agreement Species
(None)

Wildlife Species of Concern
California Floater
Western Pearlshell
Southern Tightcoil
Eureka Mountainsnail
Lyrate Mountainsnail
Brian Head Mountainsnail
Deseret Mountainsnail
Yavapai Mountainsnail
Cloaked Physa
Utah Physa
Wet-rock Physa
Longitudinal Gland Pyrg
Smooth Glenwood Pyrg
Desert Springsnail
Otter Creek Pyrg
Hamlin Valley Pyrg
carinate Glenwood Pyrg
Ninemile Pyrg
Bifid Duct Pyrg
Bear Lake Springsnail
Black Canyon Pyrg
Sub-globose Snake Pyrg
Southern Bonneville Pyrg
Northwest Bonneville Pyrg

See Appendix A for the rationale behind each wildlife species of concern designation.

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Table 2.9-6

Sensitive Plant, Wildlife and Fish Species
of Manti-La Sal National Forest
December 2007

Intermountain Regional Forester’s list of sensitive plant, wildlife, and fish species that could occur on the Manti Division of the Manti-La Sal National Forest (MLNF).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SPECIES INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plants</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Arizona Willow</strong>&lt;br&gt;Salix arizonica</td>
<td><em>Salix arizonica</em> occurs in wet meadows along perennial streams and occurs only in the Muddy Creek drainage on the MLNF (NatureServe 2007, UNPS 2007, USDA NRCS 2007).</td>
</tr>
<tr>
<td><strong>Canyon Sweet-vetch</strong>&lt;br&gt;Hedysarum occidentale var. canone</td>
<td><em>Hedysarum occidentale var. canone</em> is found on sites with a high water table, near springs or stream beds within the pinyon/juniper vegetation type at 5,500 to 7,000 ft. elevation. River birch and squaw brush are associated species. It is endemic to Duchesne, Carbon and Emery counties (NatureServe 2007, UNPS 2007, USDA NRCS 2007).</td>
</tr>
<tr>
<td><strong>Carrington Daisy</strong>&lt;br&gt;Erigeron carringtoniae</td>
<td><em>Erigeron carringtoniae</em> occurs in limestone outcrops and escarpments in subalpine vegetation type on wind blown ridge tops and snowdrift sites at high elevations of the Wasatch Plateau (9,000 to 11,000 feet) (UNPS 2007, USU 2007, USDA NRCS 2007).</td>
</tr>
<tr>
<td><strong>Creutzfeldt-flower</strong>&lt;br&gt;Cryptantha creutzfeldtii</td>
<td><em>Cryptantha creutzfeldtii</em> occurs in shallow, rocky, heavy clay soils; open Mancos shale slopes. It is endemic to central Utah in Carbon and Emery counties at 5,000 to 6,500 ft. elevation (NatureServe 2007, UNPS 2007, USDA NRCS 2007, USU 2007).</td>
</tr>
<tr>
<td><strong>Link Trail Columbine</strong>&lt;br&gt;Aquilegia flavescent rubicunda</td>
<td><em>Aquilegia flavescents rubicunda</em> occurs near spring seeps and perennial wetland sites on the east side of the Wasatch Plateau (NatureServe 2007, UNPS 2007, USDA NRCS 2007).</td>
</tr>
<tr>
<td><strong>Musinean Groundsel</strong>&lt;br&gt;Senecio musinensis</td>
<td><em>Senecio musinensis</em> occurs on limestone barrens and talus slopes of the southern Wasatch Plateau (NatureServe 2007, UNPS 2007, USDA NRCS 2007). There are no limestone barrens or talus slopes in the project area.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>SPECIES INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Animals</strong></td>
</tr>
<tr>
<td>Bald Eagle</td>
</tr>
<tr>
<td><em>Haliaeetus leucocephalus</em></td>
</tr>
<tr>
<td>Bonneville Cutthroat Trout</td>
</tr>
<tr>
<td><em>Oncorhynchus clarki utah</em></td>
</tr>
<tr>
<td>Colorado River Cutthroat Trout</td>
</tr>
<tr>
<td><em>Oncorhynchus clarki pleuriticus</em></td>
</tr>
<tr>
<td>Columbia Spotted Frog</td>
</tr>
<tr>
<td><em>Rana luteiventris</em></td>
</tr>
<tr>
<td>Flammulated Owl</td>
</tr>
<tr>
<td><em>Otis flammeolllus</em></td>
</tr>
<tr>
<td>Greater Sage Grouse</td>
</tr>
<tr>
<td><em>Centrocercus urophasianus</em></td>
</tr>
</tbody>
</table>

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Div. of Oil, Gas & Mining

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<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SPECIES INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Goshawk <em>Accipiter gentilis</em></td>
<td>In Utah, most nests can be found in mid-elevation sites occupied by quaking aspen or coniferous forest (Graham et al. 1999). Goshawks forage in fairly dense (generally greater than 40 percent canopy cover) conifer/aspen forests, and they nest in even denser stands (generally greater than 70 percent canopy cover).</td>
</tr>
<tr>
<td>Peregrine Falcon <em>Falco peregrinus</em></td>
<td>Peregrine falcons may travel more than 18 miles from the nest site to hunt for food, however average foraging distance from the eyrie extends out to 10 miles, with 80 percent of peregrine falcon foraging occurring within a mile of the nest (Spahr et al. 1991).</td>
</tr>
<tr>
<td>Spotted Bat <em>Euderma maculatum</em></td>
<td>In Utah, the spotted bat is likely found throughout the state. It is known to use a variety of vegetation types from approximately 2,500 to 9,500 feet, including riparian, desert shrub, spruce/fir, ponderosa pine, montane forests and meadows. Spotted bats roost alone in rock crevices high up on steep cliff faces (Oliver 2000).</td>
</tr>
<tr>
<td>Three-toed woodpecker <em>Picoides tridactylus</em></td>
<td>Three-toed woodpeckers use forests containing spruce, grand fir, ponderosa pine, tamarack, and lodgepole pine. In Utah the species is considered to be a permanent resident of coniferous forests above 8,000 ft. Three-toed woodpeckers are dependent on live and dead trees for foraging and nesting (UDWR 2005).</td>
</tr>
<tr>
<td>Townsend’s Big-eared Bat <em>Corynorhinus townsendii pallescens</em></td>
<td>Townsend’s big-eared bats use buildings, caves, and mines as day roosts, night roosts, and maternity roosts. In Utah, wintering habitats of this species is better known than any other bat species, where it is well known as a hibernator in Utah utilizing caves and mines as hibernaculum (Oliver 2000). This species uses a variety of habitat in Utah including: desert scrub, pinyon/juniper, sagebrush, mountain brush, mixed forest, and ponderosa pine.</td>
</tr>
</tbody>
</table>
Table 2.9-7
Federally Listed Threatened(T), Endangered(E), Candidate(C), and Birds of Conservation Concern (BCC) Species in the Skyline Mine Permit Area*

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
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<tbody>
<tr>
<td><strong>BIRDS</strong></td>
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<td></td>
</tr>
<tr>
<td>Greater Sage Grouse</td>
<td>Centrocercus Urophasianus</td>
<td>C</td>
</tr>
<tr>
<td>Mexican Spotted Owl</td>
<td>Strix Occidentalis Lucida</td>
<td>T</td>
</tr>
<tr>
<td>Southwestern Willow Flycatcher</td>
<td>Empidonax Traillii Extimus</td>
<td>E</td>
</tr>
<tr>
<td>Yellow Billed Cuckoo</td>
<td>Coccystus Americanus</td>
<td>T</td>
</tr>
<tr>
<td><strong>FISHES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonytail Chub</td>
<td>Gila Elegans</td>
<td>E</td>
</tr>
<tr>
<td>Colorado Pikeminnow (Squawfish)</td>
<td>Ptychocheilus Lucius</td>
<td>E</td>
</tr>
<tr>
<td>Humpback Chub</td>
<td>Gila Cypha</td>
<td>E</td>
</tr>
<tr>
<td>Razorback Sucker</td>
<td>Xyrauchen Texanus</td>
<td>E</td>
</tr>
<tr>
<td><strong>Flowering Plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barneby Reed-Mustard</td>
<td>Schoenocrambe Barnebyi</td>
<td>E</td>
</tr>
<tr>
<td>Jones Cycladenia</td>
<td>Cycladenia Humulis var Jonesii</td>
<td>E</td>
</tr>
<tr>
<td><strong>MIGRATORY BIRDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bald Eagle</td>
<td>Haliaeetus Leucocephalus</td>
<td>BCC</td>
</tr>
<tr>
<td>Black Rosy Finch</td>
<td>Leucosticte Atrata</td>
<td>BCC</td>
</tr>
<tr>
<td>Brewer's Sparrow</td>
<td>Spizella Breweri</td>
<td>BCC</td>
</tr>
<tr>
<td>Burrowing Owl</td>
<td>Athene Cunicularia</td>
<td>BCC</td>
</tr>
<tr>
<td>Calliope Hummingbird</td>
<td>Stellula Calliope</td>
<td>BCC</td>
</tr>
<tr>
<td>Cassin's Finch</td>
<td>Carpodacus Cassinii</td>
<td>BCC</td>
</tr>
<tr>
<td>Ferruginous Hawk</td>
<td>Buteo Regalis</td>
<td>BCC</td>
</tr>
<tr>
<td>Fox Sparrow</td>
<td>Passerella iliaca</td>
<td>BCC</td>
</tr>
<tr>
<td>Golden Eagle</td>
<td>Aquila Chrysaetos</td>
<td>BCC</td>
</tr>
<tr>
<td>Juniper Titmouse</td>
<td>Baeolophus Ridgwayi</td>
<td>BCC</td>
</tr>
<tr>
<td>Loggerhead Shrike</td>
<td>Lanius Ludovicianus</td>
<td>BCC</td>
</tr>
<tr>
<td>Long-Billed Curlew</td>
<td>Numenius Americanus</td>
<td>BCC</td>
</tr>
<tr>
<td>Olive-Sided Flycatcher</td>
<td>Contopus Cooperi</td>
<td>BCC</td>
</tr>
<tr>
<td>Peregrine Falcon</td>
<td>Falco Peregrinus</td>
<td>BCC</td>
</tr>
<tr>
<td>Pinyon Jay</td>
<td>Gymnorhinus Cyanopeplus</td>
<td>BCC</td>
</tr>
<tr>
<td>Prairie Falcon</td>
<td>Falco Mexicanus</td>
<td>BCC</td>
</tr>
<tr>
<td>Sage Thrasher</td>
<td>Oreoscoptes Montanus</td>
<td>BCC</td>
</tr>
<tr>
<td>Short-Eared Owl</td>
<td>Asio Flammaeus</td>
<td>BCC</td>
</tr>
<tr>
<td>Swainson's Hawk</td>
<td>Buteo Swainsoni</td>
<td>BCC</td>
</tr>
<tr>
<td>Williamson's Sapsucker</td>
<td>Sphyrapicus Thyroideus</td>
<td>BCC</td>
</tr>
<tr>
<td>Willow Flycatcher</td>
<td>Empidonax Traillii</td>
<td>BCC</td>
</tr>
</tbody>
</table>

*List generated for Skyline Mine Permit Area from US Fish & Wildlife IPAC Trust 7/2/2015  
(See Appendix A-2 Volume 2 for IPAC Trust Resource Report for Skyline Mine Lease Area)
Several wildlife studies have been done previously at and adjacent to the Skyline Mine area in collaboration with the Utah Division of Oil, Gas & Mining (DOGM), Utah Division of Wildlife Resources (DWR) and the USDA Forest Service (USFS). Because the North Lease Tract area is so close in proximity to the active mine site, results from previous studies including literature, field data, species lists, habitat classifications, and so on can be directly correlated. From these studies, it has been reported that the area inhabits 73 mammalian, 8 amphibian and 23 reptilian species.

In addition to these studies, Parrish (1992) conducted a study for wildlife occurrences in this area. A copy of the final report has been included in this document. In this report assessment of wildlife species potentially occurring in this area was conducted in three phases: 1) literature review and compilation of available background data, 2) consultation with agency personal i.e. DWR, USFS and the U.S. Fish and Wildlife Service (USFWS), and 3) aerial survey of the project area from existing maps of raptor nests. For additional wildlife information refer to Tables 2.9-1 through 2.9-3. and the Parrish (1992) Report.

**Fishes**

According to the study, no background information from a literature review was known to exist on the occurrence of fishes within the study area, but at least eight species potentially occur in drainages located within the project area. Moreover, redside shiner and mountain sucker have been reported to occur in the creeks of Winter Quarters Canyon. Refer to Section 2.8 for additional information pertaining to fish and macroinvertebrates.

Revised: 11/02

**Herpetofauna**

Also according to this study, no background information from a literature review was known to exist on the occurrence of reptiles and amphibians within the study area. The area has the potential habitat for at least 8 species of amphibians and 23 species of reptiles, most of which were classified as "common" in the table provided in the study.

Revised: 11/02
Mammals

At least 73 mammal species potentially occur in the area on a seasonal or year-round basis.

Furbearers

Approximately 10 furbearers potentially occur within the North Tract Lease or adjacent areas including beaver, mink, bobcat, ringtail, long-tailed weasel, badger, striped and spotted skunk.

Game Species

At least 5 big game species (mountain lion, black bear, elk, moose, mule deer) are known to occur in the project area. Three of these species (elk, moose and mule deer) occur on a regular basis. The area has been categorized as high value summer habitat for mule deer, critical value summer habitat for elk, and high value winter habitat of moose. DWR classifies hunts for mountain lion and black bear as “special”, because hunting is only allowed by special limited permit, under special circumstances determined by the DWR.

Birds

No site-specific lists of birds have been prepared for the area, however, a list of potential species for the project was included in the study. This list included 147 species that may occur seasonally or year long. Of these species, at least 67 may be considered permanent residents. The general area has several species of migratory waterfowl and shoreland birds due to its proximity to wetland, riparian and open waters. Herons, egrets and migrant passerines are likely to be seen using the area. Several species of upland game birds are also known to occur in the foothill regions of the area including chukar, blue grouse, ruffed grouse, and sage grouse. Mourning doves may also be common summer residents and nest in small trees of riparian areas.

Surveys to determine the presence of the Northern Goshawk and the Northern Three-toed Woodpecker will be conducted in the North Lease area in Spring 2005, prior to any longwall mining being conducted. Details of the timing of the surveys and methods to be used are outlined in Appendix A-2, “Biological Studies in the Winter Quarters Canyon Creek and Woods Canyon Creek - A Study Plan”. In the event either or both of the birds are located, the Permittee commits to implementing suitable protection method, in consultation with the appropriate regulatory agencies (DOGM, USFS, DWR, etc.).

THREATENED & ENDANGERED SPECIES

Because no surface disturbance in planned for the North Lease Tract Area, no impact to endangered, threatened, or otherwise sensitive species should occur.

Revised: 08-24-05
2.9.5(a) Winter Quarters Ventilation Facility (WQVF)

Considerable work studying the wildlife has been conducted in Winter Quarters Canyon, whether associated with the North Lease area of mining or exploration drilling. Various wildlife surveys have been conducted every year from 2005 through 2008, with surveys specifically conducted in the vicinity of the WQVF pad site in 2008 and 2009. To summarize the affects of the WQVF surface disturbance on wildlife, a summary report was drafted by Tetra Tech in 2009, and an additional survey by Western Land Services. Both studies are provided in Appendix A-3, Volume 2. The following briefly identifies the wildlife, their status, and the location of detailed analysis:

- Mammals: 2009 Tetra Tech report (Appendix A-3, Volume 2); Minimal effects.
- Goshawk, Flammulated Owl and other Wildlife report (Appendix A-3, Volume 2); Minimal effects / no owls found
- T&E Species: 2006 through 2009 Tetra Tech reports (Appendix A-3 Volume 2) None found.
- Noise: 2009 Tetra Tech report; Minimal effects
- Habitat Loss: Minimal temporary habitat loss when compared to the extent similar habitat in the surrounding area. The total affected area will be limited to approximately eight (8) acres that will be returned to the pre-disturbance habitat at reclamation.

Significant portions of the area have been previously disturbed through logging, grazing, and historic mining uses. During development of the facility, daily activity will include vehicle traffic and construction activities. After construction, the use of the canyon will return to historic uses, with only an exhaust fan operation remaining. The WQVF will not be accessed on a regular basis, most inspections of the fan and associated facilities will be via underground access. The road is will not be opened for year-round use after construction. Access will be limited by a locked gate.

Revised: 12-30-09
2.9.6 WILDLIFE OF THE SCOFIELD WASTE ROCK EXPANSION (~5 ac.)

The Scofield Waste Rock site expansion encompasses approximately 5.13 acres of ground previously undisturbed by mining activities. The remainder of the approximately 37.5 acre Waste Rock permit area was a pre-SMCRA, pre-disturbed site.

Because only a minimal amount of acreage is anticipated to be disturbed at one time (approximately 3 acres) - and consistent with historic use of the site, little or no effect to the resident wildlife is expected. However, a review of the existing information in conjunction with additional studies was conducted.

Impact Analysis
The Waste Rock site is adjacent to the town of Scofield, Utah, and is considered a limited value wildlife use or 'occasional use area' since the area is used minimally as a big game migratory area. Figures 2.9.1-A and 2.9.2-B illustrate the summer range, winter range, and migratory routes for both elk and Mule deer. Utah Division of Wildlife personnel Leroy Mead, visited the site in April 2007 and conversed with Utah Division of Oil, Gas, and Mining personnel in September 2007 indicating impacts to big game would be minimal.

Impacts to Herpafuna are minimal because the drainages in the area are both ephemeral and the expansion activities do not add any additional impact to the stream courses.

A raptor survey was conducted in 2007. Two red-tailed hawks were encountered within a 1/4-mile of the site, but no goshawks were observed. An apparently inactive nest located approximately 1/8-mile west-southwest of the site was observed. This nest was not noted during a similar survey conducted in 1995. Skyline Mine has committed to observing the nest in 2008 to determine any use or activity. Findings will be reported in the Annual Report.

Threatened & Endangered Species
In 2007 the site was assessed for incidental species observations for the presence of threatened, endangered and special status species, management indicator species and important habitat (including elk calving, mule deer fawning, and sage grouse breeding and nesting) and migratory bird use with the project area. Findings of the surveys support extension of the Waste Rock area. The Scofield Waste Rock site does not have the correct habitat (too high of elevation) for the threatened and endangered species listed for Carbon county, Utah.

Revised: 12-30-09
Habitat Loss
The amount of habitat loss due to surface disturbance is minimal when considering the extent of similar surrounding habitat, and areas of contemporaneous reclamation that were previously disturbed prior to the current mining activities. Disturbed areas will be minimized to approximately 3 acres as the area is contemporaneously reclaimed. Noise and human activity in the expansion area is consistent with the historic mining activities. Also, wildlife studies indicates the surrounding area is used as a migratory route between summer and winter ranges. Enhancement measures at reclamation will include the planting of seeds and woody species seedlings that are diverse and palatable to wildlife, and a pond to be used by both wildlife and livestock. The pond is being left intact at the landowner=s request - historically the pond has only periodically retained a very limited water supply.

2.9.7 WILDLIFE OF THE NORTH OF GRABEN (NOG) BLEEDER SHAFT

The NOG Bleeder Shaft is within the North Lease where multiple wildlife surveys have been conducted. Tables 2.9-1 through 2.9-3 provide a historic species list of mammals, amphibians, and reptiles whose published ranges exist in the general area of the Skyline Mine. Tables 2.9-4 and 2.9-5 have been updated (2015) to include the federally listed threatened, endangered, candidate, and sensitive species in Carbon, Emery, and Sanpete Counties. In addition, Figure 2.9.3-A has been modified and updated and Figures 2.9.3-B, 2.9.3-C, & 2.9.3-D have been added to illustrate the endangered mammalian species in relation to the Skyline Mine lease areas. Table 2.9-4, Threatened, Endangered, and Candidate species list has been updated. Table 2.9-5, Utah Sensitive Species List has been updated. Table 2.9-7, has been added which summarized the Threatened, Endangered, and Candidate species likely to occur in the entire lease area. This table was generated from data included in the US Fish & Wildlife Service Information Planning and Conservation (IPaC) Trust Resource Report for Skyline Mine Lease area. (See IPaC Report in Appendix A-2, Volume 2). The Yellow-billed cuckoo has recently been listed at Threatened. Although the IPaC report and county list indicates the possibility of their presence, the project area is above the known elevation range of the species, and there is no suitable habitat in the area. (See Appendix A-2, Volume 2 for Alpine memo dated July 2015).
The area is considered critical summer habitat for deer and elk. During development of the facility, daily activity will include vehicle traffic and construction activities. After construction, the use of the area will return to historic uses, with only an exhaust fan operation remaining. Construction of the pad will occur in Fall of 2015, so the critical summer fawning/walving period will not be impacted. Construction of the fan facility will occur in spring/summer of 2016, since the ventilation facility is needed by Fall of 2016. If construction begins after June 1st, when the peak fawning/calving period begins, the area will be surveyed to detect the presence of any potentially fawning/calving individuals. This will consist of walking the area 1000 feet below the construction area. If any individuals are encountered, they will be monitored, and construction will not begin until the individual is no longer in the area (See Alpine memo dated July 2015). After construction, the impacts will be minimal since the fan system that is being installed will be equipped with an Exhaust Silencer with an overall pressure level of 76dBA at 36" from the fan. Access will be limited by a locked gate.

No sage grouse habitat exists in the area. Figure 2.9-8 has been added which shows Utah DWR’s Sage Grouse Management Area threat analysis, including habitat areas. Skyline Mine lease area is shown relative to the Sage Grouse Management Areas. A wildlife survey report conducted in 2014 which addressed goshawk, raptors, American three-toed woodpecker, and Threatened and Endangered species determined no species of concern would be impacted by the construction of the shaft (See Appendix A-2, Volume 2 for Alpine Ecological report and Alpine memo dated July 2015).

2.9.8 Swens Canyon Ventilation Facility (SCVF)
The SCVF is permitted to encompass approximately 9.7 acres. The project also includes an approximately 2.62 mile power line, with a permitted 15-foot wide corridor which totals approximately 4.8 acres. Minimal disturbance is anticipated with the power line as the 3-phase, 12.5 kV, single pole power line, with compact construction has been adapted for raptors and no road building will be involved with the installation. Access to the power corridor will be limited to minimal cross-country travel with either a rubber-tired or tracked vehicle.

General wildlife and raptor surveys conducted in both 2013 and 2014 were consistent with previous studies with no threatened or endangered species being observed in either the power line corridor or the SCVF site. A specific Western Boreal Toad survey was also conducted in 2014 indicating the absence of the species. (See Appendix A-3, Volume 2 for studies conducted by Alpine Ecological). Noise will not be an issue after construction as Revised: 5-27-16
no fan is planned for the facility. The power line is buried through Upper Huntington to minimize visual impacts. Habitat loss through the power line corridor will be minimal as vegetation should be re-established in the following growing season. Habitat disturbed by the SCVF will be re-vegetated at reclamation at a lower woody-species density with an increased forb and grasses density to provide a better post mining habitat. Areas used for wildlife, logging, and grazing will be returned to their historic uses. Skyline commits to adhering to any wildlife seasonal exclusionary restrictions that the US Forest Service employs.

2.9.7 WILDLIFE OF THE SOUTHWEST RESERVE - FLAT CANYON LEASE

Tables 2.9-1 through 2.9-7 provide both historic and current (2015) species list of mammals, amphibians, and reptiles whose published ranges exist in the general area of the Skyline Mine. A separate US Fish and Wildlife species list by counties identifies the threatened and Endangered species for the area and the likelihood of their presence (See Appendix A-3, Volume 2 for Alpine Ecological report). The list does not identify any specific species of concern for the project area. Figure 2.9.3-E illustrates the ranges for the Greater Sage Grouse. Brood-rearing habitat for the Greater Sage Grouse exists to the west of areas to be mined in the Flat Canyon lease with winter habitat existing to the northeast of the Skyline project area. However, No leks have been identified in the lease or adjacent areas.

The Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) in 2002 determined there were no threatened and endangered, or sensitive species present in the lease area. In February 2013, Allen Rowley, Acting Forest Supervisor for the Manti LaSal National Forest determined the 2002 EIS was current and did not need additional updating. A raptor/wildlife/sensitive species survey of the area was conducted in 2011 and 2012 which updated both the raptors and other wildlife in the area to meet the Special Coal Lease Stipulations #3 and #4 of Coal Lease Tract (UTU-77114) – (See Appendix A-3, Western Land Services, Inc. reports for details). The area is designated as crucial summer habitat for both mule deer fawning and elk calving. Although habitat for amphibians such as the boreal toad was found, no species of concern were present. An additional presence/absence survey was conducted in 2014 with no amphibians being found (report located in Appendix A-3 Volume 2). No impacts to Wildlife are anticipated with the Flat Canyon lease as no surface disturbance is associated with the lease.

