PRO/007/030
Blue Blaze

Pages Replaced 1/22/92

Section 6

GEOLOGY

6.0 Scope

Geologic information for the Blue Blaze No. 1 and No. 2 Mine areas have been assembled to address requirements set forth in UMC 783.13 and 783.14.

6.1 Methodology

Geologic data from Beaver Creek Coal Co. including Drill Logs have been updated with more recent drilling and mining information. In addition, more recent published and in-house reports have been reviewed.

6.2 Regional Geologic Framework

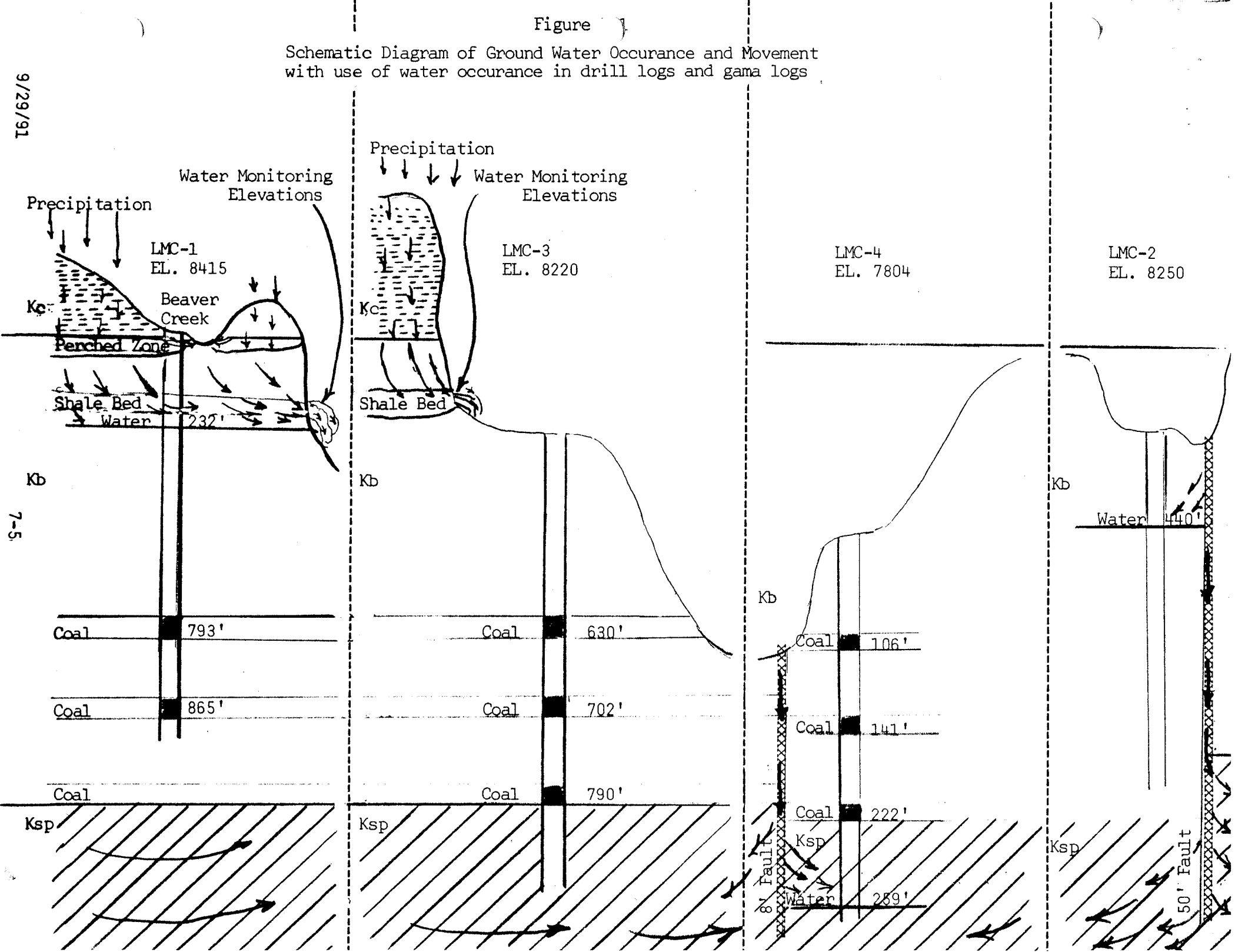
The Blue Blaze No. 1 and No. 2 Mines are located within the northern portion of the Wasatch Plateau (Figure 6-1). The Wasatch Plateau is the northwestern outlier of the eroded San Rafael Swell. The plateau dips westward producing a great monoclinal fold that is interrupted by faults in the borderlands of the Great Basin. Superimposed over the region are numerous structural features including anticlines, synclines, faults and igneous intrusions.

The Wasatch Plateau is comprised of Tertiary Cretaceous sedimentary rocks. These rocks are principally siliclastic of both continental and marine origin. Coal seams of economic significance occur in the Cretaceous sediment (Table 6-1). The igneous intrusions are Tertiary lamprophyres.