Revised: 12-30-16

Incorporated

Feb 13, 2017

Div. of Oil, Gas & Mining
LITERATURE CITED


Revised: 9/04/02


Revised: 9/04/02

2-106
2.10 RAPTORS

A raptor study was conducted in 1980 by Dr. Clayton White of the faculty of Brigham Young University. Subsequent surveys were performed in the area by the Utah Division of Wildlife Resources ("DWR") in 1993, by DWR, DOGM, and Coastal in 1995, by DWR and Canyon Fuel Company ("CFC") in 1997, and CFC and DWR in 1999. This section summarized these reports. Complete copies of the reports may be found in Appendix Volume A-2.

In 1980, the Skyline Mines project area was studied by Dr. White during two different periods, a two-day early spring period and four-day brooding season period. Of prime consideration in this study was the determination of the presence or absence of two threatened or endangered species, the peregrine falcon (Falco peregrinus) and bald eagle (Haliaeetus leucocephalus). Additionally, all other raptors seen were recorded. Because of the elevation of the mines and the nature of the habitat, the numbers of individuals and numbers of species (diversity of raptors was found not to be as great as compared to lower elevations where the habitat was and continues to be less uniform.

In addition to Dr. White's reported field observations, the federal and state resource managers in the area were contacted to obtain information on raptors presence. Don Ward, U. S. Forest Service Biologist and Larry Dalton, Utah Division of Wildlife Resources Biologists, had only general and limited information on the area. However, as an indication of the species that might be expected to occur in the Skyline Mines area, data from Jones (1979) are given in Table 2.10.1. These data come from the area between Huntington and Ferron Canyons to the south of Skyline Mines. The frequency or density of raptors studied by Jones was also highest at elevations lower than the equivalent to the Skyline Mines area. Several species of raptors may pass through the area in migration, but their numbers are not known nor has their length of stay been documented. Species likely to pass through the area are the marsh hawk (Circus cyaneus), Swainson's hawk (Buteo swainsoni), bald eagle (Haliaeetus leucocephalus), and rough-legged hawk (Buteo lagopus).
TABLE 2.10-1
RAPTOR SPECIES SEEN AND HABITAT SUITABILITY IN MANTI DIVISION, MANTI-LASAL NATIONAL FOREST

<table>
<thead>
<tr>
<th>Areas Surveyed</th>
<th>Species observed and expected¹</th>
<th>Habitat³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goshawk</td>
<td>Sharp-shinned</td>
</tr>
<tr>
<td>1. Huntington C.</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>2. Rilda C.</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>3. Mill Fork C.</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>4. Tie Fork C.</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>5. Crandall C.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6. Grimes Wash, Danish Basin</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7. Cottonwood C.</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>8. Straight C.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>10. Upper Joes Valley</td>
<td>P</td>
<td>-</td>
</tr>
<tr>
<td>11. North Horn Mtn.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12. Upper Rock C.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13. Lower Rock C., East Rim</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14. Ferron C., Bull Hollow</td>
<td>-</td>
<td>P</td>
</tr>
<tr>
<td>15. Ferron C., Flagstaff Peak</td>
<td>P</td>
<td>-</td>
</tr>
<tr>
<td>16. Muddy Creek C.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Species and structures: + = observed, - = not observed, P = probable occurrence.
2. Cavities assumed used by Great-horned Owls.
4. Roosting habitat suitability judged with respect to wintering Bald Eagles.
The Winter Period - 7-8 April, 1980

Larry Dalton, Utah Division of Wildlife Resources, indicated that bald eagles arrive at Scofield Lake approximately 15 November and leave at variable times in early winter corresponding to the "freeze up" of the lake. This is normally before January. Bald eagles do not utilize Electric Lake at the south edge of the study area. Food supplies there may be insufficient.

Although bald eagle roosting site locations are unknown, it is unlikely that the birds utilize any of the study area regularly.

Only a goshawk (Accipiter gentilis), a red-tailed hawk (Buteo jamaicensis) and a golden eagle (Aquila chrysaetos) were seen in the Skyline area. Snow cover is generally too deep to provide open areas for prey species. Reports of golden eagles were received from several other persons who visited the general area during the winter. Raptor species that might occur there probably move to lower elevations during the winter. The great-horned owl (Bubo virginianus) might also winter in the immediate area of the mines, but none was seen.

The Breeding Season Survey, May 17 - 18, 1980

The mine portal site and twelve drill hole sites were visited and the immediate area searched for nesting raptors. No nests were located and only a few species were observed in flight. The individual raptors observed were recorded on Raptor Count Sheets and sites visited and raptors seen are plotted on a map. Those species seen were: eight sightings of red-tailed hawk and one kestrel (Falco sparrowius); one golden eagle and one great-horned owl.

It is highly likely that all of the species given on Table 2.10-1 occur in the Skyline Mine region, but since they probably occur in low numbers only extensive survey work would reveal their presence.
In May 1993, a survey was conducted by the DWR of the Skyline Mine lease area during which four stick nests were observed. Additionally, red-tailed hawks were observed in James Canyon, Burnout Canyon, Eccles Canyon, and Winter Quarters Canyon. Goshawks were observed in Eccles and Burnout Canyons and a Cooper's hawk and golden eagle were observed in the area. Roosting locations for the raptors observed were not located at the time of the survey. A map of the nest and raptor sighting locations is provided in Appendix Volume A-2.

Another survey was conducted by the DWR with help from DOGM and a mine employee in June 1995. This survey was limited to the western portion of the lease near Electric Lake and to the Winter Quarters area. During this survey, no nest were found but seven hawks and three golden eagles were observed in the area. Maps of the survey area and locations of raptor sighting is provided in Appendix A-2.

In June 1997, a survey of the Skyline Mine area was conducted by Mr. Ben Morris of DWR and Mr. Eric Petersen, a consultant to Canyon Fuel Company. The survey was conducted with the aid of a helicopter. During the survey three red-tailed hawk nests were noted. One nest was occupied by a red-tailed sitting on two eggs. Two additional nests were noted as tended. A kestrel nest was also noted as tended. Of the 13 previously noted Golden eagle nests in the area, 12 were not found during this survey and one was inactive. Additionally, a single nest was found but the responsible raptor species was not known. The results of this survey and additional information provided by DWR is provided in Appendix Volume A-2.

In October 1999, a raptor survey of the Skyline Mine area, Utah Power and Light Tract, and the Flat Canyon Tract was conducted by Mr. Chris Colt of DWR and Messrs. Chris Hansen and Gary Taylor of Canyon Fuel Company. The survey was conducted with the aid of a helicopter. During the survey two nests were noted. The nests could either be red-tailed hawk or goshawk. A map of the results of the survey is provided in Appendix Volume A-2.
Prior to the construction of the Swens Canyon Vent Facility (SCVC) raptor and wildlife surveys were conducted in both 2013, 2014, and 2015 (see Appendix A-2, Volume 2 for reports). A juvenile goshawk nest was found on the edge of the power line corridor and will be monitored in 2016. Because of the location, wildlife biologist Mace Crane anticipates the nest will not be occupied in the future. Assuming it is occupied during construction, appropriate mitigation measures will be implemented per US Forest Service personnel instructions. See Figure 2.10-1 for avian protection on the line posts and power line clearing area. No long-term impacts due to increased vehicle and human activity are anticipated at the vent facility after construction because the site is adjacent SR-264 with moderate daily traffic and a popular campsite is located adjacent to the road and Swens Canyon Creek.

Raptor surveys indicate that there may be raptors nesting in the vicinity of the Scofield Waste Rock Disposal site. A raptor survey was conducted in 1995 by Skyline Mines to determine if there were any active nests within a 1/2 mile radius of the disposal site. No nests were found by environmental personnel from Skyline Mine. Another raptor survey was conducted in 2007 for the waste rock expansion site and one raptor nest was identified within 3 mile. According to the analysis, the nest has been in place for some time and the raptors have habituated to the activities of the waste rock site. This nest will be monitored in spring 2008 for its status. Results of the status will be reported in the Annual report.

2.10.1 Conclusion

Raptor species, normally found in conifer forests, occur in small numbers on the Skyline Mine area. Nesting habitat for tree nesting species provides the only readily available habitat there. Bald eagles pass through the area and stop over in adjacent regions during that migration. They, however, move on as winter sets in. Peregrine falcons may also pass over the area in migration, but any number that would do so is certainly small. No nesting sites of either species are known nor suspected in the Skyline area. The nearest known sites are in excess of 20 miles from the Skyline area. The overall elevation of the mining region is high enough and the habitat such as to restrict the density and diversity of raptors. It is concluded that development of the skyline Mine area will not have and adverse effect on critical raptor species, and any species that may be affected are common enough that the impact will be minimal on the populations.

Revised 5-27-16

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2-111
WOOD POLES
APPROXIMATELY 200 STRUCTURES
NO NEW ROADS FOR CONSTRUCTION PLANNED
ANY ROADS BUILT FOR CONSTRUCTION WILL BE RECLAIMED

INSULATED AVIAN PROTECTION ON
LINE POST

INSULATED GROUND FOR
AVIAN PROTECTION

POLE DETAIL
SCALE: NONE

POWERLINE CLEAR AREA
SCALE: NONE

THIS AREA CLEAR

45'

5'

56'

6'
2.10.2 RAPTORS OF THE NORTH LEASE TRACT AREA

A raptor study was conducted by White (1980) for the Skyline Mine area and summarized in Section 2.10 of this document. The raptor report White (1980) can be found in Appendix Volume A-2. Prime emphasis was given to the threatened or endangered species -- the peregrine falcon and the bald eagle, but other raptors were also recorded during the field work of the study.

Another raptor survey was performed at the time of the wildlife study by Parrish (1992). Within this report a table was formulated that comprised 15 diurnal raptors and 10 species of nocturnal raptors that potentially occur in the project area. An aerial survey by helicopter was performed on March 5, 1992 where 11 raptor nests were mapped, five of which were within the boundaries of project area. The remaining nests were within 1 mile of the area. A large nest, probably used by golden eagles, was located in Woods Canyon, just outside the permit boundaries.

A subsequent ground-truthing study was done to check the presence or absence of raptors in the 11 nests on July 4-5, 1992. Adult and/or juvenile raptors were found to be present in the general vicinity and 4 nest sites were within the project area. Two of these active nests were being used by red-tailed hawks, with signs of nesting activity. The two additional sites were occupied by Northern goshawks, one of which had signs of nesting activities.

Of the remaining 7 nests, attempts to locate 2 of them were not made because of time constraints, 1 was inaccessible and the remaining 4 were unoccupied by raptors and lacked evidence of nesting activities. During the field study additional raptor observations were made including one juvenile and two adult red-tailed hawks, and two goshawks.

During a survey by the USFS in 2002 a goshawk nest was located. The permittee was not given the exact location of the nest but was given an activity exclusion zone of ½ mile radius with the diameter center being the ½ section on the South section line of Section 3, Township 13 South, Range 6 East.

Because no surface disturbance is planned in the North Lease Tract Area, critical habitat for raptors should remain unaffected.

An additional baseline Northern goshawk survey will be conducted in the North Lease area prior to Revised: 8-24-05 2-111a
July 1, 2005. Details of the method of the survey are outlined in Appendix A-2, Biological Studies in Winter Quarters Canyon Creek and Woods Canyon Creek - A Study Plan. Results of the survey will be provided in Appendix A-2, Volume 2 when completed.

Raptor surveys were conducted in 2005, 2007, 2008, 2009, 2011, and 2013 in the Winter Quarters area associated with drilling programs. Those surveys and the presence or lack of presence of raptors has not prohibited our work in the area. The raptor surveys are located with the respective exploration permits for each year. A summary report addressing the affects on raptors with the addition of the Winter Quarters Ventilation Facility is included in Appendix A-3, Volume 2. In 2009, an additional survey of the Northern goshawk, flammulated owl, and other comprehensive wildlife was conducted with similar results. No long term detrimental affects associated with the ventilation facility are anticipated. The 2011 survey identified a newly established goshawk nest in the lease modification area. This nest will continue to be monitored in future annual surveys, with additional lands to be monitored as mining advances in the North Lease modification area.

The North of Graben (NOG) Bleeder Shaft area is within the North Lease area and has been monitored for raptors on an annual basis. Based on the 2014 survey, no raptors will be affected by the proposed construction of the shaft. A specific raptor survey was conducted in 2014 specifically for the NOG Bleeder Shaft area with no nests being found. See Appendix A-2, Volume 2 for Alpine Ecological report.

THREATENED & ENDANGERED SPECIES
No threatened or endangered species have been documented in studies surrounding the Winter Quarters Ventilation Facility that would prohibit construction. See Appendix A-2, Volume 2 and Appendix A-3, Volume 2 for reports. Because no surface disturbance in planned for the North Lease Tract Area, no impact to endangered, threatened, or otherwise sensitive species should occur.

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2.10.3 Raptors of the Flat Canyon Lease

The Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) in 2002 determined there were no threatened and endangered species, or sensitive species present in the lease area. In February 2013, the Acting Forest Supervisor for the Manti LaSal National Forest determined the 2002 EIS was current and did not need additional updating. Although some habitat exists for the Bald Eagles (winter), migratory birds, Flammulated Owl, and the Three-toed Woodpecker exist in the area, no sightings have been noted. In addition, a raptor/wildlife/sensitive species survey of the area was conducted in 2011 and 2012, which updated the information for the area to meet the Special Coal Lease Stipulations #3, and #4, and #15 as outlined in the Flat Canyon Lease Tract (UTU-771114). (See Appendix A-3, Volume 2 for the Western Land Services, Inc. report for details). Because no surface disturbance is planned for the Flat Canyon lease area, no impact to endangered, threatened or otherwise sensitive species should occur.

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2.11 SOILS

At each vegetation reference site a soil pit was excavated to the parent material layer. The exposed soil profile allowed for determination of information for classification of the soils into taxonomic units. The portal-yard and bypass access road areas were also sampled. Soils collected at the portal-yard sites were taken as a composite of the top six inches of the profile.

In addition to depth information obtained from the soil pit descriptions, there were 100 depth measurements along the transect areas and in the validation sites. Those readings were obtained by observing the depth of penetration of a sharpened steel rod.

Soils were classified to family unit according to the system utilized for classification of soils by the Soil Conservation Service (Johnson, 1975). Use of this method will allow correlation of permit area soils at the series level when the Soil Conservation Service completes the mapping effort of adjacent areas.

The data compiled on soils suggest that a cryic temperature regime is a proper designation for this area. Cryic is typically conifer-aspen related, with some high meadows included. These areas are too cold for cultivation of crop plants by ordinary means. Frigid designation is given to soils typical of aspen-sagebrush types, and some crops can be grown. Most of the soils are in the udic (moisture arriving in summer) regime.

Maps of soil/plant associations including cadastral locations are presented in the Vegetation and Soils Report submitted in the original application and are in Volume A-2. All soils have textures ranging from sandy loams to clay loams, and are considered neither unusual for the area in general nor for the vegetation types those soils support. The soils are not of a textural class that would be considered a problem either in
disturbance or in reclamation activities. A comparison of spruce-fir and aspen soils, which as broad categories make up more than 80 percent of the permit area soils, shows that the pH and salinity measurements are probably normal for this climatic regime with the pH range from somewhat acidic to neutral for spruce-fir and aspen soils. There is a slight difference in soil reaction between spruce-fir (pH 5.0) and aspen (pH 6.0) soils, but this is also considered to be characteristic (i.e., evergreen conifer types more acidic than the deciduous forest of aspen.)

Saline soil measured in the permit area, at reference site 2 - (Plate 2.7.1-1), aspen with an EC x 10³ value of 1.88, is considered extremely low when compared to agricultural soils. A slight difference between soils is noted when depths are compared. The solum of aspen extends to an average depth of 20 inches from nine locations and to 18 inches at seven locations of the spruce-fir. This corresponds to the average depths of penetrometer readings in aspen of 19.9 inches and of 18.1 inches in spruce-fir soils.

It is also apparent that soils in aspen communities are more fertile in the commonly applied fertilizers, N, P, and K, and also in most micro-nutrients. The levels of Fe, Mg, and Mn are considered to be adequate for growth of native vegetation, even though somewhat below amounts reported for average soils in the western United States (Shacklette et al., 1971). Moderate amount of Zn, Ca, and K indicate that adequate quantities of these minerals are present, except in sagebrush soils.

High amounts of Ca, especially in the B-horizon of spruce-fir soils, are not considered a problem in immobilization of P due to the acid pH for these soils. Concentrations of Ca in sagebrush and aspen soils could become a problem in P relations if soils are altered to become more basic. NO₃-nitrogen is low in quantity, as was expected for these soil types. Average amounts of NO₃-nitrogen are inadequate in all soils of the region and all horizons. All areas would respond to addition of nitrogen, as
indicated by the low total nitrogen content from all vegetation types.

In summary, the most important fertilizer to be applied in reclamation attempts is nitrogen. The addition of nitrogen should be timed with suitable moisture content in the soils (fall and spring). The soils are classified by the vegetation type with which they are correlated, as recommended by the Soil Conservation Service. Complete soils information is provided in the 1980 Supplemental Soils Report of Vol. A-2.

Only soil from the "A and B" horizons were collected and put into the topsoil stockpile and considered as "useable" for reclamation purposes. The soil from the "C" horizon was considered unsuitable and therefore not removed and not put into the topsoil stockpiles. The portal area topsoil stockpile contains 91,586 cubic yards of top soil. Included in the portal area stockpile is 15,295 cubic yards of top soil removed from the conveyor bench. The top soil removed from the conveyor bench is non-National Forest Service Topsoil, and can be used on non-National Forest Service disturbed areas. The remaining 76,291 cubic yards is soil removed from National Forest lands, and must be used within the National Forest boundaries. The loadout area topsoil pile contains 27,787 cubic yards. The South Fork topsoil stockpiles contain 2,990 cubic yards, and was derived from National Forest Service lands, and will all be used on National Forest lands in the South Fork area. The topsoil stockpile at the Scofield disposal site contain 1,444 cubic yards.
Table deleted - information moved to Vol. 3, Sec. 4.6.4
**TABLE 2.11-2**

**TOPSOIL VOLUMES**

DELETED
TABLE 2.11-2 (continued)
TOPSOIL VOLUMES

DELETED
Additional Study

In coordination with Soil Conservation Service (SCS) personnel, the Permittee designed and performed a soil survey at the reconnaissance level for the permit area and a high-intensity detailed soil survey for the surface disturbance areas. Nondisturbed areas were surveyed at an Order 3 level. Survey results are located in Appendix Volume A-2 and in Volume 5, Section 19 for the South Fork breakout area.

Survey standards were based on those described in the National Soil Survey Handbook and the Revised Soil Survey Manual which are standards for the National Cooperative Soil Survey Standards.

Survey maps are of a scale greater than 1:12,000 for all areas. As the survey progressed mapping unit descriptions including potential productivity of existing soils were developed in compliance with the above standards and submitted with all survey results.

The soils and other strata of the portal area were sampled, mapped, and studied in detail.

Endangered Plant Studies, Inc. (EPS) and Dames & Moore (D&M) have reported results of studies performed in the Skyline permit area, including detailed study of the portal area. EPS excavated soil pits in the portal area and other parts of the permit area. Soils were described, classified, sampled and analyzed as outlined in the Vegetation and Soils Report. In addition, D&M sampled soils at frequent intervals and obtained continuous cores of bedrock at 26 locations in Eccles Canyon, including the portal area. These borehole descriptions are presented in Section 2.2, Geology and Geotechnical, of this plan. The EPS and D&M reports are in Appendix Volumes A-2 and A-3.

In order to characterize overburden in the portal area, it is necessary to relate the D&M study to the geologic characteristics...
present in the Skyline permit area (Described in Section 2.2, Geology Report). Soil types and distributions were mapped by EPS (Map 2.11-1) and the numerous soil descriptions and analyses can be readily extrapolated using the EPS report. Consolidated rock strata of the Blackhawk Formation are more difficult to map, however, and make the extrapolation of core data more difficult.

In this Application, the Aberdeen Sandstone and the overlying upper coal-bearing unit of the Blackhawk Formation are described. In the portal area, the Aberdeen Sandstone lies from 0 to 4 feet below the lowest coal seam to be mined and is continuous and of uniform lithology. Therefore, the Aberdeen description as presented suffices to characterize the lowest unit of interest throughout the portal area, even though it is poorly exposed. In contrast to the Aberdeen, the overlying sedimentary rocks are variable in extent and lithology. Because of the highly variable nature of these poorly exposed rocks, detailed mapping of individual lithologic units in the subsurface is not feasible. However, certain generalizations can be made regarding the relative percentages of the rock types present. Recent interpretative geologic work has focused on modelling ancient depositional environments for the sedimentary rocks in the coal-bearing sequence immediately overlying the Aberdeen Sandstone. Based on concepts developed it is possible to make general statements about the frequency of occurrence of various rock types in any area of the property. These predictions based on depositional models are believed to be more reliable than simple extrapolation between boreholes.

Stratigraphic studies in the permit area are based primarily on subsurface geophysical logs. These logs are available at the Skyline Mine office. The sources used to interpret lithology include the natural gamma, the gamma-gamma (density), the single-point resistivity, and sometimes the spontaneous potential and caliper logs. Studies of the relative percentages of sandstone, siltstone, claystone, and coal in each borehole suggest that ancient stream channels present in a specified

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stratigraphic interval had preferred orientations, and tend to be stacked in echelon or otherwise concentrated along trends of high sandstone percentage.

Using these results, relative proportions of the several lithologies can be extrapolated to the portal area, even through individual channels may not be correlated between boreholes. In the 200 feet of strata immediately overlying the Aberdeen Sandstone, paleochannels have a preferred east-west orientation in the portal area. Based on extrapolation along this trend, percentages of lithotypes have been estimated for the portal area. For the described 200-foot stratigraphic interval, and excluding coal seams, the major lithologies are: sandstone 40%, siltstone 30%, and claystone 30%.

These lithologies have been described in detail in Section 2.2 (Geology) and in Volume A-3. The percentages may vary considerably from percentages in many boreholes drilled by D&M in the portal area. However, on the average these percentages are more representative of the character of the non-coal strata than estimated for individual boreholes.

Scofield Waste Rock Site

A complete description of the vegetation and soil is available in Appendix Volume A-2 in the report, "Report of Vegetation and Soils, Proposed Waste Rock Disposal Site", prepared by Endangered Plan Studies, Inc., November, 1981. Drawing Number 2.11-2 on Page 2-120(b) shows the soil typing of the waste rock area. A second soil survey report conducted in 2006 by Clement Drilling & Geophysical, Inc., (Appendix Volume A-2, Volume 2) uses the United States Department of Agriculture (USDA), Natural Resources Conservation Services' (NRCS) WEB Soil Survey (WSS) utility. This survey was conducted in areas previously undisturbed by mining activities where topsoil exists. In 2007, the proposed disturbance is to expand the Waste Rock pile up the hill. The disturbance may eventually cover approximately 5.13 acres should be area expand to proposed capacity. Expansion of the pile will be done incrementally, stripping only the topsoil and subsoil necessary for the estimated area necessary for approximately one (1) to two (2) years of waste rock placement. Suitable topsoil and subsoil will be separated, stored, marked with appropriate signage for protection, to be used during reclamation of the site (Map 3.2.8-2). See Section 4.6.4.1 for additional information concerning the Topsoil/Subsoil Handling Plan.
South Fork Breakout Area

The soil for this area was classified by the U.S.S.C.S. as a Croydon Series. The Croydon Series consists of deep, well-drained, moderately slowly permeable soils on mountain slopes. These soils formed in alluvium and colluvium derived dominantly from sandstone and shale. These soils are fine-loamy, mixed Argic Cryoborolls. The A11 is 0-5 inches, dark yellowish-brown loam, moderate medium granular structure; soft, very friable, slightly plastic, many very fine, fine, and medium roots and few coarse roots. The A12 is 5-16 inches, yellowish-brown loam, weak coarse subangular blocky structure parting to moderate medium granular; soft, very friable, slightly plastic; many very fine, fine, and medium roots and few coarse roots. The A2 is 16-23 inches very pale-brown loam, moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; 10% pebbles. The B21T is 23-33 inches, light yellowish-brown clay loam, moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine, fine and medium roots, common very fine pores; few moderately thick clay films on faces of peds and in pores; 5% pebbles and 5% cobbles. The B22T is 33-48 inches, light yellowish-brown clay loam; strong medium subangular blocky structure; very hard, very firm, sticky and plastic; few very fine and fine roots; common very fine pores; many moderately thick clay films on faces of peds; 10% pebbles. R at 48 inches; weathered sandstone.

Water Tank Area

No soils information was gathered at this site, as the site is the abandoned road bed. A pad for the tanks was constructed of road cut material taken from the road construction of SR264.
SOILS MAP
Scofield Waste Rock Disposal Site

Soil Boundaries
Scale 1" = 500'

Note: The information on this map was compiled by Keith Zobell, Utah Fuel Company from information contained in "Report of Vegetation and Soils, Proposed Waste Rock Disposal Site, November, 1981" by Endangered Plants Studies, Inc. and "Soil Survey of Carbon Area, Utah, Part of Carbon County" by the U.S. Soil Conservation Service.

Drawing Number 2.11-2

2-120(b)
SOILS OF THE NORTH LEASE TRACT AREA

No surface disturbance for the North Lease area was originally proposed. In 2009 the M&RP was modified to include the Winter Quarters Ventilation Facility (WQVF). Prior to the WQVF construction, a review of the soils in the area from the existing Soil Survey of Carbon County, Utah and USDA Forest Service were conducted. The soil map units in the survey are presented on Drawing No. 2.7.7-1b.

Winter Quarters Ventilation Facility Area (WQVF)

A detailed description of the soils in the WQVF area is available in Appendix A-2, Volume 2, titled, "Soils survey for the proposed Winter Quarters vent location near Scofield, Utah". The report uses United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) WEB Soil Survey (WSS) utility and associated NRCS soils reports. The vent facility will disturb approximately 1.7 acres of topsoil. Based on the soil survey 1/2 feet of suitable soil and subsoil will be separated, stored, marked with appropriate signage for protection. This material will be used during reclamation of the site. Due to the limited amount of A horizon material identified in the survey, depth of the salvaged material will be based on depth of significant rock. Attached to the soils report are the analysis of the soils collected during the survey. See Section 4.6.4.1 for additional information concerning the Topsoil/Subsoil Handling Plan.

The existing Winter Quarters Canyon road was improved with additional road base, gravel, and drainage, but no topsoil was removed because the improvements remained within the footprint of the existing road.

U. P. & L. Tract

The soils for this area are classified into six groups as determined by Daniel M. Larsen, U. S. Forest Service. The following are the soil types: 1) Pando - Adel Families Complex, 2) Bundo - Lucky Star - Scout Families Complex, 3) Adel - Merino Family Complex, 4) Gateway - Adel families Complex, 5) Lucky Star - Adel Families Complex, and 6) Lucky Star - Bundo - Adel Families Complex.

Pando - Consists of deep, well drained, moderately permeable soils on mountain slopes. The soils are formed from colluvium from sandstone and shale. Slopes are 30 to 60 percent. Soils are classified as loamy-skeletal, mixed Boralfic Cryoborolls. A1 is zero to four inches of dark grayish brown loam; very dark brown moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; 10 percent gravel; slightly acid; clear smooth boundary. A2 is four to 11 inches of grayish brown cobbly loam, very dark grayish brown moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; 10 percent gravel and 10 percent cobbles; moderately acid; gradual wavy boundary. E is 11 to 23 inches pale brown very cobbly silt loam, brown moist; weak medium subangular blocky structure; soft, friable, slightly sticky and nonplastic; few very fine and fine roots; 20 percent gravel and 30 percent cobbles; moderately acid; gradual wavy boundary. Bt is 23 to 45 inches of very pale brown extremely cobbly clay loam, yellowish brown moist; moderate medium subangular blocky structure; and, firm sticky and...
plastic; few fine roots; 15 percent gravel and 50 percent cobbles; moderately acid. Cr is 45 of soft weathered sandstones with some soil between fractures.

Adel - Consists of deep and very deep, well drained, moderately permeable soils on mountain slopes. The soils are formed from colluvium, residuum, and alluvium for sandstone, limestone, and shale. Slopes are 15 to 70 percent. Soils are classified as fine-loamy, mixed Pachic Cryoborolls. A1 is zero to four inches of brown loam, dark brown moist; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine roots; medium acid; clear smooth boundary. A2 is four to 28 inches of brown loam, dark brown moist; weak medium subangular blocky structure; soft, friable, slightly plastic; few fine and common very fine roots; 10 percent gravel; medium acid; clear smooth boundary. Bw is 28 to 42 inches of pale brown loam, brown moist; weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few fine and very fine roots; 10 percent gravel; medium acid; gradual wavy boundary. C1 is 42 to 50 inches of pale brown gravelly silt loam, brown moist; massive; slightly hard, friable, slightly sticky and slightly plastic; 15 percent gravel; medium acid; gradual wavy boundary. Cr is 50 inches and is weathered shale.

Bundo - Consists of deep and very deep, well drained moderately rapidly permeable soils on mountain and canyon slopes. The soils are formed from colluvium derived mostly from sandstone. Slopes are 20 to 60 percent. Soils are classified as loamy-skeletal, mixed Typic Paleboralfs. O is three to zero inches of spruce needles, leaves, bark and twigs. A is zero to six inches of pale brown gravelly fine sandy loam, brown moist; weak fine granular structure; soft, friable, nonsticky and nonplastic; few very fine and medium roots; 20 percent gravel and 5 percent cobbles; slightly acid; clear smooth boundary. El is 6 to 28 inches of very pale brown very gravelly very fine sandy loam, light yellowish brown.
brown moist; massive; soft, very friable, nonstricky and nonplastic; few fine and medium roots; 10 percent gravel and 20 percent cobbles; moderately acid; gradual irregular boundary. E2 is 28 to 50 inches of very pale brown, very gravelly, very fine sandy loam, light yellowish brown moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; 35 percent gravel and 15 percent cobbles; moderately acid; gradual irregular boundary. Bt is 50 to 60 inches of light yellowish brown, extremely cobbly, sandy clay loam, yellowish brown moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common moderately thick clay films on per faces; 15 percent gravel and 50 percent cobbles; moderately acid.

Gateview - Consists deep, well drained, highly permeable soils on mountain slopes. The soils are formed from sandstone and shale. Slopes are 30 to 60 percent. A1 is zero to five inches of dark grayish brown fine sandy loam. A2 is five to 23 inches of grayish brown fine sandy loam. Bw is 23 to 40 inches of light yellowish brown cobbly loamy sand. Cr is 40 to 45 inches of soft sandstone and interbedded shale.

Lucky Star - Consists of deep and very deep, well drained, moderately to moderately rapidly permeable soils on mountain and canyon slopes. Soils are formed from colluvium from sandstone and shale. Slopes are 30 to 70 percent. Soils are classified loamy-skeletal, mixed Cryic Paleborolls. A1 is zero to three inches of grayish brown loam, very dark grayish brown moist; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and few fine roots; 10 percent gravel; slightly acid; clear smooth boundary. A2 is three to 15 inches of grayish brown cobbly loam, dark brown moist; moderate fine granular structure;

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soft, friable, slightly sticky and slightly plastic; common very fine and few fine roots; 10 percent gravel and 10 percent cobbles; moderately acid; clear smooth boundary. E is 15 to 38 inches of very pale brown very cobbly very fine sandy loam, brown moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; 20 percent gravel and 35 percent cobbles; moderately acid; gradual wavy boundary. Bt is 38 to 57 inches of very cobbly clay loam, brown moist; moderate medium subangler blocky structure; hard, firm, sticky and plastic; few fine and medium roots; 35 percent gravel and 25 percent cobbles; common moderately tick clay films on ped faces; moderately acid. R is weathered sandstone.

Merino - Consists of shallow, well drained, moderately permeable soils on ridges and mountain slopes. Soils are formed from residual and colluvial materials form sandstone. Slopes are 10 to 60 percent. Soils are classified as loamy-skeletal, mixed, nonacid Lithic. A is zero to five inches of brown very cobbly loam, dark brown moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine and few medium roots; 10 percent gravel and 25 percent cobbles; neutral; clear wavy boundary. C is five to 12 inches of pale brown very cobbly loam, yellowish brown moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; 25 percent gravel and 35 percent cobbles; neutral; clear smooth boundary. R is 12 inches of sandstone bedrock.

Scout - Consists deep, well drained, moderately rapid to rapid permeable soils on mountain slopes. The soils are formed from colluvium and glacial till from sandstone. Slopes are 30 to 70 percent. Soils are classified as loamy-skeletal, mixed Typic

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Cryochrepts. A1 is zero to six inches of dark brown fine sandy loam. A2 is six to 18 inches of yellowish brown cobbly loamy fine sand. E is 18 to 27 inches of light yellowish brown gravelly loamy fine sand. Bw is 27 to 44 inches of light yellowish brown very gravelly loamy fine sand. Cr is 44 to 61 inches of yellow cobbly loamy fine sand.

James Canyon

In September 2001, the permittee reopened the abandoned James Canyon county road that had been reclaimed in the 1970's by the Forest Service. The road was reopened as part of a BLM exploration permit to allow for emergency road construction, construction of a drill pad, and drill two ground water wells. Subsequent M&RP modifications approved by the Division allowed for the burial of a 16-inch HDPE pipeline from the wells to Electric Lake and burial of electric cable from the drill site to UP&L power lines located at the top of Trough Springs Ridge. The James Canyon Road intersects with the Manti-LaSal National Forest Monument Peak Road that traverses Trough Springs Ridge. The James Canyon road continues from the intersection to the drill pad located in the SW1/4SW1/4, Section 35, T13S, R6E and from there to Electric Lake.

Initial road construction approved by the Forest required the mine to remove any available topsoil from the road and drill pad. The available soils in the road were removed from the road surface and stored as a windrow on outslope side of the road and were protected from erosion by reseeding with the approved seed mix. Topsoil was removed from the drill pad and transported to a location at the intersection of the James Canyon Road and the Monument Peak Road (Drawing 3.4-1). The drill pad and access road were built on an area with high bank cut slopes previously disturbed by road construction. The growth media in the A1 horizon varied from 0 to 4 inches for an average of 2 inches. This soil was recovered and no soil was left or squandered. Approximately 126 cubic yards of soil have been stored in a signed pile (see stockpile layout for details). The drill pad topsoil storage area is surrounded by silt fence for erosion control and field fenced to

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discourage public access. Subsoils were used for construction of the drill pad. Following construction of the road and drill site a soils study by EIS Environmental and Engineering Consultants was performed on the available soils in the windrow, stockpiled drill pad soils, and the soils in the section of the road from the drill pad to Electric Lake. A copy of the study has been included in Appendix A-2 of this M&RP.

The soils study reported three basic soil units are within the immediate James Canyon Road area. The units were described generically as A - soils under aspen, T - soils formed by calcareous tufa, and S - soils in the sagebrush type. The majority of the soil along the James Canyon road from the Monument Peak Road to the drill pad was classified as type A. The soils found in the upper section of the James Canyon Road where the pipeline is buried were also identified as type A. The soils beyond the soil type A section were classified as type S. A 100 foot section of the road within area affected by the pipeline was identified as type T.

The majority of the road route is along south facing slopes that support an aspen-grass-forb vegetation type. The A-type soils have developed from sandstone and shale. Typically the soils have a dark brown to very dark grayish brown surface layer of sandy loam or loam texture and a granular structure. The A horizon is generally 16 to 24 inches thick and represents the topsoil layer. Subsoils are sandy loam with about 15 to 30 percent sandstone rock fragments of gravel and cobble size. This layer is brown to yellowish brown in color and is generally 20 to 40 inches in thickness. The soil layer below the subsoils is more clayey material. The clayey material is a dark grayish brown or brown clay loam or silty clay loam with a blocky structure. The soils classify as Pachic Palecryolls and Pachic Haplocryolls.

The T-type soils have a dark brown surface layer that is about 7 to 12 inches thick over a nearly white subsoil formed in tufa that grades to a rock structure at about 20 to 24 inches. Mixed soils materials are present on the
old roadway with tufaceous material below. The soils are loamy and highly calcareous. This soil is present along the pipeline route approximately 1/4 mile southwest of the drill pad in an area about 100 feet in length.

The lower portion of the James Canyon road containing the pipeline changes from the A-type soils to the S-type soils. The A horizon has a measured thickness from 6 to 12 inches. The soils are shallower to bedrock and have thinner dark colored surface layers than the aspen. Below the topsoil layer the soils are pale brown to brown and typically have a loam texture. The soils range from shallow to greater than 40 inches over bedrock. The deeper soils are present in pockets of colluvial material. Sandstone and shale bedrock is exposed in the cut slopes of the old road. Commonly a sandstone layer of two to four feet in thickness is present over the shale.

Five soil samples representing the three different soil types were obtained and analyzed for reclamation revegetation capabilities as described by the Division's reclamation guidelines. Each sample was rated fair to good for supporting revegetation.

A summary of the soil testing results and rating are provided below:

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<th>Parameters</th>
<th>Rating</th>
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</thead>
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<tr>
<td>pH</td>
<td>All rated good, except one sample had a pH of 5.9 (5.9 to 7.5)</td>
</tr>
<tr>
<td>EC</td>
<td>All rated good (0.18 to 0.56)</td>
</tr>
<tr>
<td>Saturation</td>
<td>All rated good (28.4 to 42.6)</td>
</tr>
<tr>
<td>Texture</td>
<td>All rated good, except on clay loam rated fair</td>
</tr>
<tr>
<td>SAR</td>
<td>All rated good (0.31 to 0.61)</td>
</tr>
<tr>
<td>Selenium ppm</td>
<td>All rated good (0.02 and less)</td>
</tr>
</tbody>
</table>

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Boron ppm
All rated good (0.06 to 0.24)

Acid/Base Potential
All rated good

AWC in/in
Four samples rated good, the subsoil sample rated fair (0.055 to 0.130)

Rock Fragments
Based on observations, the topsoil would rate good and subsoils would be rated fair

The soil survey described above was performed by Daniel M. Larsen, Professional Soil Scientist in accordance with the standards of the National Cooperative Soil Survey.

The initial reclamation of the James Canyon Road performed in the 1970's consisted of constructing large water bars across the road at approximately 150 foot intervals followed by reseeding with a Forest approved seed mix. Vegetation, consisting mainly of grasses, sage brush and aspen, had begun to encroach upon the road.

Following construction of the road and drill pad and the soils study, a 16-inch HDPE pipeline was buried in the James Canyon road from the drill pad to Electric Lake. Burial of the 16-inch pipeline required first the removal and placing aside the top few inches of soil on the flat portions of the road and cutting through the water bars. Where possible, the roots of the established vegetation were left in place to promote revegetation of the pipeline route. Subsoils removed from the pipeline trench were kept segregated from the topsoil previously removed. The trench was excavated to a depth of at least three feet and extended from near the wellhead to a location in Electric Lake that is several feet below the high water level. The pipe was placed in the trench and the subsoils placed and compacted over the pipe. After placement and compaction of the subsoils, the available topsoil was spread over the replaced soils and disturbed area. Vegetation that was previously disturbed by the removal of the upper soil layers was redistributed with the topsoil.
The pipeline area was reclaimed immediately after construction. The surface was deep gouged and left in a roughened condition. Water bars previously constructed by the Forest Service during the initial abandonment operations were re-established. The disturbed area of the road was reseeded using the approved seed mix for the area. No significant modifications to the current land surface occurred. No work occurred outside the boundaries of the abandoned county road.

During final reclamation of the well site, the pipe will be plugged at both ends with a cement plug. No pipe will be left exposed at final reclamation. Reclamation costs for plugging of the pipe and removal of the pipeline below the high water level of Electric Lake have been provided in this M&RP.

Following the placement of the 16-inch pipeline, an 8-inch wide 30- to 40-inch deep trench was excavated from the drill pad to the top of Trough Springs Ridge and three 3/4-inch diameter insulated power cables were placed in the trench. A smaller cable for communication purposes was also placed in the trench. After placement of the cables, the soils were replaced and compacted within the trench. Since most of the cable trench was excavated in an existing road, no other reclamation was performed. However, a short section of the trench located between the Monument Peak Road and the top of Trough Springs Ridge where the UP&L power lines are located was reclaimed after backfilling. The surface of the trench in this area was roughened and reseeded with the approved reclamation seed mix for this area. The seed mix is provided in Section 2.75 of this M&RP.

Reclamation activities for the portion of the road from the drill site to the Monument Peak road are discussed in Section 4.4 of this M&RP. The section of the disturbed area reclaimed as above will be monitored and evaluated for revegetative success at the time of final reclamation.

2-120(k) Revised 11-2001

DIV OF OIL GAS & MINING
North of Graben (NOG)Bleeder Shaft

A detailed description of the soils associated with the NOG Bleeder Shaft is available in Appendix A-2, Volume 2, titled, "Order 2 Soil Survey of the North of Graben (NOG) Bleeder Shaft Area" (January 16, 2015). The survey conducted by Long Resources Consultants, Inc. provides a comprehensive assessment of the various soils within the area. The permit area encompasses approximately 3.0 acres. The soil type is represented by the McCadden Family, with shallow soil depths overlying shallow sandstone bedrock. It is considered to have good-to-fair available water capacity, and fair-to-good reclamation material with pH values ranging 6.2 - 7.0 and a saturation range of 44.1 - 72 percent. The soil pit (14SKY07) sampled at the site location identified a rich A-horizon of approximately 4-inches. The entire A-horizon will be salvaged. Where there is less than six-inches in the A horizon, up to 4-inches of the subsoil (Bw1 horizon) will be collected and stockpiled for reclamation. Quality control for the salvage of the topsoil will be primarily by color conducted under the guidance of trained personnel. To confirm the nutrient status of the topsoil, an analysis of the available nitrogen, phosphorus, and potassium will be conducted once the material is placed in the topsoil pile. At post-construction of the site, an as-built survey of the site will be conducted to confirm the amount of topsoil salvaged.

Swens Canyon Ventilation Facility (SCVF)

A detailed description of the soils associated with the Swens Canyon Ventilation Facility (SCVF) and associated power line is available in Appendix A-2, Volume 2, titled, "Order 2 Soil Survey of the Powerline Corridor Swens Pad Ventilation and Escape Shafts Coal Pile Expansion at the Skyline Mine" (December 2014). The survey conducted by Long...
Resources Consultants, Inc. provides a comprehensive assessment of the various soils that are within the power line corridor and the pad site. No soils are anticipated to be disturbed along the power line with the exception of soils moved for the placement of the single, wooden poles, and the area where the buried section of cable daylights, which are both exempt due to the limited disturbance. The buried section of power line will be bored from the Swens pad using a directional drilling method. Where the buried cable connects to the above-ground section, any potentially disturbed topsoil will be salvaged and a sample collected to test nitrogen, phosphorus, and potassium analyzing for future treatment when reclaiming. The power line corridor is approximately 2.6 miles in length and will be approximately 15-feet wide with no disturbance of the topsoil anticipated. Installation will be conducted using rubber-tired vehicles or tracked vehicles keeping the number of access trips necessary for construction to a minimum.

The SCVF pad site encompasses approximately 9.7 acres with two (2) soil types present. The majority of the site is represented by the Hailman soil family, with a sandy loam on 5-15% slopes. The soil pit identified an estimated topsoil depth is approximately 16-inches (S1 from Figure 2 of soil survey). The remainder of the site consisting of the access road is represented by the Karnack soil family with a sandy loam on 10-35% slopes (S2), with an estimated topsoil depth of approximately 10-inches. Prior to construction, soil samples will be collected from the A and B horizion at sample locations 14SK14 and 14SKY15 and analyzed for available nutrients nitrogen, phosphorus, and potassium per DOGM 2008 guidelines. Approximately 1-foot of topsoil will be salvaged and stored. Plate 3.2.4-4F illustrates the removal areas, and estimated depths of combined topsoil and subsoil to be stockpiled totaling approximately 15,100 cu-yds. Topsoil (~8750 cu-yd) and subsoil (~6350 cu-yd) will be segregated on the pile using orange fencing/construction fabric. Once stored, the topsoil will be analyzed for available nitrogen, phosphorus, and potassium for future soil treatment. Efforts will be made to minimize the steepness of the slopes of the topsoil by configuring the pile with the steeper slopes being subsoil. A berm and silt trap will be used to retain the material until vegetation is established. The surface of the pile will also be deep-gouged, seeded, and top-dressed with mulch or straw. The seed mix is the same used for the North of Graben Bleeder shaft (Section 4.7, Table 4.7-10A).
Johnson, We. M. 1975. Soil Taxonomy, a basic system of soil classification for making and interpreting soil surveys. Supt. of Doc. SCHIST, Washington, D. C.


Larsen, Daniel M. Soil Survey of the Manti-LaSal National Forest Manti Division, Utah Parts of Carbon, Emery, Sanpete, Sevier, and Utah Counties (Soil Survey Area 645), March, 1997

Revised 4-2001
INTRODUCTION

The Skyline property, located in the northern end of the Wasatch Plateau coal field, is the site of a system of underground coal mines developed by Canyon Fuel Company, LLC. The general area of the Skyline property lies within Carbon, Sanpete, and Emery counties in Townships 12, 13, and 14 South and Ranges 6 and 7 East, approximately seventy-eight air miles southeast of Salt Lake City, Utah and twenty-two air miles northwest of Price, Utah (refer to Figure 2.12-A). The portal and yard area are located in Eccles Canyon just west of and within the National Forest boundary line. A Utah State highway (SR-264) runs past the portal yard area east down Eccles Canyon to a coal loadout facility located at the canyon mouth. A conveyor system parallels the road from the mine to the loadout facility at the mouth of Eccles Canyon. West of the town of Scofield, a facility which includes substation and fan is located in Winter Quarters Canyon.

2.12.1 Existing Land Uses

Pre-mining land uses of the Skyline property and adjacent area consist of wildlife habitat, grazing, recreation, natural gas transmission and forestry.

Wildlife Habitat

A listing of wildlife thought to inhabit the permit area may be found in Table 2.9-1. A more detailed discussion of the wildlife may be found in the consultants report in Volume A-2.

Grazing

Seven (7) National Forest Sheep allotments are contained partially within the North lease area (refer to Map 2.12.1-1). The addition of the Flat Canyon lease includes portions of the Eccles, Swens, Bear Canyon, and Boulger allotments. The numbers of livestock and season of use data for each allotment are contained in Table 2.12.1-1.

Private lands east of the National Forest boundary and west of the Flat Canyon Lease in Sanpete County (and within the USFS boundary) are grazed by similar numbers of sheep both before and after 7/1 to 9/30 (U.S. Geological Survey, 1979).
Figure 2.12-A
Location of Skyline Project Area
TABLE 2.12.1-1

SHEEP ALLOTMENT DATA FOR THE FOUR ALLOTMENTS CONTAINED PARTIALLY WITHIN THE COAL LEASE AREA WITHIN THE NORTH LEASE AREA OF THE SKYLINE MINE

<table>
<thead>
<tr>
<th>Allotment</th>
<th>Sheep Numbers</th>
<th>Season of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eccles Canyon</td>
<td>627</td>
<td>7/13 - 9/30</td>
</tr>
<tr>
<td>Granger Ridge</td>
<td>950</td>
<td>7/1-9/30</td>
</tr>
<tr>
<td>Bean Ridge</td>
<td>1048</td>
<td>7/1-9/30</td>
</tr>
<tr>
<td>Mansion</td>
<td>850</td>
<td>7/1-10/10</td>
</tr>
<tr>
<td>East Gooseberry</td>
<td>269 (USFS land)</td>
<td>7/1-10/10</td>
</tr>
<tr>
<td>East Gooseberry</td>
<td>581 (Private land)</td>
<td>7/1-10/10</td>
</tr>
<tr>
<td>French Creek</td>
<td>800</td>
<td>7/1-9/30</td>
</tr>
<tr>
<td>Swens</td>
<td>900</td>
<td>7/1 – 9/30</td>
</tr>
<tr>
<td>Bear Canyon/Birch Creek</td>
<td>1100</td>
<td>7/6 – 9/30</td>
</tr>
<tr>
<td>Boulger/Beaver Dams</td>
<td>1200</td>
<td>7/6 – 10/5</td>
</tr>
<tr>
<td>Burnout</td>
<td>942</td>
<td>7/1 – 9/25</td>
</tr>
<tr>
<td>Monument Peak</td>
<td>333</td>
<td>7/1 – 9/30</td>
</tr>
<tr>
<td>Bob Wright</td>
<td>1013</td>
<td>7/20 – 9/5</td>
</tr>
<tr>
<td>Trough Springs</td>
<td>1000</td>
<td>8/15 – 9/30</td>
</tr>
</tbody>
</table>

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Recreation

Recreational use of the lease area affected by surface operations consists primarily of hunting big game, game birds, and small game species; fishing in Eccles Canyon below the portal area; from the south fork to the mouth of the canyon sightseeing, snowmobiling, and cross country skiing. Limited camping and picnicking also occurred in the mouth of Eccles Canyon (U.S. geological Survey, 1979).

Eccles Canyon Road provides the only direct access from Scofield Reservoir to Huntington Canyon and is used as an access route from the Scofield Reservoir recreation area to the recreational use areas at higher elevations in the northern end of the Wasatch Plateau (U.S. Geological Survey, 1979). Mining in the vicinity of Boulger Reservoir and the adjacent Flat Canyon campground may potentially impact recreation in the future. At the time of lease acquisition, no undermining of Boulger Reservoir or the Flat Canyon campground is planned. An existing spring collection system that provides water to the campground may be impacted due to subsidence. In the event transmission of water is interrupted, the mine is committed to repairing any breaks to the line and will provide water as outlined in Section 2.5.3. Prior to any proposed undermining of either the reservoir or campground, specific mitigation will be determined in consultation with the Utah Division of Wildlife Resources, Utah Division of Oil, Gas, and Mining, US Forest Service (campground), and Canyon Fuel Company. Per Special Lease Stipulation #25 of lease UTU-77114, Prior to undermining, a plan will be submitted that outlines type of mining, when and how the dam will be taken out of service while subjected to mining-induced acceleration of 0.1g and greater, and what mitigation measures will be taken to place the dam and reservoir back into full service.

Natural Gas Transmission

A natural gas pipeline traverses the permit area from southeast to northwest. Additionally, an abandoned gas well is located in the Eccles Canyon portion of the permit area. A small building associated with Gas Well No. 8 is located in Eccles Canyon. The location of these features are all shown on Map 2.12.1-1.

Forestry

Forest uses are limited primarily to cutting firewood and fence posts. Occasional timber sales from National Forest lands are made to salvage insect-killed spruce timber. One such sale, totalling 2.5 million board feet, was made in the Kitchen Creek drainage basin on the west side of the coal lease area in 1977.

Private Land - Winter Quarters Canyon, Flat Canyon Lease

Both current (20098) and historic Land uses of private land in Winter Quarters canyon are varied and include grazing, wildlife habitat, recreation - primarily hunting big game, game birds, and small game species, forestry or timber production, and mining related activities. Addition of the ventilation facility in 2010 is consistent with the historic uses. Land Uses of the private land in Flat Canyon include grazing, wildlife habitat, and recreation with the proposed mining not impacting the historic uses. Plate 2.12.1-1 has been updated to identify structures, primarily cabins located west of lease UTU-77114.
2.12.2 Capability and Productivity of the Permit Area Affected by Surface Operations and Facilities

Portions of the permit area affected by surface operations and facilities of the underground Skyline Mines are capable of supporting limited forestry, grazing, and recreational uses. Farming in the area is prohibited by the steep and rocky terrain of Eccles Canyon. Additional surface facilities such as the Winter Quarters and Swens Canyon ventilation facilities are on south-facing slopes with minimal impacts to the historical uses. During reclamation, the Swen Canyon area will likely be made more productive by reducing the density of woody-species during reclamation.

FORESTRY AND GRAZING

Land Use Capability

Data concerning resource availability for forestry and grazing uses within the permit area affected by surface operations and facilities were collected and assimilated by Dr. Joseph R. Murdock, professor of Botany and Range Science at Brigham Young University, Provo, Utah (1979). Vegetative plot studies were made in the affected permit area within five general area classifications: the spruce-fir timber type, the aspen timber type, the sagebrush type, the riparian type and the unrecovered disturbed area type, composed of existing roads and the unrecovered site of an abandoned gas well and the abandoned Eccles Mine located on the proposed portal site. From these specific vegetative plot studies, the productivity and capability of supporting grazing and forestry uses were determined for each general area. The plot studies revealed that both the spruce-fir timber type and the unrecovered disturbed area type contained no significant herbage usable for grazing purposes.

The number of animal units and animal unit months that the other three areas are capable of supporting was determined by converting the available green plant species desirable by sheep to a dry weight basis and assuming that one 1,100 pound cow having one calf, which constitutes an animal unit, consumes 27 pounds per day. The results of this analysis are presented in Table 2.12.2-1 for the yard area, the conveyor corridor and the bypass road.

The capability of the area affected by surface operations and facilities to support forestry uses was determined from the total land area in the spruce-fir and aspen timber types and the available timber volume per area as published by the U.S. Forest Service in the "Land and Resource Management..."
Plan" for the Manti-LaSal National Forest, (1986). The spruce-fir timber type contained approximately 10,000 board-feet per acre and the aspen timber type contains 5,300 board-feet per acre. Therefore, within the affected area, there were approximately 201,000 board-feet of the spruce-fir timber and 93,800 board-feet of aspen timber.

Productivity

Sheep currently graze the lease and permit areas in accordance with the sheep allotments as specified in Table 2.12.1-1. The area proposed for disturbance in Winter Quarters Canyon for the Ventilation Facility pad was assessed for productivity by Natural Resource Conservation Service (NRCS) Area Range Management Specialist, Mr. Dean Stacy. The productivity analysis encompassed areas that will not be affected with the pad design restricted to the south-facing slope with the disturbance being no closer than approximately 25-30 feet from the creek. His productivity assessment identified that due to previous and current uses (grazing and logging), the area ranks low on the Potential Natural Community Scale. Only the south facing slope (Mountain Big Sagebrush) was as productive as anticipated (approximately 1,300 lb/ac). Both the Willow and Aspen communities were under-productive with production estimates of approximately 800 lb/ac. The area of the substation is estimated at only 300 lb/ac (See NRCS report in Appendix A-2, Vol. 2).

The NRCS was similarly contacted for the Swens Canyon Ventilation Facility (SCVF) concerning farmland (See Jeremiah Armstrong correspondence in Appendix A-2, Vol. 2). Since the area is dominated by mountain big sage brush, a conservative productivity value of approximately 1,300 lb/ac is used on Table 2.12.1-1.

Recreation

Recreational use of the area affected by mine surface operations and facilities is limited primarily to sight seeing, fishing, hunting, snowmobiling and cross country skiing.

Eccles Canyon presently supports and is capable of supporting a self-reproducing population of cutthroat trout from South Fork to the mouth of the canyon. The only time a fishery potential exists above South Fork near the mine portal area is in the springtime when runoff volumes are highest (Winget, 1979). Similarly, the Winter Quarters Ventilation Facility (WQVF) has minimal (if any) impact on the fishery due to the limited flow in the creek, and channel morphology in the pad area that is dominated by riffles with an absence of pools and cut banks critical to fish habitat. A 25-30 buffer zone exists between the WQVF pad and Winter Quarters Creek providing adequate habitat.

Highway (SR-264) through Eccles Canyon provides the only access route between recreational facilities in the north end of the Wasatch Plateau and the Scofield Reservoir recreation area. The U.S. Forest Service states that Electric Lake has added a considerable amount of recreational traffic to Eccles Canyon and that 1977 vehicle counts from June to the middle of October were approximately 22,000 which averages 160 vehicles per day. This number is increasing with the completion Revised: 5-27-16

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### TABLE 2.12.2-1

GRAZING POTENTIAL FOR THE AREA TO BE AFFECTED BY MINING SURFACE OPERATIONS AND FACILITIES

(Does not include State Highway SR-264)

<table>
<thead>
<tr>
<th>Surface Facilities Area</th>
<th>General Area Classification</th>
<th>Land Area (Acres)</th>
<th>Average Forage Production (lbs/ac)</th>
<th>Animal Unit Month (AUM)</th>
<th>Grazing Potential-Animal Unit Month (AUM) with 25% Harvest Efficiency for proper grazing utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Portal Yard Area</td>
<td>Spruce Fir</td>
<td>16.47</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Aspen</td>
<td>7.93</td>
<td>586</td>
<td>5.9</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>Sagebrush</td>
<td>2.50</td>
<td>917</td>
<td>2.9</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>Disturbed</td>
<td>8.50</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Riparian</td>
<td>1.00</td>
<td>182</td>
<td>0.2</td>
<td>0.06</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>36.40</td>
<td>9.0</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>2 Conveyor Corridor</td>
<td>Aspen</td>
<td>3.20</td>
<td>586</td>
<td>2.4</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>Sagebrush</td>
<td>5.77</td>
<td>917</td>
<td>6.7</td>
<td>1.67</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>8.97</td>
<td>9.1</td>
<td>2.27</td>
<td></td>
</tr>
<tr>
<td>3 Railroad Loadout Area</td>
<td>Grass-Forb</td>
<td>10.32</td>
<td>746</td>
<td>9.7</td>
<td>2.44</td>
</tr>
<tr>
<td></td>
<td>Spruce Fir</td>
<td>3.50</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Riparian</td>
<td>0.04</td>
<td>182</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>13.86</td>
<td>9.8</td>
<td>2.44</td>
<td></td>
</tr>
<tr>
<td>4 Waste Rock Disposal Area</td>
<td>Disturbed</td>
<td>12.81</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>12.81</td>
<td>0</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>5 Water Tank &amp; Well Pads</td>
<td>Aspen</td>
<td>0.26</td>
<td>586</td>
<td>0.2</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>South Fork Breakout</td>
<td>0.96</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>1.22</td>
<td>0.2</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>6 WQ Vent Pad</td>
<td>Sagebrush</td>
<td>2.36</td>
<td>1300</td>
<td>3.9</td>
<td>0.97</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>2.36</td>
<td>3.9</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>7 NOG Bleeder Shaft</td>
<td>Grass-Aspen</td>
<td>3.00</td>
<td>586</td>
<td>2.2</td>
<td>0.56</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>3</td>
<td>2.2</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>8 Swens Vent Pad</td>
<td>Sagebrush</td>
<td>9.7</td>
<td>917</td>
<td>11.3</td>
<td>2.81</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>9.7</td>
<td>11.3</td>
<td>2.81</td>
<td></td>
</tr>
<tr>
<td>9 Powerline</td>
<td>Aspen</td>
<td>6.3</td>
<td>586</td>
<td>4.7</td>
<td>1.17</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>6.3</td>
<td>4.7</td>
<td>1.17</td>
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<tr>
<td>TOTAL</td>
<td></td>
<td>94.62</td>
<td>50.13</td>
<td>12.52</td>
<td></td>
</tr>
</tbody>
</table>

Revised 7-23-2015

**INTEGRATED**

**OCT 09 2015**

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of the new highway. A stated management requirement of the Forest Service resulting from this vehicle count is to "provide new access connecting the Scofield area with Huntington Canyon" (U.S Forest Service, 1979). The design of the Swens Canyon Ventilation Facility incorporated elements such as burying the power line, eliminating a permanent sedimentation pond, and placing the topsoil storage area to the south of the pad to minimize visual impacts to Huntington Canyon.

Farming

Referring to agricultural lands within the lease and permit areas for the Skyline mine, T.B. Hutchins, State Soil Scientist for Utah, in a letter addressed to Keith Welch, Environmental Coordinator for the Permittee, made the following written statement, "Field evaluation of the area outlined on your map in Eccles Canyon shows no prime farmland in the area".

Farming in the lease and permit areas would be impractical due to the steep terrain (50 - 80 percent slopes).

PREVIOUSLY MINED AREAS

Underground Mined Areas

The abandoned Eccles Canyon coal mine, located in the southwest quarter of the southwest quarter of section 13 of T13S and R6E; and the abandoned Winter Quarters coal mine located within Winter Quarters Canyon are the only mines located in the proposed mine plan area. Drawing 2.2.7-7 shows a portion of the Winter Quarters mine in relation to the permit area. The Eccles Canyon mine, operated intermittently from 1899 to 1952, mined the Lower O-Connor "A" seam using the room and pillar method. The mine covered an area of approximately 500 feet south of the portal and 700 feet west of the National Forest boundary, (See Figure 2.12-B) (Doelling, 1972 and Heath, 1979). Doelling (1972) states, "Little is known about the Eccles Canyon.....Production figures are incomplete but estimated to be small." The Eccles Canyon Mine portals have been covered and sealed by SR-264 and the Skyline Mine benches. Both mines have been abandoned for several years.

No other known minerals of value have been mined within the lease and permit area. There are two producing and two abandoned gas wells located in Eccles Canyon. These gas wells are not classified as "mining". Therefore, no other minerals have been mined within the Skyline coal lease area.

Revised: 5-27-16
Surface Mined Areas

There have been no previous surface mines located within the mining plan area or adjacent areas. The waste rock disposal area was an abandoned strip mine. The Waste Rock site was expanded in 2007 into an area previously undisturbed by mining activities (approximately 5 acres). Areas previously disturbed by mining activities were contemporaneously reclaimed and made available to both livestock grazing and wildlife use. Land use for the area effectively remains the same with domestic livestock and wildlife. See Section 2.9 for details on Wildlife.

LOCAL LAND USE CLASSIFICATIONS

Both the county zoning ordinances and the "Land and Resource Management Plan" for the Manti-LaSal National Forest, prepared by the U.S. Forest Service (1986), classify local land-use for the lease area of the Skyline Mine as recreation, forestry and mining.

County Zoning Ordinances

The Emery County zoning map dated 1970 and the Carbon County zoning ordinance amended February 15, 1977 with a revised zoning map dated 1974 have zoned the Skyline property for recreation, forestry, and mining (RF&M). Section 8-7-1 of the Carbon County zoning ordinance states:

"Recreation, forestry, and mining zone has been established as a district in which the primary use of the land is for recreation, forestry, grazing, wildlife, and mining purposes. In general this zone...is characterized by...high grazing lands interspersed by ranches, recreational camps and resource outdoor recreational facilities and mines and facilities related thereto."

U.S. Forest Service Land Management Plan

The majority of the lease area lie within the boundary of the National Forest, and are therefore subject to the "Land and Resource Management Plan" for the Manti-LaSal National Forest prepared by the U.S. Forest Service (1986). National Forest System lands within the permit area include the following management units (Management emphasis for each unit is described):

RNG (Range) Management Unit - Emphasis is on production of forage and cover for domestic livestock and wildlife.
TBR (Timber) Management Unit - Emphasis is on management for production and use of wood-fiber for a variety of wood products.

UC (Utility Corridor) Management Unit - Emphasis is on providing transportation corridors for major cross-country pipelines, electrical transmission lines and telephone lines. This unit currently contains a gas transmission pipeline constructed and operated under a Forest Service special-use permit issued to Questar Pipeline Company (main line 41). The USFS was consulted on the Swens Canyon Ventilation Facility and determined the burying of the associated power line through Huntington Canyon was the primary mitigation measure implemented.

RPN (Riparian) Management Unit - Emphasis is on management of riparian areas and all the component ecosystems. The units consist of a zone approximately 100 feet measured horizontally from the edge of all perennial streams and springs, and from the shores of lakes and other still water bodies.

MMA (Minerals Management Area) Management Unit - Emphasis is on making land surface available for existing and potential major mineral developments.

In the "Land and Resource Management Plan" the Forest Service lists specific objectives pertaining to management of resources and resource uses on National Forest System lands. The Forest Service portion of the disturbed area (portal area) is currently identified as a Minerals Management (MMA) Unit. After completion of coal mining activity, the area will revert to a Range (RNG) Management unit. Similarly, the 3.0 acres permitted by the NOG Bleeder shaft will revert to a Range (RNG) Management unit once mining is complete.

COMPATIBILITY OF MINING OPERATION WITH FOREST SERVICE MANAGEMENT EMPHASIS AND OBJECTIVES

All mining activities related to the Forest Service "Land and Resource Management Plan" will be coordinated with the appropriate Forest Service personnel prior to implementation. While the mine is located on the Forest Service land boundary, creating primarily visual and traffic pattern related impacts, these effects are considered to be rather short term and will be essentially eliminated upon mine closure.

Revised: 5-27-16
ARCHAEOLOGY AND PALEONTOLOGY IMPACTS

State and Federal laws require protection of certain cultural resources. The mining operation is considered compatible with the requirements of all agencies in this area, since to date, there are no known archaeological or paleontological sites within the proposed disturbed areas. Section 2.1.1 and Appendix Volume A-4 contain additional discussion and documentation on these cultural resources. Class I and Class III inventories were conducted in preparation of the Swens Canyon Ventilation Facility. No cultural resources of concern were identified (see Appendix Volume A-4, Vol. 2 for report).

BUILDINGS, PUBLIC ROADS, AND OTHER MAN-MADE FACILITIES

There are few man-made features located within the Skyline Mine permit area. One abandoned gas well is located within the permit area in Eccles Canyon. The only building located within the permit area is a small structure associated with Gas Well No.8. A natural gas pipeline traverses the permit area and an associated gas tank is located east of the southeastern boundary of the lease area. The location of public roads, including SR-264, within and adjacent to the lease area are illustrated in Map 2.12.1-1. A USGS gauging station was located near the mouth of Eccles Canyon but was removed during the summer of 1985. (See also the reclamation discussion in Part 4.)

CEMETERIES, NATIONAL TRAILS AND WILD RIVERS

There are no cemeteries, national trails, or wild rivers located within or adjacent to the Skyline Mine lease and permit areas. There are no national trails, or wild rivers located within or adjacent to the Skyline Mine lease and permit areas. The Mine=s rock disposal site is adjacent to the Scofield, Utah cemetery, but currently there area no plans to disturb any areas immediately adjacent to the cemetery. The area of disturbance is located approximately 2-mile southeast of the existing cemetery.

SCOFIELD WASTE ROCK SITE

As mentioned in Section 2.12.2, the Wasste Rock disposal area was previously disturbed by mining activities. However, the disposal area was expanded in 2007 into areas previously undisturbed by mining activities (the area was logged in the 1990s). A archaeological study conducted in 2006 concluded the expansion will have no effect on any known cultural resource sites (See Appendix A-3).

LAND USE OF THE NORTH LEASE TRACT AREA

The North Lease Tract Area is located north and adjacent to the Skyline Mine. Consequently, the landuse of the North Lease Tract Area is very similar to that described in Section 2.12 for the Skyline property.

The general area of the Skyline property lies within both Carbon and Emery counties, whereas, the North Lease Tract lies only within Carbon County.
Land uses of the areas consist of wildlife habitat, grazing, recreation, natural gas transmission and forestry.

**Wildlife Habitat**

A listing of wildlife that inhabit the North Tract Area can be found in Section 2.9.5 with additional details about the general mine area in Appendix Volume A-2.

**Grazing**

National Forest Sheep allotments are maintained in the area. Private lands are grazed by similar numbers of sheep.

**Recreation**

Recreational use of the area consists primarily of hunting (big game, game birds, and small game species), sightseeing, snowmobiling, and cross country skiing. Limited camping and picnicking also occurs.

**Farming**

As indicated in the soil section of the North Lease Tract Area, farming in the area is prohibited by the steep and rocky terrain of the area.

**Alluvial Valley Floor**

**Winter Quarters Canyon / Woods Canyon**

Minor amounts of Alluvial Valley Floor (AVF) are located in the mouths of Winter Quarters Canyon and Wood Canyon. The AVF determination was based on elevation of mapped alluvial sediments located in Mud Creek, existing surface irrigation ditches located in Woods Canyon, and field observations. In Winter Quarters Canyon the AVF is delineated by mapped alluvial sediments located at the same elevation in the Mud Creek drainage, and surface irrigation ditches that divert water off of Winter Quarters Creek. In Woods Canyon, the AVF is delineated by sediments located in the mouth of the canyon located at the same elevation of the alluvial sediments in the Mud Creek drainage. Plate 2.3.4-2 illustrates the potentiometric surface of wells located within the permit area and completed below the coal seam in the basal portion of the Blackhawk formation and Star Point Formation. As discussed in detail in the Probably Hydrologic Consequence (HC1 reports), the

Revised: 12-18-07
hydrologic regime of the permit area is separated from the AVF of Pleasant Valley by the Connelville, O’Conner, and Pleasant Valley faults. The Pleasant Valley fault is likely the primary source of seeps and springs located along Route 96 at approximately 7,760 ft elevation east of Woods, Winter Quarters, and Green Canyons. Other existing seeps and springs located between the permit area and the AVF are located within the Blackhawk formation will not be impacted. A total of 44 acres are located in Winter Quarters Canyon and approximately 3 acres are located in Woods Canyon. The crop grown in both canyons (pasture grass) is not harvested for sale. It is consumed in place by livestock.

**Mud Creek**

EarthFax (2002) evaluated the erosional stability of the Mud Creek channel from Eccles Creek to the town of Scofield. As part of this evaluation, the channel roughness was determined for selected channel cross-sections using the Manning’s methodology. The Manning’s ‘n’ values ranged from 0.029 below the Eccles Creek confluence (MC-1) to 0.042 just south of the Town of Scofield (MC-3). The roughness of the floodplain was estimated to be 0.06, typical of other vegetated flood plains.

The longitudinal profiles of Pleasant Valley and the Mud Creek channel from above its confluence with Eccles Creek to the inlet to Scofield Reservoir are discussed below under geometry and physical characteristics.

Mt. Nebo (2002) conducted a riparian vegetation study along Eccles and Mud Creeks and found that the vegetation generally consists of grasses, rushes, sedges, and willows. Vegetation was determined to be generally stable with no severe riparian degradation. Some areas were visually observed to have minor unstable segments evidenced by exposed roots, slight undercutting, and erosion.

EarthFax (2002) collected channel bank and bottom samples from three locations on Mud Creek. The samples were analyzed for physical parameters (sieve analysis, unit weight, direct shear, and Atterberg limits). The sample results are presented in Appendix B of the February 2002 report (located in Addendum to PHC, July 2002, Appendix D). These results show the bank soils to be silty sands to clayey silts. The report indicated that the channel banks and bed materials are structurally and erosionally stable.

The Soil Conservation Service classified the soils in the Pleasant Valley as belonging to the Silas and Silas-Brycan Series. Both are deep to very deep soils in alluvial valleys, derived from the sandstone and shale of the Blackhawk Formation. Soil pH ranged from 6.6 to 8.4 and salinity values were less than 2 mmhos/cm (SCS, 1988).

Descriptions of typical pedons of the Brycan and Silas series, as published by the Soil Conservation Service (1988), are provided in Attachment 2. According to these descriptions, subsurface soils (below
a depth of about 24 inches) generally consist of loam to silty loam or sandy clay loam with a subangular blocky structure. The soil tends to be slightly hard to hard, firm, with very fine roots and a pH of approximately 7-8.

**Geometry and Physical Characteristics.** Attachment 1 presents the longitudinal profiles of Pleasant Valley and the Mud Creek channel from above its confluence with Eccles Creek to the inlet to Scofield Reservoir. Based on the overall distances and the change in elevation, the slope of the valley is 0.0128 ft/ft and the slope of the channel is 0.0091 ft/ft. The difference in the slopes is due to the increased length of the channel. The channel meanders through the valley and follows a longer path. The sinuosity ratio of the channel is 1.6. This indicates that the channel is approximately 60 percent longer than the valley. In a preliminary estimate of sinuosity for Mud Creek (EarthFax Report provided in Appendix D, Table 4, July 2002 Addendum to the PHC) an average sinuosity of 1.1 was shown in Table 4, however updated information from aerial photography indicates a considerably longer flow path than previously estimated. Thus the 1.6 sinuosity ratio is felt to represent actual conditions of the creek.

Attachment 1 also presents cross-sections of the valley. Six valley cross-sections are presented to show the various sections of the valley. The cross-section locations are presented in Figure 2.12-B. Cross-section 1681 represents the upper narrow portion of the valley where the stream is incised and confined. Cross valley slopes toward the stream channel in this upper section were determined to range from 0.05 to 0.22 ft/ft. In the lower valley cross-sections, the valley broadens and the valley bottom cross-slopes flatten to 0.02 to 0.10 ft/ft, allowing channel incision to reduce. These slopes are consistent with slopes determined from the collar elevations between the water level monitoring piezometers installed at the current EarthFax study cross-sections.

Appendix D of the EarthFax (2002) report (located in Addendum to PHC, July 2002, Appendix D) presents channel cross-sections which are representative of the various channel reaches of Mud Creek. The channel width of Mud Creek ranges from 15 to 20 feet. Based on visual observation of the creek, the channel is slightly incised and low flow terraces are limited in extent and discontinuous. In some places, no low flow terraces exist at all.

A broad flood plain does not exist for this creek. As shown by the valley cross-sections in Attachment 1 and the cross-sections in Appendix D of the EarthFax report, the creek channel is slightly incised in the bottom of the valley. The valley bottom has a generally moderate (2 to 10 percent) cross slope toward the creek. This configuration results in a limited flood area adjacent to the creek with high capacity. For flooding to extend out of this limited area requires a significant
flood, notably greater than the combined flow of the natural runoff plus the mine discharge. Therefore, the field areas adjacent to Mud Creek are not likely to be affected by flooding from the combined flows.

EarthFax (2002) conducted an evaluation of the hydrologic conditions and erosional stability of the channel banks. Based on the combined mine discharge of approximately 10,000 gallons per minute and natural flows, the channel flows at approximately bankfull conditions. Structural stability evaluations using the bank and channel bed samples with the GEOSLOPE computer program demonstrated that the banks are stable and unlikely to fail due to the combined flow in the channel. Erosional stability evaluations using maximum allowable velocity methods for channel, bank, and flood plain, indicated that channel materials, consisting of silty sands and clayey silts and which are well vegetated with various natural grasses and willows, are able to handle the combined flow without significant erosion.

Very little sinuosity of the stream channel exists in both Winter Quarters and Woods Canyons. In Winter Quarters, the channel length measured approximately 10 percent longer than the length of the property, indicating a sinuosity of 1.1. The channel width of Winter Quarters ranges from 6 to 8 feet. Based on visual observation of the creek, the channel is slightly incised and low flow terraces are limited in extent and discontinuous. In most places, no low flow terraces exist at all. The alluvial sediments in Woods Canyon are limited in extent and were not measured.

**Stream Flow.** The US Geological Survey has been monitoring long-term stream flow on Mud Creek below the Winter Quarters Confluence at Scofield, Utah since 1979. A plot of the daily mean flow is presented in Figure 2.12-C. Although the period of record is 1979 through 2002, a break in the record occurred between 1986 and 1991, during which time no flow data were collected. Flows during the period of record have ranged from a maximum of 389 cfs in May 1984 to a low of 1.6 cfs in January 1980. The periods of high flow generally occur during the spring snow melt period in May through June lasting for a duration of approximately 30 to 45 days. Following the snowmelt period, the stream flow drops gradually to the low flow period which occurs generally during fall and winter months. Some minor short-term events occur, but the duration is generally less than a day and the flows have historically not been greater than the snowmelt events.

In August 2002, EarthFax, as part of an on-going study, installed a series of piezometers at six locations along Mud Creek. The piezometers were located on both sides of the stream to identify the water table and determine the potential for groundwater movement toward or away from the creek. The location of the piezometers and the corresponding water levels are shown on the valley cross-sections in Attachment 1. Of the valley cross-sections only four correspond to piezometers which were measured.

Revised: 08-24-05
Upon completion of the EarthFax report all piezometer information will be provided. Based on the water levels from the piezometers, it is apparent that the lower portion of Mud Creek is a stream with the groundwater table beneath the adjacent alluvium elevated relative to the water surface in the stream channel.

Therefore, groundwater contributes to the creek flow through the lower portion of the Pleasant Valley. This is further supported by the wetland and spring areas adjacent to the stream identified by Mt. Nebo in Reaches 4 and 5 (Eccles Creek confluence to Scofield Reservoir).

A field study currently underway by EarthFax shows that the lower reaches of Mud Creek are gaining stream flow. This is evidenced by the piezometer water levels being higher than the water surface in the stream (see valley cross sections presented in Attachment 1). Under such conditions, the groundwater flow direction is from the pastures toward the stream. Given the steep slope of the valley bottom toward the stream and the associated relatively steep slopes of the groundwater surface toward the stream, any increase in the water surface of the stream will only raise the potentiometric surface beneath the valley within a relatively small zone adjacent to the stream. Thus, there is no significant potential for the combined flow in the stream channel to increase the groundwater table under a substantial portion of the pastures.

Utilizing the US Geologic Survey stream flow data, the base flow contribution to Mud Creek was estimated. Using the fall and winter data for the early portion of the flow record, before significant mining activity and discharge occurred the base flow for Mud Creek is estimated to range between 1.6 and 5 cfs. The variation in flow is based on the prior year's precipitation, with wet years yielding higher base flows.

Based on the flow readings in the stream channel at MC-1 (18.24 cfs) thru MC-3 (24.44 cfs), the stream flow increases in a downstream direction. While there are some interferences with inflows from contributing surface stream flow and irrigation return flows, the major portion of the increase likely represents base flow contribution. The flow difference between MC-1 and MC-3 is 6.6 cfs. Assuming that approximately 2 to 3 cfs is contributed from the side drainages, the base flow contribution would be on the order of 3 to 4 cfs. This fall is within the range estimated from the US Geologic Survey records.

Stream flow in Winter Quarters, measured quarterly at the western property boundary over the last few years, ranges from 108 to 871 gpm and averages 342 gpm. Stream flow in Woods Canyon, measured Revised: 08-24-05
quarterly at the mouth of the canyon over the last few years ranges from 23 to 410 gpm, and averages 120 gpm.

**Monitoring Plan.** In coordination with the Division of Oil, Gas, and Mining, Canyon Fuel has developed a work plan to evaluate mine-water discharge impacts in Mud Creek. The plan requires characterization of the existing channel and groundwater conditions, gathering and monitoring of stream flow data, evaluation of historic land use, collection of water quality data, evaluation of bank stability, and performance of long-term monitoring.

A copy of the plan is included in Attachment 3 for both EarthFax Engineering, Inc and Mt. Nebo Scientific. The sampling results are incorporated into Appendix B of the February 2002 report (located in Addendum to PHC, July 2002, Appendix D) and will continue to be incorporated into the Addendum to the PHC as sampling results become available.

As indicated in the work plan:

Flow and water-quality data (TDS, TSS, total phosphorus) will be collected at monitoring points MC-2 through MC-5 four times per year (i.e., seasonally), when accessible, for a period of one year following a sustained reduction in mine-water discharge to a rate of 5,000 gpm or less (i.e., pre-September 2001 levels). Channel cross sections and longitudinal profiles will be collected from each reference site annually during the same period. Flow and water-quality data will also be collected any time there is an increase in discharge rates from the mine of at least 25% above the average rate for the prior month.

**Fields and Crops.** The farms and field areas in Pleasant Valley are delineated on Figure 2.12-D. Table 2.12.3 shows the ownership, crop grown, size, and yield for each of the farms. Information concerning land ownership was obtained from Plate 1.6-1. The crop grown on each parcel was determined from field observations over a period of several years. The size of each parcel was determined from field observation, using Plate 1.6-1 as a basis. Historical yield information is not available for the private land. However, Mr. Ray Jensen, Range Specialist for the BLM, indicated that the area owned by the U.S.A. is classified as sub-irrigated grazed land with a historical yield for the site of about 2-3 tons per acre of grass (Jensen, personal communication). This exceeds the Soil Conservation Service (1988) production estimates of 1.25 to 1.75 tons per acre for the range sites in the bottom of the Pleasant Valley. Although the yield varies from year to year depending on precipitation and management, it was assumed for this response that the average yield estimated by the BLM (i.e., 2.5 tons per acre) would be applicable to all areas in Table 2.12.3. The anticipated annual yield for each farm was calculated.
using this value.

TABLE 2.12.3
FARM OWNERSHIP, SIZE, AND YIELD

<table>
<thead>
<tr>
<th>Land Owner</th>
<th>Crop Grown</th>
<th>Size (ac)</th>
<th>Annual Yield (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Rodakovich, Trust</td>
<td>Pasture Grass</td>
<td>68</td>
<td>170</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>Pasture Grass</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>Utahna Pace Jones Trust</td>
<td>Pasture Grass</td>
<td>322</td>
<td>805</td>
</tr>
<tr>
<td>Fred &amp; Sheila Jensen</td>
<td>Pasture Grass</td>
<td>88</td>
<td>220</td>
</tr>
<tr>
<td>William A. &amp; Mattie Cornaby</td>
<td>Pasture Grass</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Rudman Land and Livestock</td>
<td>Pasture Grass</td>
<td>3</td>
<td>7.5</td>
</tr>
</tbody>
</table>

The crop grown in the subject area (pasture grass) is not harvested for sale. Rather, it is consumed in place by livestock. Therefore, its value must be calculated based on the replacement cost of imported feed if the pasture grass becomes unavailable.

Standard ranching practices suggest that a grazing cow or horse requires approximately 0.75 tons of feed per month while a fed animal requires about 0.5 ton of feed per month. The difference is due to the reduced energy output of an animal that is given its feed versus that which must forage for feed. Based on a cost of $100/ton of hay, and a consumption rate of 0.5 tons per animal per month, the cost of feed ranges from approximately $50 to $75/animal/month.

Impacts which may result would be either the loss of production and income as a result of flooding or increased saturation of the root zone. Flooding impacts would occur if the pasture land were inundated for extended periods. Saturation impacts would occur if the water table underlying the pastures were raised for extended periods of the growing season.

Based on the information presented by EarthFax (2002), the flooding potential from the combined flow of natural runoff and mine discharges is very small. The combined flow only reaches bankfull stage and does not reach the top of bank or flood plain areas. Therefore, no flooding impact is expected to the adjacent pastures/farming activities along and adjacent to Mud Creek.

Revised: 08-24-05
TABLE 2.12.4
FARM GRAZING USAGE

<table>
<thead>
<tr>
<th>Land Owner</th>
<th>Number of Animals</th>
<th>Required Feed (tons/month)</th>
<th>Cost to Replace Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Rodakovich, Trust</td>
<td>20 Cattle, 4 Horses</td>
<td>12.0</td>
<td>$1,680</td>
</tr>
<tr>
<td>U.S.A.*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Utahna Pace Jones Trust *</td>
<td>25 Cattle</td>
<td>12.5</td>
<td>$1,750</td>
</tr>
<tr>
<td>Fred &amp; Shiela Jensen</td>
<td>65 Cattle, 2 Horses</td>
<td>33.5</td>
<td>$4,690</td>
</tr>
</tbody>
</table>

* Acreage available for grazing for the USA and Utahna Pace Jones parcels varies based on the water elevation of Scofield Reservoir. Most years USA has no grazing land available due to inundation.

Assuming that Table 12.2.4 represents average grazing usage for the farms, this represents a maximum replacement feed cost of $8,120/month if all pasture production were eliminated. This assumes the unlikely scenario that all pasture grass would be lost.

Impacts which may result would be either the loss of production and income as a result of flooding or increased saturation of the root zone. Flooding impacts would occur if the pasture land were inundated for extended periods. Saturation impacts would occur if the water table underlying the pastures were raised for extended periods of the growing season.

Based on the information presented by EarthFax (2002), the flooding potential from the combined flow of natural runoff and mine discharges is very small. The combined flow only reaches bankfull stage and does not reach the top of bank or flood plain areas. Therefore, no flooding impact is expected to the adjacent pastures/farming activities along and adjacent to Mud Creek.
REFERENCES


Daniels, Ronald W., Coordinator of Mine Land Development, Division of Oil, Gas, and Mining, Salt Lake City, Utah, in a personal communication in August, 1979.


Murdoch, Joseph R., Professor of Botany and Range Science, Brigham Young University, Provo, Utah, in a personal communication in September, 1979.


Winget, Robert Newell, Assistant Professor of Zoology and Research Associate for the Center of Health and Environmental Studies, Brigham Young University, Provo, Utah, in a personal communication in August, 1979.

Revised: 11/02
USGS 09310700 MUD CREEK BL WINTER QUARTERS CANYON AT SCOFIELD, UT

DAILY MEAN STREAMFLOW, IN CUBIC FT PER SEC

DATES: 08/22/1978 to 09/30/2001

EXPLANATION
— DAILY MEAN STREAMFLOW  × MEASURED STREAMFLOW  — ESTIMATED STREAMFLOW

Figure 2.12.C. USGS Mud Creek Streamflow Record
SECTION 2.12 LAND USE
ATTACHMENT 1

VALLEY AND CHANNEL PROFILES AND VALLEY CROSS-SECTIONS
Valley Cross-Section Sta. 1681
Looking Upstream
Valley Cross-Section Sta. 7300
Looking Upstream
Valley Cross-Section Sta. 14480
Looking Upstream

Station (ft)

Elevation (ft)

- Topo
- Water Level
Valley Cross-Section Sta. 17340

Looking Upstream

Station (ft)
Valley Cross-Section Sta. 22016
Looking Upstream
Valley Cross-Section Sta. 30330
Looking Upstream
SECTION 2.12 LAND USE
ATTACHMENT 2

SOIL DESCRIPTIONS FROM SOIL CONSERVATION SERVICE (1988)
Brycan Series

The Brycan series consists of very deep, well drained, moderately slowly permeable soils on alluvial fans and in valleys. These soils formed in alluvium derived from shale and sandstone. Slope is 3 to 8 percent. Elevation is 7,700 to 8,600 feet. Average annual precipitation is 16 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are fine-loamy, mixed Cumulic Haploborolls.

Typical pedon of a Brycan loam in an area of Silas-Brycan loams, about 2.5 miles north of the town of Scofield, about 2,500 feet south and 2,500 feet west of the northeast corner of sec. 21, T. 12 S., R. 7 E.

A11—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium platy structure parting to weak fine granular; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; mildly alkaline (pH 7.8); abrupt smooth boundary.

A12—4 to 12 inches; brown (10YR 4/3) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots and few medium roots; common very fine and fine pores; mildly alkaline (pH 7.8); clear smooth boundary.

B21—12 to 24 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and slightly plastic; common very fine and fine roots; common very fine and fine pores; moderately alkaline (pH 7.8); clear smooth boundary.

B22—24 to 32 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and slightly plastic; few very fine and common fine roots; common very fine and fine pores; mildly alkaline (pH 7.8); clear smooth boundary.

C1—32 to 42 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine pores; mildly alkaline (pH 7.8); abrupt smooth boundary.

C2ca—42 to 60 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine pores; slightly calcareous; splotches of calcium carbonate; moderately alkaline (pH 8.2).

The profile is mildly alkaline or moderately alkaline.

A horizon: Value is 3 to 5 when dry and 2 or 3 when moist, and chroma is 1 to 3. Reaction is neutral or mildly alkaline.

B2 horizon: Value is 5 or 6 when dry and 3 or 4 when moist, and chroma is 3 or 4.

C horizon: Value is 4 to 6 when dry and 3 or 4 when moist, and chroma is 3 or 4.

Silas Series

The Silas series consists of very deep, somewhat poorly drained, moderately permeable soils on narrow alluvial valleys. These soils formed in alluvium derived from shale and sandstone. Slope is 0 to 3 percent. Elevation is 7,200 to 8,600 feet. Average annual precipitation is 16 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are fine-loamy, mixed Cumulic Cryoborolls.

Typical pedon of Silas loam, about 2 miles north of the town of Scofield, about 500 feet north and 1,100 feet east of the southwest corner of sec. 20, T. 12 S., R. 7 E.

A11—0 to 2 inches; dark grayish brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; mildly alkaline (pH 7.8); abrupt smooth boundary.

A12—2 to 17 inches; dark grayish brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; weak moderate subangular blocky structure parting to moderate coarse granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; common very fine and fine pores; neutral (pH 7.2); abrupt wavy boundary.

A13—17 to 28 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and fine pores; neutral (pH 7.2); abrupt wavy boundary.

C1—28 to 43 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; common medium faint yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; mildly alkaline (pH 7.4); clear smooth boundary.

C2—43 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; common medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; neutral (pH 7.2).

The mollic epipedon is 20 to 34 inches thick. The water table is at a depth of 20 to 40 inches.

A horizon: Value is 3 to 5 when dry and 2 or 3 when moist, and chroma is 1 to 3. Reaction is neutral or mildly alkaline.

C horizon: Value is 5 to 7 when dry and 4 or 5 when moist, and chroma is 2 or 3. Texture is loam or sandy clay loam with thin layers of silt loam and fine sandy loam.
SECTION 2.12 LAND USE
ATTACHMENT 3

ECCLES AND MUD CREEK WORK PLAN
WORK PLAN TO EVALUATE
MINE-WATER DISCHARGE IMPACTS IN
ECCLES CREEK AND MUD CREEK

CANYON FUEL COMPANY
Skyline Mine
Scofield, Utah

July 2002

Prepared by
EARTHFAX ENGINEERING, INC.
Engineers/Scientists
Midvale, Utah
# Canyon Fuel Company

## Skyline Mine

### Eccles and Mud Creeks Work Plan

**July 30, 2002**

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WORK PLAN TO EVALUATE
MINE-WATER DISCHARGE IMPACTS IN
ECCLES CREEK AND MUD CREEK

1.0 INTRODUCTION

In early August 2001, a fractured channel sandstone was encountered in the Skyline Mine, resulting in a significant inflow of groundwater to the mine. In an effort to minimize environmental impacts and meet effluent limitations, much of the water encountered was initially pumped to inactive sections of the mine for temporary storage.

It was assumed that the water encountered would have a high inflow for a short duration and then decrease with time, as frequently occurs in the area. However, rather than decreasing significantly with time, the inflow has remained fairly constant. Once available underground areas for water storage were filled, the mine began pumping both the inflow water and the stored water to the surface to prevent mine flooding and allow continued operation. Since early September 2001, discharges from the mine to Eccles Creek have ranged between about 10,000 and 15,000 gpm, compared with an average discharge for the prior 18 months of about 4,000 gpm.

On October 11, 2001, EarthFax Engineering, Inc. conducted a reconnaissance geomorphic evaluation of Eccles Creek to assess potential impacts of the discharge on the stability of the stream channel. The results of this evaluation were combined with an assessment of potential water-quality impacts in a letter report to Canyon Fuel Company dated October 24, 2001. Additional information regarding potential impacts to phosphorus concentrations was provided on December 3, 2001 and December 13, 2001.
On November 26, 2001, EarthFax conducted a more extensive field evaluation of the impacts of mine-water discharges on Eccles and Mud Creeks. Samples of the bed and bank materials were collected to allow an assessment of the structural and erosional stability of the stream channels. In addition, subsequent analyses were conducted to determine the potential effects of mine-water discharges on peak annual flows in the streams and the potential impacts to man-made structures in the streams. An evaluation of alternative discharge points was also conducted. The results of these investigations were presented in a letter report to Canyon Fuel Company on February 27, 2002.

Following a review of the submitted information, Canyon Fuel Company and EarthFax met with representatives of the Utah Division of Oil, Gas and Mining to discuss the results. In these meetings, the Division requested additional information to better quantify and monitor potential impacts to Eccles and Mud Creeks. The objective of gathering this additional information is to:

1. Quantify whether or not increased flows may be causing erosion and/or sediment deposition in quantities that are adverse to the hydrologic regime of Eccles Creek and Mud Creek.
2. Quantify the degree to which the increased flows may be contributing to sediment and phosphorus loads in Scofield Reservoir.
3. Provide a means for monitoring potential long-term impacts to the morphology of Eccles and Mud Creeks.
4. Quantify whether or not changes are occurring in the elevation of the water table in the alluvial deposits adjacent to Eccles and Mud Creeks due to the increased flows.
5. Collect data to determine whether or not an Alluvial Valley Floor exists adjacent to Mud Creek.
6. Quantify whether or not changes are occurring to the vegetation adjacent to the stream corridor due to the increased flows. Also, quantify whether or not vegetative changes occur as a result of the potential future decrease in present discharge rates from the mine.

The purpose of this document is to present a work plan for the collection of data to address items 1 through 5 above. A separate work plan will address item 6.
2.1 Establish and Characterize Reference Sites

Reference sites will be established on Eccles and Mud Creeks at the approximate locations shown on Figure 1. Sites EC-1, 2, and 3 as well as MC-1, 2, and 3 correspond to cross sections used in previous investigations (EarthFax Engineering, 2002). Sites MC-4 and MC-5 will be established to evaluate conditions on Mud Creek within a section of agricultural pasture and upstream from the Eccles Creek confluence, respectively. Site MC-6 will be in an area of dryland pasture.

All reference sites will be established in general conformance to the recommendations of Harrelson et al. (1994). This will involve the following:

- Establishing benchmarks at each site. Benchmarks will consist of cement or boulder monuments, with a metal marker stamped with the site number. Photographs will be taken and descriptions provided to allow others to return to the sites in the future.

- Establishing monumented cross sections. The endpoints of cross sections will be marked with roof bolts or steel reinforcing bar that has been driven into the ground. If roof bolts are used, the bars will be painted to increase visibility. If steel reinforcing bars are used, plastic survey end caps will be placed on the bar ends. The locations of the cross section endpoints with respect to the benchmarks will be measured, using a tape and Brunton compass, with the measurements noted in the field log book. The location of another permanent feature (e.g., embedded boulder, long-lived tree, etc.) will also be measured and noted, to provide triangulation.

- Surveying the channel cross section at each site. A measuring tape will be attached to one of the cross section monuments and stretched tight and level across the stream to the other monument. The level of the tape will be checked with an attached bubble level. Surveying will be performed using a survey level.
and rod. Elevations will be shot at each important feature or change in elevation (e.g., slope breaks, channel banks, bankfull stage, etc.). The survey will be closed by re-shooting the station benchmark.

Surveys the longitudinal profile at each site. The profile will extend a distance of at least 20 times the channel width (half upstream and half downstream from the cross section location). At a minimum, data to be collected from the profile will include the channel bottom, the water surface, indications of bankfull stage, and the top of the stream bank. Measurements will be collected on intervals approximately equal to the channel width. Data will be collected using a survey level and rod, with the location of the starting and endpoints being measured as noted above.

Establishing photo points. As recommended by Harrelson et al. (1994), convenient locations will be selected to take photographs upstream, downstream, and across the channel at each cross section location. These locations will be noted in the field book, with respect to the benchmark.

Collecting streamflow data. The flow will be measured using standard procedures with a rotating-cup flow meter.

Samples of the bed and bank materials will be collected at the newly established stations (MC-4 through MC-6) to evaluate geomorphic and stability relationships at those locations. Similar samples were collected in February 2002 at the remaining sites (EarthFax Engineering, 2002) and are still considered valid.

2.2 Determine Depth to Groundwater

The depth to groundwater will be determine at each of the reference sites on Mud Creek. This will be accomplished by installing two temporary piezometers in the alluvium on each side of the stream. The piezometers will be installed using portable flighted augers and a hammer drill. Perforated PVC pipe will be installed in the hole and the water table allowed to stabilize for a period of at least 4 hours prior to measuring the depth to water. The relative elevation of the piezometer will be established by standard surveying techniques from the previously-
established benchmark at each site. Within the constraints offered by each site, the locations of each piezometer will be sited in an attempt to determine the slope of the water table perpendicular to the stream channel at each reference site.

2.3 Gather Available USGS Flow Data

Flow data on file with the U.S. Geological Survey will be gathered for Eccles Creek near Scofield, Utah (station 09310600) and for Mud Creek below Winter Quarters Canyon at Scofield, Utah (station 09310700). If these data are available electronically, they will be provided to the Division in electronic form. Otherwise, paper copies will be provided.

2.4 Gather and Evaluate Historic Aerial Photographs

Historic aerial photographs will be gathered of Pleasant Valley between the town of Scofield and the confluence of Mud Creek and Eccles Creeks. Both private sources (on file with aerial photography companies) and government sources (USDA, USGS, EROS) will be searched. These photographs will be evaluated to assess historic land use in this reach of Pleasant Valley. Use this information, together with the additional data collected as part of this study, to evaluate whether or not Pleasant Valley can be classified as an Alluvial Valley Floor.

2.5 Collect Additional Water-Quality Data

Water-quality samples will be collected at monitoring points MC-2 through MC-6. In addition to the collection of flow data as indicated in Section 2.1, these samples will be analyzed for total dissolved solids (TDS), total suspended solids (TSS), and total phosphorus.
2.6 Evaluate Bank Stability Indexes

As field information is gathered, sufficient data will be gathered to determine the bank erodibility hazard (Rosgen, 1996; 2001) for each reference site. These data will include measurements of the following values:

- Bank height
- Bankfull depth
- Rooting depth
- Root density
- Bank slope
- Degree of surface protection of the bank

The in-stream velocity gradient (between the core of maximum velocity and the stream bank) and the ratio of average hydraulic stress and near-bank hydraulic stress will also be calculated. Each of these indexes will be compared with typical values provided by Rosgen (1996; 2001) to provide another assessment of bank stability in addition to that provided previously (EarthFax Engineering, 2002).

2.7 Long-Term Monitoring

Flow and water-quality data (TDS, TSS, total phosphorus) will be collected at monitoring points MC-2 through MC-6 four times per year (i.e., seasonally), when accessible, for a period of one year following a sustained reduction in mine-water discharge to a rate of 350 gpm or less (i.e., pre-March 1999 levels). Average sediment yield contributions to Scofield Reservoir will be calculated from the TSS and flow data. Channel cross sections and longitudinal profiles will be collected from each reference site annually during the same period. Flow and water-quality data
2.8 Review Past Studies

The records of State and Federal agencies (e.g., Utah Department of Natural Resources, Utah Department of Environmental Quality, U.S. Geological Survey, etc.) will be searched to obtain copies of past studies performed on Eccles and Mud Creeks. These reports will be reviewed for additional baseline information regarding the streams.

2.9 Prepare Project Report

Once the initial data are collected and evaluated, a report will be prepared and submitted to the Utah Division of Oil, Gas and Mining for review. This report will include drawings of the cross sections and longitudinal profiles, copies of photographs collected during the field investigation, copies of data collected, results of data evaluations, and copies of field notes.
3.0 REFERENCES


FIGURE 1. LOCATION OF REFERENCE SITES
ATTACHMENT 3
ECCLES AND MUD CREEK WORK PLAN
INTRODUCTION

Excess stream flows have been generated from coal mining activities at the Skyline Mine located in central Utah. Continuing studies will be conducted in the plant communities of Eccles Canyon Creek and Mud Creek as an attempt to monitor changes in the riparian communities as a result of these flows.

The studies began in 2001. More studies will be conducted for two additional years beginning in 2002 and being completed in 2003. Results of the studies will evaluated following that time period to determine whether or not additional studies will be needed.

STUDY OBJECTIVES

The purpose of the study will be to conduct research in an attempt to determine the impacts to the riparian plant communities from the increased flows that have occurred in Eccles Canyon Creek and Mud Creek. Primary study objectives for these communities will be to: 1) describe the current status, 2) quantify riparian complexes, 3) assess current condition of the plant communities, 4) assess impacts of increased flows on these communities, 5) provide defensible data with regard to community changes, and 5) provide a database and structure for more intensive studies if needed in the future.

METHODS

With some changes, the basic design and methods for the studies will follow the Level III format as described by the U.S. Forest Service (USDA Forest Service. March 1992. Integrated riparian evaluation guide. Intermountain Region. Ogden, UT). Pertinent sections of this document have been included in the Appendix of this study plan.

Quantitative and qualitative data will be recorded in the field. Fieldwork will be conducted in July and August. Final sample design will be determined in the field, but generally, sample locations
will be placed in a regular-random fashion every 300 - 600 ft in the Eccles Canyon Creek and 600 - 1200 ft in Mud Creek. At these locations permanent line transects were placed across (or perpendicular to) the stream channel. By design, the line transects will vary in length based on several factors. Although sometimes limited by topographical features such as bedrock outcrops, it will be our intent to make the transects long enough to cover the entire stream and its riparian communities, plus an additional 10-15 ft on each side of the stream to record the current adjacent upland communities. Monitoring the total extent of the riparian plant communities including some upland community information should provide information about possible increases or decreases of the riparian communities relative to the adjacent upland communities. When a transect is placed, the line-intercept method will be employed to measure the extent of each plant community. The plant communities will be named by the dominant two plant species or if only one species dominated the community by a wide margin, the plant community will named by this single species.

Qualitative data will also recorded at each sample location including the dominant upland communities on each side of the stream and general notes about each sample location. Color photographs were taken at each sample location. The sample locations and extent of the line transects will be permanently marked using wooden stakes, flagging and/or blue pin flags.
Appendix

to

Continuing Studies of the Effects
Of Increased Flows on Riparian Communities
At Eccles Canyon Creek & Mud Creek

- A Study Plan -

Contains excerpts from:

Chapter 4. LEVEL III RIPARIAN AREA EVALUATION

A. Objectives

1. Provide detailed quantitative site information for riparian complexes to:

   a. Describe current status.
   b. Quantify potential.
   c. Provide data for defensible management decisions.
   d. Validate Forest Standards and Guidelines.
   e. Develop design criteria for riparian and aquatic habitat improvement projects.
   f. Quantify management effects.
   g. Identify factors limiting achievement of potential or management goals.

2. Provide a monitoring framework to evaluate management activities.

The decision to complete a Level III evaluation is issue driven. There must be a need for the information detail that Level III generates. A number of resource surveys are described in this Chapter. Each Forest will identify by project area which surveys to use. Surveys that are not included in this handbook may also be used.

B. Guidelines

Identify specific objectives for conducting a Level III riparian evaluation and the information needs to address those objectives. Identify and apply suitably efficient and reliable techniques to provide the needed information. Data forms for Level III vegetation, channel morphology, and aquatic community habitat surveys are included in Appendix A. Other resources are to be inventoried using existing procedures and forms. Assessment of some resource attributes may require development of new methodology and data forms. If an undocumented technique is used, the Forest should document the assumptions and procedures used. All forms used in Level III riparian evaluation need to include the Key ID number described in Level II so that eventual data base linkages may be made.

Guidelines related to the two principal purposes for Level III riparian evaluations follow.

1. Complex Characterization

Level III riparian evaluations employ methods to quantitatively describe the physical and biological characteristics of a riparian complex. Data collection for characterization often involves use of subsampling techniques within a complex.

A variety of resource attributes must be examined to adequately characterize riparian complexes. All resource surveys including channel morphology, fish habitat, vegetative cross section, green line, soils, and foliage height/volume information should be conducted in a manner that allows them to be tied to specific sample locations within the complex. Some resource attributes, such as those associated with vegetation, will be surveyed only at the specific sample locations. Others will be sampled over the entire complex. For example, if soil information is lacking, a soil map for the entire complex will be produced to the Order 1 or 2 intensity.
level. Channel morphology and aquatic community habitat attributes will be evaluated over the length of the stream in the complex using a calibrated ocular estimation (COE) survey approach described by Hankin and Reeves (1989) (see Appendix H).

2. Monitoring

Forest Service policy recognizes three types of monitoring: Implementation, effectiveness, and validation. These strategies are to be applied to monitor Forest Plan implementation. They are also useful in determining if requirements of the Clean Water Act, as administered by the State water quality agencies, are being met (i.e., applied best management practices are protecting beneficial uses).

Implementation monitoring documents whether or not management practices were applied as designed. Project and contract administration is a part of implementation monitoring. During riparian projects, the project administrator or contracting officer documents proper implementation and reasons for variance from design.

Effectiveness monitoring documents how well the management practices meet intended objectives for the riparian area. The Riparian ID Team reviews projects on-site during or after implementation to evaluate design adequacy and to provide feedback on needed additions or changes. Monitoring evaluates the cause and effect relationships between management activities and condition of the riparian dependant resources. Terrestrial and in-stream methods together constitute monitoring that evaluates and documents the total effectiveness of site-specific actions.

Validation monitoring determines if predictive model coefficients and assumptions are appropriate. A long-term commitment to data collection is often required to establish an adequate data base. If the standard requires utilization of no more than 50 percent of streamside herbaceous forage for example, and this fails to achieve the desire instream habitat condition, the standard would have to be modified, for less forage consumption for the riparian complex(s).

A fourth type of monitoring, sometimes referred to as "baseline monitoring," also has application to riparian monitoring. Baseline monitoring is conducted to determine long term trends, natural variability, and/or to provide a benchmark for comparison purposes. Recurring inventory of "reference complex" characteristics is an example of a common type of baseline monitoring. In this case, baseline monitoring is used to define "potential" and "natural variability" for specific riparian complexes. These "reference conditions" provide the basis of comparison for effectiveness monitoring.

Selection of physical and biological attributes for monitoring riparian conditions should be based on Forest Plan standards and guidelines, desired future conditions, state water quality standards (related to protection of beneficial uses such as salmonid spawning, cold water biota, primary and secondary contact recreation, and domestic, municipal, and agricultural water supply), and on specific project objectives for the riparian area. Methods used to monitor and evaluate these attributes should be well documented, replicable between years and observers, and result in quantitative data with known reliability (i.e., confidence intervals).

C. Methods

This section briefly describes some techniques for characterization and monitoring of riparian complexes. The methods are listed under these two objectives by functional area for organizational purposes. However, the results need to be assessed in an interdisciplinary framework to draw conclusions and make management recommendations.

In addition to the methods listed below, photographs may be used to visually represent the data being collected. Although photographs may not be used to provide quantitative data, they can be an important aid.
in information transfer and understanding. Photographs should be taken in the same locations that data are being collected. If photographs are to be used to document changes through time, the photo location should be monumented and the compass bearing of the photo documented. Photographs taken with 35mm color print film is best suited for reports and small documents. Black and white print film is best suited for publications. Some may desire to use slide film and have prints made from the slides, while others may choose to use two cameras - one for slides and one for prints.

1. Complex Characterization

   a. Aquatic Community Habitat: Some suitable techniques and recommendations for their application follow.

      (1) Calibrated Ocular Estimation (COE) Survey: The COE survey approach can be used to efficiently provide quantitative information on current aquatic conditions within a complex or over several complexes. This approach provides the means to assess complex conditions and evaluate dispersed and cumulative land use effects. Because aquatic habitat types are the basic sample unit of this approach, COE surveys generate information useful for identifying environmental features limiting fish production and developing project design criteria. See Hankin and Reeves (1989) and Appendix H for additional information.

      (2) Macroinvertebrate Survey: Macroinvertebrate community composition and relative species abundance can be effectively used to evaluate the overall health or condition of aquatic community habitat. GAWS Macroinvertebrate survey procedures and data forms are referenced in R-4 FSH 2609.23. EPA Rapid Bioassessment procedures may also be employed (Plafkin, et. al., 1989).

      (3) Instream Flow Survey: The Region's GAWS instream flow survey methodology can be used to estimate the quantity and quality of aquatic community habitat available at flow levels other than those measured at the time of survey. It may be appropriate to apply the inventory technique where activities are proposed that would deplete or supplement natural flow regimes. Survey procedures and data forms are referenced in R-4 FSH 2609.23. Where litigation related to the findings is anticipated, it is recommended that the U.S. Fish and Wildlife Service's "Instream Flow Incremental Methodology" be applied. Regardless of the methodology applied, it is important that a COE survey of the stream or stream reach be completed prior to selection of instream flow study sites.

      (4) Fish Population Survey: A variety of standard fish population survey methods may be used to inventory and monitor fish population characteristics. Fish population surveys must be coordinated with and/or performed by state fish and wildlife management agencies. Where water clarity and stream size permit, visual estimation techniques described by Hankin and Reeves are recommended. Where visual estimation is not possible, it may be necessary to employ removal-depletion or mark-recapture electrofishing techniques to estimate fish species/life stage composition and abundance. Because of wide natural fluctuations in year-class strength, a paired comparison to reference (i.e., control) will be necessary to assess fish density trends over time.

   b. Soils Data and Inventory:

   The kinds of soils and soil materials play a key and important role in the riparian area. The particle size distribution and sequences in which soil materials have been deposited during fluvial processes directly effect riparian area function. Riparian soils may be both saturated and unsaturated. During the Level III riparian evaluation, soil data is collected on depth of soil mottles, texture, color, structure, cohesiveness, stratification of parent materials, boulders and cobbles, percent of coarse fragments in the dominate soils, buried organic horizons, thickness of organic surface, ground water table and other soil parameters. The soil inventory report generally provides information on geomorphic, process, soil parent material, soil substrata, landforms, soil temperature and moisture regimes and other soil related factors in the landscape.
Soil information is analyzed and interpretative information can be provided for such key areas as:

- Surface erosion
- Stream bank stability
- Soil compaction
- Soil productivity potentials
- Soil revegetation potential
- Area extent of riparian area (based on free and unbound soil water)
- Influence on ground water movement

Orders of intensity in soil inventory are necessary to designate the detail of soil information on which management decisions will be based. Detailed soil information is needed if stream structures are to be constructed to raise the water table and stabilize the banks of a severely eroding riparian area. This would require refined distinctions among small, homogeneous areas of soil. The orders of intensity are intended to obtain only the necessary detail and no more, to answer these questions about soils. See Soil Survey Manual, Chapter 2, page 2-14, for Key for Identifying Kinds of Soil Surveys which compares the five orders of soil survey. The number of map units, their composition, and the detail of mapping vary with the complexity of the soil patterns and the specific needs of the user. Thus the soil survey intensity is matched to the needed uses and the soil-related problems of the area. The soils mapped in an inventory will be identified by names that serve as references to a national system of soil taxonomy.

1) **Order 1 Surveys**: First order surveys are made for very intensive land uses requiring very detailed information about soils, properties for generally small areas. The information can be used in planning for land drainage, construction sites, materials for streams or streambank protection, Habitat Type management prescriptions, and other management uses that require very precise site-specific knowledge of the soils and their variability.

Field procedures permit observations of soil boundaries throughout their length. The soils in each delineation are identified by transecting or traversing. Remote sensing is used as an aid in boundary delineation. Map units are mostly consociations with some complexes, and are phases of soil families, soil series, or are miscellaneous areas. Delineations have a minimum size of about 1 hectare (2.5 acres) or less, depending on the map scale, and contain a minimum amount of contrasting inclusions within the limits permitted by the kind of map unit used. Soil map base scale is generally 1:15,840 or larger.

2) **Order 2 Surveys**: Second order surveys are made for intensive land uses that require detailed information about soil resources for making predictions of suitability for use and of treatment needs. The information can be used in planning for general land disturbances, construction of roads and bridges, vegetative manipulation, or some broader Habitat Type prescriptions, and similar uses that require precise knowledge of the soils and their variability.

Field procedures permit plotting of soil boundaries by observation and by interpretation of remotely sensed data. Boundaries are verified at closely spaced intervals, and the soils in each delineation are identified by transecting or traversing. Map units are mostly consociations and complexes. Occasional undifferentiated groups or associations are also used. Components of map units may be phases of soil families. Delineations are variable in size, with a minimum of about 0.6 to 4 hectares, (1.5 to 10 acres) depending on landscape complexity and survey objectives. Contrasting inclusions vary in size and amount within the limits permitted by the kind of map unit used. Base map scale is generally 1:12,000 to 1:31,680, depending on the complexity of the soil pattern within the area.

An accompanying report describes, defines, classifies, and interprets the soils. Interpretations predict the behavior of soils under different uses and the soils' response to management.
(3) **Soil Compaction:** Compaction of soil increases soil bulk density and decreases porosity as a result of the application of mechanical forces such as weight and vibration or animal trampling. Soil compaction is determined by ocular estimating and volumetric core sampling. Compaction sampling is accomplished along the vegetative cross-section transects, with two or three samples taken for each dominant soil type where they support dominant vegetative community types. Samples are needed for both disturbed and undisturbed sites for comparison. (Reference, *Interim Guidelines For Sampling Soil Resource Conditions*, USDA Forest Service, R-6, 1981.)

Soils differ in their inherent ability to resist compaction. Important factors needing evaluation include: soil texture, soil structure, organic matter content, and rock fragment content.

(4) **Soil Puddling:** This condition occurs under wet-soil conditions when the exerting force mechanically destroys the soil structure by compression and shearing. It results in total deformation of the soil particle process. It is usually a problem in soils with a clay content greater than 35 percent or with a moisture content at or greater than field capacity (35-53 percent moisture by weight, depending upon texture.) Bearing strength of the saturated soil under compression approaches zero. The saturated soil cannot support vehicle traffic or trampling by animals or humans without sustaining damage. A puddled soil inhibits root, air and water movement. The natural restoration period is not specifically known but, field evidence indicates that it may persist somewhat less than compaction because the puddled zone is relatively thin (Moehring, 1970).

c. **Hydrology and Stream Dynamics:**

Although riparian evaluation is not intended to be the vehicle for completing Water Resource Inventory, it is often necessary to conduct a water resource investigation to provide answers to specific questions or resolve problems identified by the Level I or Level II Riparian Evaluations.

The appropriate Order of Water Resource Inventory for Level III riparian evaluations depends on the questions to be answered or project(s) being proposed. Order 2 inventory would be used to evaluate watershed level influences on the riparian complex(es) of concern. Order 1 inventory may be used for site-specific design purposes.

Water Resource Inventory for Level III riparian evaluations must ultimately identify any watershed level phenomenon that is influencing the complex(es) of concern, including watershed condition, upland hydrology, off-site erosion, water quality, landform processes, base level changes, flow regime, and management influences. The Water Resources Inventory Handbook (FSH 2509.16) should be consulted to design and execute the inventory.

In addition to the hydrologic measurements taken in the aquatic community habitat section, the following hydrologic evaluations should be considered. The issues driving the Level III riparian evaluation may require specific types of water resource investigations. These may be:

1. **Channel Maintenance Instream Flow Quantification:** (used when dewatering, stream diversions, hydropower, water rights, etc. are issues.)

2. **Floodplain (and Wetland) Delineation and Analysis:** (when facilities development, peak flows, management influence on peak flows, etc. are issues. See FSH 2509.17, Chapt. 20 for details.)

3. **Water Quality Investigations:** (see FSH 2509.16 for references concerning water data acquisition.)
(4) **Channel Morphology:** (when channel and floodplain hydraulics, aquatic habitat, etc. are issues, and monitoring is desired. Use standard channel cross-section survey procedures.)

(5) **Channel Stability:** For sediment erosion in meadow streams, see example figure 6. When evaluating forested streams, see Channel Stability Evaluation Chart (Appendix F).

For the bulk of riparian complexes evaluated at Level III, the hydrologist will further refine the information gathered in previous levels. This will include verification of the ocular stream typing from Level II using a Wolman pebble count and possibly a description of stream sub-types present in the complex. See the Interpretations and Applications Section of this Guide for how this information is used.

A number of interpretations from water resource inventory information are made by extrapolating relationships to similar watersheds. Level III riparian evaluation may be used to verify those relationships for site-specific conditions on the Forest or derive new relationships. A well designed monitoring program is required to derive these relationships.

d. **Vegetation:**

Several inventory processes are available to gather intensive vegetation information at Level III. Any or all of the following approaches may be used, depending on specific needs.

Each riparian complex is usually composed of a mix of 4 to 10 community types. A measurement of the percent each type covers within a complex (community type composition) can provide an indication of potential or ecological status. The percent of the complex covered by community types which are indicators of unnatural disturbances, such as heavy grazing and trampling or soil compaction from recreational activities, provides an indication of impact. These measurements can be used to determine if management has been suitable for achieving the predetermined desired condition on areas where desired future condition has been identified based on presence or absence of specific community types.

If there is a set kind and number of community types within a complex in "natural" condition, and if new types enter the scene when "unnatural" disturbing factors are present, we can measure the percent composition change in the types through two different line intercept processes.

(1) **Cross-Section Composition:** Several pace transects (at least five) are established perpendicular to the riparian complex in such a way as to cross the entire riparian area (Figure 2). Beginning and ending points for each transect are permanently marked with stakes that should be placed far enough back into the non-riparian area to allow subsequent measurements in case the riparian area expands. Community type composition is obtained by tallying the number of steps encountered for each type in relation to the number of total steps used in all transects. A hand held tally whacker (counter) will aid in this sampling process. Note, since different individuals have distinct step lengths each person should test themselves with a measured transect so that steps can be converted to feet. For Cross Section Composition and Cross Section Composition Summary Sheet (Level III), see Appendix A. Photographs will be taken at each of the permanent starting point cross section stakes. The photographs will depict the setting of the cross section. Optional photos can be taken at the location(s) where the cross section crosses the stream channel.
Percent composition for each community type is calculated as follows: (Assumes examiner’s step equals 2.5 feet):

Total number of feet for the Kentucky bluegrass community type

<table>
<thead>
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<th>Feet</th>
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<tr>
<td>$T_2$ 18</td>
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<tr>
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<td>45'</td>
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<td>$T_4$ 24</td>
<td>60'</td>
</tr>
<tr>
<td>$T_5$ 32</td>
<td>80'</td>
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112 280'

Total number of feet sampled in all transects

<table>
<thead>
<tr>
<th>Steps</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_1$ 40</td>
<td>100</td>
</tr>
<tr>
<td>$T_2$ 40</td>
<td>100</td>
</tr>
<tr>
<td>$T_3$ 40</td>
<td>100</td>
</tr>
<tr>
<td>$T_4$ 40</td>
<td>100</td>
</tr>
<tr>
<td>$T_5$ 40</td>
<td>100</td>
</tr>
</tbody>
</table>

---------

200 500

Composition of Kentucky bluegrass for the complex = $\frac{280}{500} = 56$ percent similarly, the composition of redtop for the complex = $\frac{30}{500} = 6$ percent (Figure 2).

Composition of all community types encountered in the complex should total 100 percent.
FIGURE 2. Use of the line intercept method to measure amount of change in community type composition after unnatural disturbances.
If the presence of Kentucky bluegrass and/or red top represents disturbance types in a complex, 62 percent of the area indicates disturbance (56 percent Kentucky bluegrass plus 6 percent red top).

The willow/beaked sedge and oatgrass community types which makeup 38 percent of the complex and are known to be natural to the area, indicate the complex is in an early-seral status.

<table>
<thead>
<tr>
<th>Natural Types</th>
<th>Ecological Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willow/beaked sedge</td>
<td>33</td>
</tr>
<tr>
<td>Oatgrass</td>
<td>5</td>
</tr>
<tr>
<td>38 percent</td>
<td></td>
</tr>
</tbody>
</table>

To determine ecological status:
- 33 = very early seral
- 16 - 40 = early seral
- 41 - 60 = mid seral
- 61 - 85 = late seral
- 85+ = PNC

(2) Green Line Vegetation Composition: Sampling community type composition along edges of live water can provide additional information over that collected by the cross-section process. Presence of permanent water in the plant rooting zone allows more rapid recovery of vegetation after disturbances. This permits a land manager to make an earlier evaluation of management geared to improve riparian condition. Also, measurement of this portion of the riparian area provides an indication of short-term trend for the riparian area. This is where the forces of water, as influenced by total watershed condition, play their most prominent role. Additionally, there is a strong relationship between amount and kind of vegetation along the water's edge and bank stability. Natural plant species in this permanently watered area have developed rooting systems which enhance bank stability. An evaluation of the vegetation in this area can thus provide a good indication of the general health of the entire watershed.

The green line is defined as that specific area where a more or less continuous cover of perennial vegetation is encountered when moving away from the perennial water source (Figure 3).

At times, the green line may be at the water's edge. Or, it may be part way back on a gravel or sandbar. The green line may be only a foot or two wide, or may be many feet wide, depending on soil and water features. Natural plant species forming the green line (e.g., beaked sedge or water sedge) are generally good buffers of water forces. Disturbance activities, such as overgrazing or trampling by animals or people, result in changes to species such as Kentucky bluegrass or red top, both of which have a reduced ability to buffer water forces.

In most riparian settings, there is a continual effort by nature to form this green line of vegetation, even where the adjacent community types are composed of the more shallow-rooted species. Well developed green line vegetation stabilizes channel banks and buffers water forces. This enhances channel stability, even for inherently unstable stream types. Therefore, an evaluation of the community type composition of the green line can provide a good indication of the general health of the riparian area.

The following procedure is used for the green line transect. The green line transect begins on the right-hand side of the stream (looking downstream) at the point where the cross section composition transect intercepts the green line (Figure 3). In settings where the stream has multiple channels, use the current most dominate channel. Sampling proceeds down the green line using a step transect approach as described in the cross-section composition measurement. Enough steps should be taken to total 363 feet lineal distance. A temporary marker is placed at the end of the transect for location of subsequent shrub measurements. The sampler then crosses the stream and repeats the sampling process for 363 feet upstream.
FIGURE 3. Location of (1) the green line in relation to the water’s edge and to sandbars and (2) location of the green line transect in relation to the cross-sectional transect.
SHRUB COUNTS
(by Age Class)

363 ft. each side (726' total)
3 ft. each side of green line = 6 ft. wide belt

1 / 10 Acre

Example

Sprouts  3
Young    21
Mature   12
Decadent 10
Dead     2

= Healthy Reproduction

FIGURE 4. Example of woody species status using a tally of individual plants, by age class, in a 6-foot wide belt along the green line. A belt transect six feet wide by 726 feet long equals one-tenth acre sampled.
NOTE: The stopping point may not coincide with the initial starting point on the other side of the stream due
to difference in lengths of meanders on each side of the stream. It is important to measure both sides of the
stream since activities (grazing pressures or water forces) may be different on each side.

On certain streams, especially those with steep gradients, the number of feet of large anchored rocks or large
logs should be tallied in place of the vegetation. Rocks and logs must be large enough to withstand the forces
of water and must appear stable in the setting being measured. The number of feet of rocks and logs would
be counted as a natural stable percentage of the green line.

The total number of feet of each community type encountered along the green line is tallied and composition
for each type computed as described in the cross section composition measurement.

\[
\text{e.g., Total feet of each type (left and right side)} = 726 \text{ feet (363 feet minimum each side)}
\]

= Community Type
Composition

An evaluation of percent of disturbance types in relation to percent of natural types (see cross-section computation) provides an indication of ecological status.

A comparison of settings where the complex is as close to PNC as possible may be used as a standard or reference to evaluate ecological status of the green line communities. Additionally, subsequent measurements of the same area will provide a measurement of trend for that complex.

A photograph can be taken at the starting point of the green line transect, looking downstream. Additional
photos may be taken along the transect if desired. These photographs should contain some reference point
or marker (boulder, large tree, etc.) so the photograph can be re-established in the future.

(3) Woody Species Regeneration: A measurement of woody species regeneration is made along the same green line transect (Figure 4). The sampler uses a 6-foot pole which has the center marked. Measurements are made by walking 363 feet on each side of the stream with the center of the pole held directly over the edge of the green line adjacent to the waterbody. Use of the green line edge as the center of the measurement helps to assure that the sampling is done in a setting where regeneration is most likely.

A modification of the above procedure may be necessary for narrow water bodies. In these settings do not
allow the left tip of the pole to extend beyond the center of the waterbody. When that would occur, align the
left tip of the pole on the waterbody (the pole is no longer centered on the green line edge. This modification
eliminates double sampling when measuring from both sides, yet insures that a full one-tenth acre area is
sampled.

All woody species rooted within the ends of the pole (3 feet either side of green line) are tallied based on the
following age class categories.

<table>
<thead>
<tr>
<th>Number of Stems</th>
<th>Age Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number stems = 1</td>
<td>- sprout</td>
</tr>
<tr>
<td>2. Number stems = 2 to 10</td>
<td>- young</td>
</tr>
<tr>
<td>3. Number stems = &gt;10, &gt;1/2 alive</td>
<td>- early, mature</td>
</tr>
<tr>
<td>4. Number stems = &gt;10, &lt;1/2 alive</td>
<td>- late, mature</td>
</tr>
<tr>
<td>5. 0 stems alive =</td>
<td>- dead or decadent</td>
</tr>
</tbody>
</table>

A tally of shrubs by age class provides a preliminary indication of regeneration of shrubs in that complex. A
high proportion of plants recorded in the sprout, young, and early mature categories would indicate the shrub
component in this complex is in an upward trend. Conversely, low numbers of plants in the sprout and young
categories would indicate current management may be suppressing woody species. A comparison of settings where the complex is in as close to PNC as possible may be used as a standard to evaluate overall shrub status. Subsequent measurements on the same area will provide a measurement of woody species regeneration trend.

For smaller stunted species such as *Salix wolfii*, change the number of stems from ten to five. And, for single stemmed species such as *Salix exigua*, *Betula* spp., and *Alnus* spp., count each stem that occurs 12 or more inches from each other as a separate plant. Place these into age classes based on overall size and health.

Not all riparian areas are well suited for growing woody species. This appears to be especially true where the complex has a low gradient and a limited amount of natural stream channel movement. In these settings, understory sedges and rushes are able to buffer the forces of water without the addition of woody species. It must be noted that most of the woody riparian species in the Intermountain Region regenerate best on settings where there is minimal competition from herbaceous species.

(4) **Nested Frequency**: See Range Analysis Handbook.

(5) **Production**: See Range Analysis Handbook.

e. **Terrestrial Habitat**:

The wildlife habitat data and vegetation data collected during the Level II evaluation should be used during Level III as a basis for developing and observing wildlife relationships to the riparian areas and adjacent upland. Observations about wildlife use patterns and presence of various wildlife species should be noted; wildlife species generally respond to vegetation and in Level III, species/habitat relationships should be established; non-game species such as songbirds should be noted.

Biologists are frequently so enthusiastic about wildlife that when presented with the opportunity to study a riparian area, they immediately begin thinking of ways to census them. Although important, highly desirable, and needed, this is probably the last step that should be taken.

Approved standardized censusing technique for fauna will be used. The wildlife/habitat relationships are developed when good wildlife data is compared with good vegetation data within a homogenous land unit. The importance of censusing in one complex can not be over emphasized. The relationship of adjacent upland vegetation should also be taken into account.

2. **Monitoring**

A primary use of Level III riparian evaluation is for monitoring changes in riparian conditions. Data are derived in a manner which permits repeated measurement over time. Remeasurements provide defensible trend data and can be used to assess whether the goals for a particular riparian area are being reached.

a. **Aquatic Community Habitat**: Some suggested monitoring applications and techniques follow.

(1) **Cumulative Effects**: Two techniques are identified as possible means to assess cumulative effects and monitor trends in aquatic community habitat over time. They may be employed separately or in concert.

   (a) **Bioassessment Survey**: Aquatic insect and fish community composition and relative species abundance can be effectively used to assess cumulative effects and trends in aquatic community habitat condition and water quality. GAWS Macroinvertebrate Survey procedures and data forms are referenced in R-4 FSH 2609.23.
(b) COE Survey: The COE survey approach of Hankin and Reeves (1989) is particularly well suited to assessing cumulative effects and monitor trends in aquatic community habitat over time. Data are collected over the entire complex (or over all the complexes in a watershed), are relational in nature and can be collected with known precision and accuracy. Select attributes that (1) are likely to be limiting production capabilities, (2) are likely to be influenced by management activities; and (3) have a "low" natural variability.

(2) Site-Specific Effects: A number of techniques may be used to assess site-specific effects and trends in aquatic community habitat over time. Among the most commonly employed technique is the GAWS Level III transect approach. General methods and data forms are referenced in Region 4 FSH 2609.23. For monitoring purposes, it is recommended that transect study sites encompass at least four stream meander cycles, and include 10 to 20 equi-distantly spaced transects. All transect locations should be "monumented" (i.e., staked and mapped).

Use of site-specific transect data to extrapolate changes in aquatic community habitat condition over larger areas such as riparian complexes or stream reaches should be done with caution. If such use is planned for the findings, it is important to complete a COE habitat survey of the entire area prior to location of the transects, to make sure that the monitoring site is representative of the larger area.

b. Soils:

Soils monitoring is conducted using soil data collected during Level II and III riparian evaluation. Soil factors commonly used are: soil puddling, changes in soil bulk density, presence of platy structure, amount of bare surface soil, extent of soil erosion, and area extent of present riparian soil as related to potential riparian area.

Implementation monitoring evaluates if soil conservation practices, reduced use, grazing management system change, or other soil enhancing practices were implemented as planned. It identifies needed changes in the Forest Plan implementation process and subjectively evaluates soil conservation practice application to determine if effectiveness monitoring is needed. The results of implementation monitoring will be documented and filed with project plans.

Effectiveness monitoring quantitatively measures how effectively soil conservation practices have limited detrimental changes in soil properties. A soil scientist who understands the relationships of soil conservation practices to various soil properties should be involved in effectiveness monitoring. Effectiveness monitoring can be designed to measure the beneficial effects of site restoration, site rest, grazing systems, reduced erosion as well as detrimental changes.

It is not possible to monitor effectiveness on all the different riparian complexes within a project area. Therefore, monitoring should be focused on the most critical soil qualities or most limiting riparian complexes within that project area. Results may then be extrapolated to other similar riparian complexes. Reliable high-quality data from a few projects is better than poor quality data from a larger number.

c. Hydrology and Stream Dynamics:

Some watershed level aspects of the riparian evaluation may not be directly monitored as part of riparian monitoring. For instance, changes in flow frequency would have to be intensively monitored over long time periods. Longitudinal channel morphology (meander amplitude and wavelength) does not lend itself to monitoring and changes may occur over long time periods.

The hydrologist should be involved in the ID Team evaluation of the implementation of management activities to see that stream and water quality protection measures are correctly applied.
(1) **Specific Water Quality Attributes**: Use EPA standard methods to monitor chemical, biochemical, and bacteriological parameters. Monitoring may be designed to define Forest-specific relationships between stream types and:

- sediment yields
- sediment transport characteristics - bedload vs. suspended sediment
- bank stability
- composition of hydric riparian species on the greenline

These monitoring designs may be data intensive and only a limited number of sites should be involved. These are considered as validation monitoring.

d. **Vegetation**: Repeated application of the techniques employed to determine vegetation characteristics for a complex (e.g., cross section composition, green line composition, and woody species regeneration surveys) provide the basis for assessing trends in vegetation condition over time.

e. **Terrestrial Habitat**: Repeated application of the techniques employed to determine vegetation characteristics for a complex provide the basis for assessing trends and management effects in terrestrial habitat condition over time.
2.13 COMMUNITY INFRASTRUCTURE AND SOCIO-ECONOMICS

Numerous significant changes have occurred in the Skyline Mines community infrastructure and socio-economic service areas since the Permittee filed its Mining and Reclamation and permit application in 1979. These changes and their effects are reflected in the balance of this renewal update report.

This report clearly illustrates that the operation of the Permittee's Skyline Mines have had no negative socio-economic impacts on the community infrastructure of the service areas of Carbon, Emery, Sanpete, and Utah counties. In fact, the report illustrates that the development and operation of the Skyline Mines has been quite beneficial and has provided support to areas involved, and that planned future growth will have no adverse effects on the four county service area.

In general, dramatic changes have taken place in the number of coal mines in operation and the resultant work force reduction. Several changes in coal mine ownership have also occurred. One coal mining operation has had several mine fires, which significantly impacted the Skyline Mines' service areas. All of these changes have impacted the general economy of the 4 county area to different degrees, and this update report will address these items in further detail.

The original survey done by the Kaiser Engineers in August 1979 addressed the capability of the communities around the Coastal Permittee's Skyline Mines being able to accommodate the needs of Utah Fuel Company employees.

Our five year operational experience has shown that the communities of Carbon, Emery, Sanpete, and Utah counties have had and do have the abilities to provide the necessary infrastructure, i.e., community services such as water, sewage systems, housing, schools, recreation, medical care, land, and commercial facilities.
2.13.1 Service Area

The Skyline Mines have a rather large service area. Conceptually the service area can be viewed as two concentric circles. The inner circle is primary to the Skyline Mines; the outer is secondary.

The primary area contains those communities that lie within a 45 minute commute, and therefore are most likely to receive the largest influx of new residents seeking employment at Skyline. The secondary service area consists of those communities requiring over 45 minutes commute time to the mine. These communities are listed on the following page by service area category.

The newly constructed Eccles Canyon road (part of SR-264) was completed with final paving by the end of the 1986 construction period. The construction of this highway has facilitated employee travel to the work area and also has provided a safe and short, year-round connecting route between Carbon, Emery, and Sanpete counties.

### PRIMARY SERVICE AREA

<table>
<thead>
<tr>
<th>Pleasant Valley</th>
<th>Sanpete Valley</th>
<th>Carbon County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scofield (8 min.)</td>
<td>Fairview (30 min.)</td>
<td>Price (50 min.)</td>
</tr>
<tr>
<td>Clear Creek (8 min.)</td>
<td>Mt. Pleasant (37 min.)</td>
<td>Helper (44 min.)</td>
</tr>
<tr>
<td></td>
<td>Spring City (44 min.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moroni (44 min.)</td>
<td></td>
</tr>
</tbody>
</table>

Revised 2-99
### SECONDARY SERVICE AREA

<table>
<thead>
<tr>
<th>Carbon County</th>
<th>Emery County</th>
<th>Sanpete County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellington</td>
<td>Cleveland</td>
<td>Ephraim</td>
</tr>
<tr>
<td>Sunnyside</td>
<td>Orangeville</td>
<td>Manti</td>
</tr>
<tr>
<td>East Carbon</td>
<td>Castle Dale</td>
<td>Gunnison</td>
</tr>
<tr>
<td>Hiawatha</td>
<td>Ferron</td>
<td>Centerfield</td>
</tr>
<tr>
<td></td>
<td>Huntington</td>
<td>Fountain Green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Milburn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterling</td>
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<tr>
<td>Juab County</td>
<td>Utah County</td>
<td>Wales</td>
</tr>
<tr>
<td>Nephi</td>
<td>Payson</td>
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</tr>
<tr>
<td></td>
<td>Spanish Fork</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Santaquin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mapleton</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Salem</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Springville</td>
<td></td>
</tr>
</tbody>
</table>

Earlier employment predictions indicated that some permanent residents from these secondary service area communities will commute to the Skyline mine for employment, but newcomers will not settle so far from the mine. Experience with other mines in the geographical area indicated that a 30 to 40 minute commute over 40 miles or less represents the maximum that miners can be expected to commute and still maintain a high degree of reliability. The Permittee’s experience at Skyline has shown that with company bussing being provided, employees will travel greater distances and remain dependable, capable and safe workers.

### 2.13.2 Growth Capability

Experience over the past five years has shown that the service area communities have had and do have more than adequate infrastructure to accommodate the relatively small growth now anticipated at the Skyline Mines. See Table 2.13-1, Growth Capability Summary.
TABLE 2.13-1

GROWTH CAPABILITY SUMMARY

<table>
<thead>
<tr>
<th>Community</th>
<th>Water</th>
<th>Sewer</th>
<th>Land For Expansion</th>
<th>Schools</th>
<th>Hospital</th>
<th>Housing</th>
<th>Commercial Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scofield</td>
<td>New</td>
<td>New</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
<td>Small</td>
<td>Minimal</td>
</tr>
<tr>
<td></td>
<td>System</td>
<td>System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairview</td>
<td>Upgraded</td>
<td>Adequate</td>
<td>Yes</td>
<td>Unused</td>
<td>None</td>
<td>Surplus</td>
<td>Partial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mt. Pleasant</td>
<td>Upgraded</td>
<td>Upgraded</td>
<td>Yes</td>
<td>Unused</td>
<td>Yes</td>
<td>Surplus</td>
<td>Full</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capacity</td>
<td></td>
<td></td>
<td>Convenience</td>
</tr>
<tr>
<td>Spring City</td>
<td>Upgraded</td>
<td>Adequate</td>
<td>Yes</td>
<td>Unused</td>
<td>None</td>
<td>Small</td>
<td>Partial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>Adequate</td>
<td>Adequate</td>
<td>Yes</td>
<td>Adequate</td>
<td>Yes</td>
<td>Significant</td>
<td>Full</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Convenience</td>
</tr>
<tr>
<td>Helper</td>
<td>Adequate</td>
<td>Adequate</td>
<td>Yes</td>
<td>Adequate</td>
<td>None</td>
<td>Significant</td>
<td>Partial</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moroni</td>
<td>Upgraded</td>
<td>Adequate</td>
<td>Yes</td>
<td>Unused</td>
<td>None</td>
<td>Surplus</td>
<td>Partial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Communities in Carbon, Emery, Sanpete and Utah counties have upgraded and are upgrading their infrastructure systems to better serve the needs of their residents. Because of anticipated growth in the late 70's and early 80's, all of the service area counties upgraded or replaced many of their outdated community infrastructure facilities. With the decline in energy demands and resultant reductions in the work force, many of the communities now find themselves with surplus service capability.

2.13.3 Labor Force

At the time the Skyline Mines were being planned and initial construction started, there was a much greater demand for employees than there is at the present time.

Employment in the coal mining service areas has declined drastically. Sanpete, Carbon and Emery counties have a current combined unemployment of 9.5%. Utah county had extensive layoffs at the U.S. Steel Geneva plant. Since the Geneva plant has resumed full operation, unemployment levels in Utah County have improved slightly.

Table 2.13-2, 1988 Work Force - Unemployment Status, indicates for the above four county area a total of 6,180 unemployed workers, or 5.0% of the total work force, available for employment.

The current distribution of manpower, Table 2.13-3, shows the manpower distribution levels and percentage employed at the Permittee's Skyline Mines by county and respective communities for the year 1988.

Tables 2.13-4, 2.13-5, 2.13-6, 2.13-7 and 2.13-8 reflect similar manpower distribution levels for the past four years, 1982 through 1986.

These tables generally reflect the uneveness of the demand for coal over the past five years that has affected the Skyline
Mines' development. Earlier predictions indicated rapid escalation of manpower levels, gradually reaching approximately 900 employees by 1991. Instead, manpower levels have increased only gradually, with intermittent reductions, primarily in the construction work force, to the current maximum of 232 employees as of December 30, 1988.

Table 2.13-9, showing projected manpower levels through the year 1991, indicates maximum employment figures to reach only 299 total employees during that five year period rather than the original projection of 900. Manpower figures probably will not increase beyond the 300 level, based on current production projections.

Table 2.13-8 also projects the percentage breakdown by county where Skyline employees will reside, based on past experience.

Kaiser Engineers review of community infrastructure and socio-economic aspects final report on the Skyline Mines projected a manning table for Pleasant Valley mines that indicated a combined total of 1,420 employees for the Skyline Mines and the neighboring Valley Camp mining operation. Table 2.13-9 reflects the actual employment numbers and manpower projections to the year 1991 for these two mining operations in the Pleasant Valley area. Projections for the years 1987 through 1991 are based on actual known projected coal demands for both mining operations and reflect as near as possible actual manpower needs in the next 5 year period.

Table 2.13-10 also indicates Valley Camp of Utah, Inc's present manpower residence locations showing a significant difference from the projections reflected in the Kaiser Engineers report of 1979.

These changes in manpower residence locations indicate workers are coming from communities that are capable of providing more and better services, and thus are even further reducing community impacts.
### TABLE 2.13-2

**1988 WORKFORCE - UNEMPLOYMENT STATUS**

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>CURRENT WORKFORCE *</th>
<th>PERCENT UNEMPLOYED</th>
<th>NO. UNEMPLOYED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBON</td>
<td>8,280</td>
<td>8.5</td>
<td>700</td>
</tr>
<tr>
<td>EMERY</td>
<td>3,550</td>
<td>9.3</td>
<td>330</td>
</tr>
<tr>
<td>SANPETE</td>
<td>6,190</td>
<td>11.1</td>
<td>690</td>
</tr>
<tr>
<td>UTAH</td>
<td>104,940</td>
<td>4.3</td>
<td>4,460</td>
</tr>
</tbody>
</table>

Total Unemployed 6,180

*Current work force is comprised of employed workers and unemployed workers available for work as of December 30, 1988.*
<table>
<thead>
<tr>
<th>UTAH COUNTY</th>
<th>PERCENT</th>
<th>SANPETE COUNTY</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapleton</td>
<td>2</td>
<td>0.86</td>
<td>Centerfield</td>
</tr>
<tr>
<td>Orem</td>
<td>5</td>
<td>2.16</td>
<td>Chester</td>
</tr>
<tr>
<td>Payson</td>
<td>7</td>
<td>3.02</td>
<td>Ephraim</td>
</tr>
<tr>
<td>Pleasant Grove</td>
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<td>Fairview</td>
</tr>
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<td>23</td>
<td>9.91</td>
<td>Manti</td>
</tr>
<tr>
<td>Springville</td>
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<td>3.88</td>
<td>Mayfield</td>
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<td>Benjamin</td>
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<td>0.43</td>
<td>Moroni</td>
</tr>
<tr>
<td>Elkridge</td>
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<td>0.43</td>
<td>Mt. Pleasant</td>
</tr>
<tr>
<td>Lindon</td>
<td>1</td>
<td>0.43</td>
<td>Spring City</td>
</tr>
<tr>
<td>Goshen</td>
<td>1</td>
<td>0.43</td>
<td>Sterling</td>
</tr>
<tr>
<td></td>
<td>62</td>
<td>26.72</td>
<td>Wales</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Indianola</td>
</tr>
</tbody>
</table>

| CARBON COUNTY      |         |                |           |         |        |
|--------------------|---------|----------------|---------|
| Helper             | 3       | 1.29           |         |         | 127    | 54.74 |
| Price              | 22      | 9.48           |         |         |        |
| Scofield           | 1       | 0.43           |         |         |        |
| Kenilworth         | 1       | 0.43           |         |         |        |
| Wellington         | 4       | 1.72           |         |         |        |
| East Carbon        | 1       | 0.43           |         |         |        |
|                   | 32      | 13.79          |         |         |        |

| EMERY COUNTY       |         |                |           |         |        |
|--------------------|---------|----------------|---------|
| Ferron             | 1       | 0.43           |         |         |        |
| Castle Dale        | 1       | 0.43           |         |         |        |
| Emery              | 1       | 0.43           |         |         |        |
| Huntington         | 1       | 0.43           |         |         |        |
|                   | 4       | 1.72           |         |         |        |

| SEVIER COUNTY      |         |                |           |         |        |
|--------------------|---------|----------------|---------|
| Aurora             | 1       | 0.43           |         |         |        |
| Glenwood           | 1       | 0.43           |         |         |        |
| Richfield          | 1       | 0.43           |         |         |        |
| Salina             | 1       | 0.43           |         |         |        |

| SALT LAKE COUNTY   |         |                |           |         |        |
|--------------------|---------|----------------|---------|
| Sandy              | 2       | 0.86           |         |         |        |
| West Jordan        | 3       | 1.29           |         |         |        |

TOTAL MANPOWER = 232
## TABLE 2.13-4

MANPOWER DISTRIBUTION - 1986

<table>
<thead>
<tr>
<th>UTAH COUNTY</th>
<th>PERCENT</th>
<th>SANPETE COUNTY</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapleton</td>
<td>2</td>
<td>1.27</td>
<td>Centerfield</td>
</tr>
<tr>
<td>Orem</td>
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<td>Chester</td>
</tr>
<tr>
<td>Payson</td>
<td>3</td>
<td>1.90</td>
<td>Ephraim</td>
</tr>
<tr>
<td>Pleasant Grove</td>
<td>1</td>
<td>0.63</td>
<td>Fairview</td>
</tr>
<tr>
<td>Provo</td>
<td>3</td>
<td>1.90</td>
<td>Fayette</td>
</tr>
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<td>Salem</td>
<td>2</td>
<td>1.27</td>
<td>Fountain Green</td>
</tr>
<tr>
<td>Santaquin</td>
<td>2</td>
<td>1.27</td>
<td>Gunnison</td>
</tr>
<tr>
<td>Spanish Fork</td>
<td>15</td>
<td>9.49</td>
<td>Manti</td>
</tr>
<tr>
<td>Springville</td>
<td>8</td>
<td>5.06</td>
<td>Mayfield</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>25.95</td>
<td>Moroni</td>
</tr>
<tr>
<td>CARBON COUNTY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helper</td>
<td>1</td>
<td>0.63</td>
<td>Mt. Pleasant</td>
</tr>
<tr>
<td>Price</td>
<td>13</td>
<td>8.23</td>
<td>Spring City</td>
</tr>
<tr>
<td>Scofield</td>
<td>1</td>
<td>0.63</td>
<td>Sterling</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>9.49</td>
<td>Wales</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>EMERY COUNTY</td>
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<tr>
<td>Ferron</td>
<td>1</td>
<td>0.63</td>
<td>Aurora</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.63</td>
<td>Glenwood</td>
</tr>
<tr>
<td>SALT LAKE COUNTY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy</td>
<td>1</td>
<td>0.63</td>
<td>Richfield</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.63</td>
<td>Salina</td>
</tr>
<tr>
<td></td>
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<td>16</td>
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<tr>
<td><strong>TOTAL MANPOWER</strong></td>
<td><strong>158</strong></td>
<td></td>
<td></td>
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</table>

* Employees presently residing in Sevier County are recent transfers from Coastal States Energy Company's Southern Utah Fuel Company mine located in Sevier County, Utah, an it is assumed they will relocate in one or more of the counties closer to the Permittee's Skyline Mines.
<table>
<thead>
<tr>
<th>Carbon County</th>
<th>Percent</th>
<th>Sanpete County</th>
<th>Percent</th>
<th>Utah County</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
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</tr>
<tr>
<td>Helper</td>
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<td>0.90</td>
<td>4</td>
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<td>Scofield</td>
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<td>0.90</td>
<td>19</td>
<td>17.12</td>
<td>Payson</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>3.60</td>
<td>Pleasant Grove</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.90</td>
<td>Provo</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>5.41</td>
<td>Salem</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.90</td>
<td>Santaquin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>5.41</td>
<td>Spanish Fork</td>
</tr>
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<td></td>
<td></td>
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<td>8.11</td>
<td>Springville</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>5</td>
<td>4.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>59</td>
<td>53.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt Lake County</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy</td>
<td>1</td>
<td>0.90</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Manpower = 111
TABLE 2.13-6
MANPOWER DISTRIBUTION - 1984

<table>
<thead>
<tr>
<th>UTAH COUNTY</th>
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</tr>
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<tbody>
<tr>
<td>American Fork</td>
<td>1.03</td>
</tr>
<tr>
<td>Mapleton</td>
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</tr>
<tr>
<td>Orem</td>
<td>3.09</td>
</tr>
<tr>
<td>Payson</td>
<td>2.06</td>
</tr>
<tr>
<td>Pleasant Grove</td>
<td>1.03</td>
</tr>
<tr>
<td>Provo</td>
<td>3.09</td>
</tr>
<tr>
<td>Salem</td>
<td>1.03</td>
</tr>
<tr>
<td>Santaquin</td>
<td>2.06</td>
</tr>
<tr>
<td>Spanish Fork</td>
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</tr>
<tr>
<td>Springville</td>
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<tr>
<td>TOTAL MANPOWER</td>
<td>36.08</td>
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<table>
<thead>
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<th>CARBON COUNTY</th>
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</thead>
<tbody>
<tr>
<td>Price</td>
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</tr>
<tr>
<td>Helper</td>
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</tr>
<tr>
<td>Wellington</td>
<td>1.03</td>
</tr>
<tr>
<td>East Carbon</td>
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</tr>
<tr>
<td>TOTAL MANPOWER</td>
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</table>

<table>
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</tr>
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<tbody>
<tr>
<td>Chester</td>
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</tr>
<tr>
<td>Ephraim</td>
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<tr>
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<td>Fountain Green</td>
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<td>Manti</td>
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</tr>
<tr>
<td>Mayfield</td>
<td>1.03</td>
</tr>
<tr>
<td>Moroni</td>
<td>5.15</td>
</tr>
<tr>
<td>Mt. Pleasant</td>
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</tr>
<tr>
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<td>5.15</td>
</tr>
<tr>
<td>Wales</td>
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<tr>
<td>TOTAL MANPOWER</td>
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2-145
### TABLE 2.13-7
MANPOWER DISTRIBUTION - 1983

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<tr>
<td>Payson</td>
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<tr>
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<td>12</td>
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<tr>
<td>Springville</td>
<td>7</td>
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<table>
<thead>
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<tbody>
<tr>
<td>Price</td>
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</tr>
<tr>
<td>Helper</td>
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</tr>
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</table>

<table>
<thead>
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<th>Sanpete County</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chester</td>
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</tr>
<tr>
<td>Ephraim</td>
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</tr>
<tr>
<td>Fairview</td>
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<tr>
<td>Fountain Green</td>
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</tr>
<tr>
<td>Manti</td>
<td>6</td>
</tr>
<tr>
<td>Mayfield</td>
<td>1</td>
</tr>
<tr>
<td>Moroni</td>
<td>6</td>
</tr>
<tr>
<td>Mt. Pleasant</td>
<td>8</td>
</tr>
<tr>
<td>Spring City</td>
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</table>

**TOTAL MANPOWER**

54 | 56.25 | = 96
TABLE 2.13-8
MANPOWER DISTRIBUTION - 1982

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<td>Lehi</td>
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<tr>
<td>Mapleton</td>
<td>1.74</td>
</tr>
<tr>
<td>Orem</td>
<td>1.74</td>
</tr>
<tr>
<td>Payson</td>
<td>1.74</td>
</tr>
<tr>
<td>Pleasant Grove</td>
<td>2.61</td>
</tr>
<tr>
<td>Provo</td>
<td>4.35</td>
</tr>
<tr>
<td>Salem</td>
<td>0.87</td>
</tr>
<tr>
<td>Santaquin</td>
<td>0.87</td>
</tr>
<tr>
<td>Spanish Fork</td>
<td>13.04</td>
</tr>
<tr>
<td>Springville</td>
<td>8.70</td>
</tr>
<tr>
<td></td>
<td>36.52</td>
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<table>
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</thead>
<tbody>
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<td>Price</td>
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<tr>
<td>Helper</td>
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<tr>
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<tr>
<td></td>
<td>10.43</td>
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</table>

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Chester</td>
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</tr>
<tr>
<td>Ephraim</td>
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</tr>
<tr>
<td>Fairview</td>
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<td>Fountain Green</td>
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<td>Manti</td>
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</tr>
<tr>
<td>Mayfield</td>
<td>0.87</td>
</tr>
<tr>
<td>Moroni</td>
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</tr>
<tr>
<td>Mt. Pleasant</td>
<td>8.70</td>
</tr>
<tr>
<td>Spring City</td>
<td>4.35</td>
</tr>
<tr>
<td></td>
<td>53.04</td>
</tr>
<tr>
<td>TOTAL MANPOWER</td>
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</tr>
</tbody>
</table>


### TABLE 2.13-9
**PROJECTED MANPOWER LEVELS**
1989 THROUGH 1991

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</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>253</td>
<td>299</td>
<td>337</td>
</tr>
</tbody>
</table>

**PROJECTED MANPOWER RESIDENTIAL PATTERNS BY COUNTY** *

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<thead>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>46</td>
<td>54</td>
<td>61</td>
</tr>
<tr>
<td>Utah</td>
<td>71</td>
<td>84</td>
<td>95</td>
</tr>
<tr>
<td>Sanpete</td>
<td>134</td>
<td>158</td>
<td>178</td>
</tr>
<tr>
<td>Other</td>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>TOTALS</td>
<td>253</td>
<td>299</td>
<td>337</td>
</tr>
</tbody>
</table>

* Projections based on previous employee history
Early projections of coal mine development in the Carbon/Emery area have proven to be incorrect and far in excess of actual existing conditions.

Table 2.13-11, which compares the projected mines to open on Federal land prior to 1985 to the current status, clearly illustrates that projections for a "booming" coal industry in the area were overly optimistic. Seven mines were projected to be operational with a combined annual production of 13.1 million tons, and total employment of 3,348 employees. Only three of the seven mines are in operation, producing only 3.70 MTPY and employing only 378 people of the projected 3,348, 2,970 less than projected.

It should also be noted that Table 2.13-10 did not contain the names of three other potential coal mine operations in the Pleasant Valley area. They were Blazon Mining Company, Aletha Mining Company, and UCO Mining Company. Blazon Mining Company did go into production for a brief period of time and then permanently closed their mine. Neither Aletha Mining Company nor UCO Mining Company went beyond the planning stages before reduced coal demand cancelled their project.

During the five year period from 1981-1985, 21 mining companies were classified as operating or potential operating mining companies. Of those 21 operating, eight are now shut down, two never became viable operations, three shut down during 1982-1983-1984, one is operating but facing a closure order, and UP&L's Wilberg (Emery) mine is closed due to a mine fire.

This summary clearly illustrates the instability and excess available work force of the Utah coal mining industry during the past five years, and further supports the premise that the Permittee's Skyline Mines' limited manpower needs have not negatively impacted, but perhaps have benefited, the service areas of Carbon, Emery, Sanpete and Utah Counties.
TABLE 2.13-10

MANNING TABLE FOR PLEASANT VALLEY MINES

<table>
<thead>
<tr>
<th>Mine</th>
<th>Year</th>
<th>82</th>
<th>83</th>
<th>84</th>
<th>85</th>
<th>86</th>
<th>87</th>
<th>88</th>
<th>89</th>
<th>90</th>
<th>91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utah Fuel Company</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees</td>
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<td></td>
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<td></td>
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<td>158</td>
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<td>280</td>
<td>330</td>
<td>330</td>
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<tr>
<td>Valley Camp of Utah Inc</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>181</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
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<tr>
<td>TOTAL</td>
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<td>278</td>
<td>276</td>
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<td>395</td>
<td>445</td>
<td>495</td>
<td>495</td>
<td>495</td>
</tr>
</tbody>
</table>

The management at Valley Camp of Utah, Inc. reports that the present residence locations have changed from 1979 to the present as follows:

<table>
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<tr>
<th>Communities</th>
<th>1979</th>
<th>1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Scofield</td>
<td>30%</td>
<td>13%</td>
</tr>
<tr>
<td>From Price/Helper</td>
<td>50%</td>
<td>37%</td>
</tr>
<tr>
<td>From Sanpete Valley</td>
<td>20%</td>
<td>28%</td>
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<td>From Utah County</td>
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<td>MINE NAME OPERATOR LOCATION</td>
<td>PROJECTED M.T.P.Y (1990 est.)</td>
<td>CURRENT LOCATION</td>
</tr>
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<td>-----------------------------</td>
<td>-------------------------------</td>
<td>----------------</td>
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<tr>
<td>&quot;B&quot; CANYON U.S. STEEL Near Sunnyside</td>
<td>1.0 Undeveloped</td>
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<td>FISH CREEK &amp; DUGOUT CANYON P G and E Near Wellington</td>
<td>3.2 Undeveloped</td>
<td>896</td>
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<tr>
<td>DEADMAN'S MINE AMCA RESOURCE 10 miles east of Kenilworth</td>
<td>1.0 Operating .65</td>
<td>280</td>
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<tr>
<td>SKYLINE MINES COASTAL STATES Near Scofield</td>
<td>4.0 Operating 1.75</td>
<td>800</td>
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<tr>
<td>BELINA #2 &amp; O'CONNOR VALLEY CAMP Near Scofield</td>
<td>2.4 Belina #2 on standby .75</td>
<td>672</td>
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<tr>
<td>MINE #1 MT. STATES RESOURCES 20 miles south of Emery</td>
<td>.5 Undeveloped</td>
<td>140</td>
</tr>
<tr>
<td>SKUMPAH CANYON ENERGY RESOURCES GROUP 20 miles east of Emery</td>
<td>1.0 Undeveloped</td>
<td>280</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>13.1</strong></td>
<td><strong>2.20</strong></td>
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* 2,970 fewer employees than predicted earlier
<table>
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<td>Aletha</td>
<td>1</td>
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<td>0</td>
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<tr>
<td>Beaver Creek</td>
<td>325</td>
<td>180</td>
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<tr>
<td>Blackhawk</td>
<td></td>
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<td>30</td>
<td>30</td>
<td></td>
<td>Shut Down</td>
</tr>
<tr>
<td>Blazon</td>
<td>37</td>
<td>37</td>
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<td>0</td>
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<td>Canberra</td>
<td>15</td>
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</tr>
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<td>Coastal States SUFCo</td>
<td>317</td>
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<tr>
<td>Utah Fuel Co. Skyline Coop</td>
<td>126</td>
<td>86</td>
<td>86</td>
<td>98</td>
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<tr>
<td>Consolidation</td>
<td>231</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>111</td>
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<tr>
<td>Emery</td>
<td>1740</td>
<td>1010</td>
<td>1050</td>
<td>760</td>
<td>869</td>
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<td>Genwall</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>24</td>
<td>24</td>
<td>Operating, but under closure Order</td>
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<tr>
<td>Kaiser</td>
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<td>96</td>
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<td>Plateau</td>
<td>380</td>
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<td>238</td>
<td>222</td>
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<td>Price River</td>
<td>560</td>
<td>169</td>
<td>165</td>
<td>145</td>
<td>50</td>
<td>Shut down</td>
</tr>
<tr>
<td>(Castle Gate)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soldier Creek</td>
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<td>88</td>
<td>90</td>
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<td>Operating</td>
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<td>Sunedco</td>
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<td>1</td>
<td>1</td>
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<td>Tower</td>
<td>73</td>
<td>23</td>
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<td>30</td>
<td>30</td>
<td>Operating</td>
</tr>
<tr>
<td>(Andelex)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train Mountain</td>
<td>60</td>
<td>25</td>
<td>25</td>
<td>37</td>
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<td>Operating</td>
</tr>
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<td>UCO/Std. Metals</td>
<td>7</td>
<td>7</td>
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<td>0</td>
<td>0</td>
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<td>U S Fuel</td>
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<td>400</td>
<td>285</td>
<td>291</td>
<td>228</td>
<td>Shut down</td>
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<td>U S Steel</td>
<td>166</td>
<td>11</td>
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<td>0</td>
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<td>(Utah)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>5228</td>
<td>2937</td>
<td>2651</td>
<td>2477</td>
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2.13-4 Suggested Action Items

Original recommended action items as identified in the study have been performed by the Permittee and Utah Fuel Company management personnel as follows:

**Scofield and the Pleasant Valley Area**

- Encourage the two (and possibly more) mining companies in Pleasant Valley to begin working on agreements to cooperate with each other and assist the local officials in solving existing problems.

- Hold an information exchange meeting with Scofield residents.

- Make a thorough investigation of the Utah Special Service District, which could provide many of the necessary community services to the mining companies and communities.

- Implement one of several housing assistance measures.

**Response:**

The Permittee and Valley Camp of Utah, Inc., being the owners of the two operating coal mines in the area, have cooperatively worked together and finalized agreements on land leases and land exchanges. Cooperative agreements have been formulated to jointly participate in the construction of the Eccles Canyon highway and also jointly share, under an agreement with each other and UDOT, snow removal maintenance costs on the highway. The road agreements have been especially beneficial to local residents in providing them with year round safe travel between SR96 and SR31. This well maintained highway (SR-264) provides year round access to local and state residents for summer and winter recreational and business activities.
Both the Permittee and Valley Camp of Utah officials have cooperatively worked closely during the past five years with Scofield-Pleasant Valley residents and elected officials in the following manner:

- Regularly attended Scofield Town Council meetings

- Are represented and regularly attend monthly meetings of the Pleasant Valley Committee (PVC). The PVC is composed of all representative users and city, county, state, and federal agencies in the Pleasant Valley area.

- Are or have finalized participating contracts with the Town of Scofield to participate in the newly proposed Scofield sewer project

- Have worked closely with the PVC and the Department of Wildlife resources in local stream improvements, by providing materials, labor, equipment, and technical expertise. Utah Fuel Company received a commendation from the American Fisheries Society for their extensive services rendered toward stream improvements resulting in significant fish migration and propagation.

The Permittee and Utah Fuel Company have participated in Scofield Town's Annual Pleasant Valley Days celebration with floats and other types of support.

Utah Fuel Company has assisted Scofield Town by grading and paving certain streets to eliminate dust, and also have constructed and installed permanent fence gates, enabling Scofield to control traffic to their sanitary land fill.

The Permittee has been actively involved throughout the entire planning stage of the Scofield sewer project, and actively assisted Scofield's representatives in receiving favorable consideration and grant approvals from the Utah State Community Impact Board.
There appears to be adequate housing available in the Pleasant Valley area, since there are several homes and property for sale, so there has been no reason to pursue the recommended housing assistance measure.

Until just recently, the Scofield Town Council has maintained a building moratorium on new home construction in the community.

**The Sanpete Valley Communities**

- Hold an information meeting in Fairview or Mt. Pleasant to inform local officials of the mining program and establish communication points.

- Monitor the housing situation in Fairview, Mt. Pleasant, and perhaps Spring City; and develop a dialogue with housing developers.

- Monitor school construction in North Sanpete School District. Provide updated employment information from time to time.

- Monitor hospital needs in the Sanpete Valley. Coordinate the mine manning schedule with local plans for a new hospital.

- Monitor water requirements, especially in Fairview.

- Request a copy of the tabulation of the Fairview resident survey.

Response:

Permittee's management officials have held several informational meetings with the local elected officials, including State Legislators, Mayors and County Commissioners of Sanpete county to keep them apprised of progress and plan changes occurring at the
Skyline Mines. Contact with the identified community leaders has been on-going throughout the Skyline Mines' progress by the Permittee's Governmental Affairs Director.

As elected officials are replaced, contact is made after each election, where changes take place, to ensure good lines of communication are maintained.

Initial contacts were made with housing developers in the Fairview and Mt. Pleasant areas, but projected housing shortages in Sanpete county communities never materialized.

Several meetings were held with both North and South Sanpete School District Superintendents to keep them updated on the Permittee's development progress. New larger school buildings have been constructed for the elementary, middle and high school grade levels; and educational facilities are more than adequate to meet educational needs for the foreseeable future.

As realistic manning schedules for the Permittee's Skyline Mines began to solidify, it became apparent that the mine's future hospital needs would not impact the Sanpete Valley Hospital in Mt. Pleasant. Hospital officials were apprised of the Applicant's manning schedules as construction and mine development progressed. A new hospital was constructed in Mt. Pleasant in May of 1984 with a 20 bed capacity, and is administered under the Intermountain Health Care directorship.

The Permittee discussed, with Sanpete County and community leaders in a community meeting, the status of their various water systems and community needs. Special attention was given to Fairview community's water situation.

Fairview, during Skyline mine development, has upgraded their water system significantly through funding from the State Community Impact Board. These community assistance grants and loans have enabled Fairview and other Sanpete communities to
install new feeder and water distribution lines, and also enabled Fairview to drill a deep well to augment their canyon spring water supply. Fairview now has a state approved culinary water system.

A copy of the Fairview resident survey tabulation was procured and evaluated by the Permittee.

Carbon/Emery Area

- Hold an information meeting in Price to inform local officials of progress and to establish communication points.
- Monitor essentials such as housing, water, sewage system, and capacity of new hospital.

Response:

Permittee held an informational meeting in the Price area in 1980 and 1981 with local, county, and state elected officials, who were updated as to the progress of the Skyline Mines construction and development phases.

Communication points were established as follows: Senator Omar Bunnell and Representative Mike Dmitrich from the State Legislature; James Simone, Chairman of the Carbon County Commission; and Mayors Walter Axelgard of Price and Charles Ghirardelli of Helper.

A similar informational meeting was held in Emery county, and local and county elected officials were updated on Skyline Mines' construction and development phases.

It was agreed that future contact people would be Mayor Drew Richards of Huntington City and the Emery County Commissioners: Gardell Snow, Chairman, of Ferron; Glen E. Jones, Huntington; and Rue P. Ware, Orangeville.
Permittee met at regular intervals with County Planning and Zoning officials and Price River Water Improvement District officials to apprise them of Skyline Mines' progress, and also to keep abreast of housing, water, and sewer developments.

Contacts were initially made with John Harris, Carbon Hospital Administrator, and also Don Larsen, Castle View Hospital Administrator. Mr. Larsen indicated that the new hospital has an 88 bed capacity - an increase of 18 beds over the old facility. The new hospital also has significant state-of-the-art technology and specialized medical services that were not offered in the old hospital.

2.13.5 Comprehensive Study Program

The Permittee conducted a comprehensive study of the social, economic, and community impacts associated with the development of the Skyline Mines. W. Robert Richards, Housing and Community consultant, 2210 Arcadia Place, Masting, California 94553, was contracted to conduct the study to assess the current and future impacts on the four county service area communities.

Mr. Richards did an in-depth analysis of the construction and mining work force, the residential patterns, the community infrastructure associated with the identified work force, housing, transportation, and recreation impacts of the Skyline Mines. His conclusions were that in the stages of construction and early mine development there would be no significant impacts on the area's work force, housing, and recreation due to the limited numbers and wide dispersion of employees. Subsequent studies have, of course, reflected this same finding, since employee numbers at Skyline Mines have remained far below predicted manpower levels and community infrastructure facilities have been significantly improved.

The Permittee hand carried copies of the comprehensive study and reviewed same with the County Commissions from Carbon, Emery,
Sanpete, and Utah Counties; the Mayors of the major municipalities in the effected counties; the Southeast Utah Association of Government officials; members of the State Legislature representing the four county service areas, and the regulatory authorities, DOGM and OSM. Recipients were encouraged to refer any questions to the Permittee and any comments to the regulatory agencies for appropriate follow-up.

Housing and company bussing were identified as possible mitigation measures, depending on projected growth scenarios for the service area.

Housing

Housing was felt to be adequate for the next two years (through 1983) if the current manpower demands remained constant and anticipated large power projects such as the Emery Gasification plant or Carbon-Emery power plants did not start construction.

None of these projected plants have materialized, and manpower demands have not remained constant; in fact they have declined significantly, (see Table 2.13-11, Manpower Needs Comparison - 1981-1985) creating a vast reservoir of unemployed workers to draw upon. In fact, Carbon, Emery, and Sanpete counties are classified as depressed areas.

The Intermountain Power Project (IPP) started initial construction on its number 1 & 2 plants in October of 1981, and announced in 1982 that proposed plants 3 & 4 were being cancelled. About that same time, Utah Power and Light cancelled its Number 4 Hunter plant. Fortunately for Carbon, Emery, Sanpete, and Utah counties, the IPP project did proceed with construction, since its coal contracts with the Permittee has enabled the Skyline Mines to continue development and increase operations.
The Intermountain Power Project is obtaining or will obtain coal from the following coal mines: Andelax (formerly Tower Resources), Plateau Mining Company, U.S. Fuel, the Skyline Mines, and Southern Utah Fuel Company. Without IPP as a customer, it is questionable whether all of the above mines would be viable operations, at least at the production levels now anticipated.

Bussing

Initially, the Permittee committed to providing free bus transportation service to the Skyline mine employees, and has, under its personal ownership, provided busses from Carbon, Sanpete, and Utah Counties. However, in 1999 the permittee determined the high cost of bussing, the continued depressed coal market, and declining numbers of employees made bussing economically impracticable.

The Permittee has made and continues to make conscientious efforts to participate in organized, multi-municipal, county and regional efforts to keep such entities informed as to Skyline Mines' activities, and address community or county concerns relative to our Skyline mining operations. The Permittee has finalized a contract with the Scofield Town officials to assist the community by participating in their proposed Scofield-Pleasant Valley sewer project. Scofield Town has formed a Pleasant Valley Sewer Advisory Board and the Permittee has a representative on that Board to provide technical expertise and make recommendations to the Board and the Scofield Town Council regarding the sewer system operation.

Revised 2-99

INCORPORATED
EFFECTIVE: MAR 09 1999
2-160
UTAH DIVISION OIL, GAS AND MINING
2.14 PRIME FARMLAND INVESTIGATION

A pre-application investigation was conducted by the Permittee to determine if any prime farmland would be impacted within the area of the proposed surface facilities in Eccles Canyon, and within Woods and Winter Quarters Canyons of the North Lease Tract. Based on the criteria in 30 CFR 783.27 paragraph (b), items 1 and 5, the Eccles Canyon area cannot be classified as prime farmland. This opinion is substantiated by Dr. Therom B. Hutchings, State Soil Scientist for the Soil Conservation Service (See Exhibit A).

A similar finding was made by the Natural Resources Conservation Service for the North Lease Tract (See Appendix Volume A-2). As shown in the Exhibit, no prime farmland or farmland of statewide importance occurs on the recently acquired North Lease. Therefore, a negative determination for prime farmland classification of the Skyline project area is requested.

Leland Sassor of the Natural Resource Conservation Service (NRCS) was contacted in December 2008 concerning a Prime Farmland Determination in the location of the proposed Winter Quarters Ventilation Facility. Provided the information, he researched the area and confirmed (verbally) later that no Prime Farmland is identified in the area of the pad location. This is consistent with earlier determinations.

Joe Dyer of the NRCS was contacted in 2012 concerning a Prime Farmland Determination in the North Lease Modification expansion area. He determined no Prime Farmland exists in the lease expansion area (See Appendix Volume A-2 for his correspondence).

Joe Dyer was contacted again in 2014 for a Prime Farmland Determination for the Swens Canyon Ventilation Facility. A ‘No Prime or unique farm lands’ determination is included in Appendix Volume A-2, Volume 2 for both Swens Canyon and the Flat Canyon Lease area in the form of an email correspondence.
August 29, 1979

Keith W. Welch
Environmental Coordinator
Coastal States Energy Company
1354 East 3300 South, Suite 303
Salt Lake City, UT 84106

Dear Mr. Welch:

Field evaluation of the area outlined on your map in Eccles Canyon shows no prime farmland in that area.

Criteria for determination of prime rangeland have not been developed and agreed upon between agencies. We can not, therefore, evaluate prime rangeland.

I am returning your map.

Sincerely,

T. B. Hutchings
State Soil Scientist

Enclosure

cc:
Ed Burton, AC, Orem
Gary Moreau, DC, Price