The Upper Cretaceous Rocks of the Wasatch Plateau were deposited along the western margin of the Western Interior Basin. The dynamic depositional sequence of the Mesaverde Group is the result of deltaic sedimentation. During the Upper Cretaceous, the area now occupied by the Wasatch Plateau was a trough, gradually subsiding, attracting drainage and receiving terrigenous clastics from the tectonically active Sevier highlands (Figure 6-1). Wave-dominated delta complexes prograded easterly into this epicontinental sea. The Sevier organic belt was tectonically active during the entire Cretaceous Period. Near the end of the Cretaceous Period, rocks that were deposited in the marginal marine environments were deformed as the result of the Laramide Orogeny.

Figure

Schematic Diagram of Ground Water Occurance and Movement
with use of water occurance in drill logs and gama logs



9/29/91

7-5

INPUT SPECIFICATIONS FOR RECLAMATION SEDIMENTATION POND

The runoff of the complete watershed area will be directed directly to the sedimentation pond until two years after the last augmented seeding and will be maintained until the removal is authorized by the Division.

	North Fork Area	Above Mine Area	Area A	Area B	Area C
Area - acres	346	140	3.88	9.88	2.24
Curve number	55.95	58.17	48	48	73
Slope length (ft.)	4725	3600	850	1050	400
Slope (%)	20	.31	.38	.53	.53
Time of concentration (hrs.)	.7866	.4806	.1770	.1775	.043
100-yr. 6-hr. Precipitation Results					
Precipitation (in.)	1.8	1.8	1.8	1.8	1.8
Peak discharge (cfs.)	1.80	1.16	0.0	0.0	.43
Total runoff (ac.ft.)	.63	.47	0	0	.06

	Area D	Area E	Area F	Area G
Area - acres	4.73	7.58	15.14	10.3
Curve number	48	48	48	80
Slope length (ft.)	500	650	500	1860
Slope (%)	.32	.37	.60	.65
Time of concentration (hrs.)	.1261	.0193	.2913	.3552
100-yr. 6-hr. Precipitation Results				
Precipitation (in.)	1.8	1.8	1.8	1.8
Peak discharge (cfs.)	0	0	0	2.86
Total runoff (ac.ft.)	0	0	0	0

Total runoff directed to the sedimentation pond during the reclamation period will be 1.16 acre feet. The sedimentation pond is sized to handle 2.38 acre feet to the bottom of the spillway.

Broad Crested Weir Formula is used for the spillway configuration during reclamation. ($Q = 3.087 \times B \times H^{1.5}$)

CFS calculations are taken from this table considering all areas will drain directly to the Sedimentation Pond.

The spillway will have 2:1 slopes, 10 ft. wide, and 1 ft. high.

Q = 6.25 cfs
B = 10 ft.
H = .3448 ft.

$5.81 = 3.087 \times 10 \times .3448$

Height of water level in the spillway = .3448 in.
Freeboard for the spillway during reclamation = .6552 in.

determined using the curve number procedure. The 100-yr, 24-hr rainfall was obtained from NOAA (1973) "Precipitation Frequency Atlas of the Western United States". The rainfall obtained for this type of storm is 2.6 inches.

Those storage requirements are designated on the Depth Capacity Table for the Sedimentation Pond provided in Table 7-6. Total capacity below the invert of the spillway is 2.38 acre-feet.

The spillway for the insized sedementation pond is designed to safely pass the runoff from a 25-yr. 6-hr. peak precipitation event. A cross section drawing of the overflow for the pond is provided in Plate 7-6 and Figure 7-5. The spillway will have a depth of 1 ft. and a width of 10 ft. with a slope of 3% for a length of 10 ft. The discharge capability using the Broad Crested Weir Formula for this structure is 30.87 cfs. This structure will contain angular rip rap grouted with cement from the exit of the pond to where it intersects the main drainage below the disturbed area at diversion ditch U-5.

Broad Crested Weir Formula is used for the spillway configuration. ($Q = 3.087 \times B \times H^{1.5}$)

CFS. calculations taken from Table 7-5 (Area G) 25-yr. 6-hr Precipitation Results.

Q = 5.81 cfs.
B = 10 ft.
H = .32845 ft.

$5.81 = 3.087 \times 10 \times .32845$

Height of water level in the spillway = .32845 ft.
Freeboard of the spillway during operations = 0.67155 ft.

The angle of enterence into the stream will be 25% slope with 1.5 inch rip rap cemented into place so no erosion can take place will be used in this design.

Inlet rip rap will be on a 50% slope and will also be of 1.5 inch rip rap cemented into place so no erosion to the impoundment will occur.

The impound will have a pipe decant that has a locking valve at the end of the pipe at the outlet. This valve will used to drain the excess water from the sedimentation pond 24 hours after any storm to allow settleing of the sediment from the impound. The decant will be 24 inches above the 60% sediment clean out level. See decant design on Plate 7-6

The use of a Sediment Marker will be placed at the edge of the pond which will indicate when cleaning of the pond is necessay. See Figure 7-6

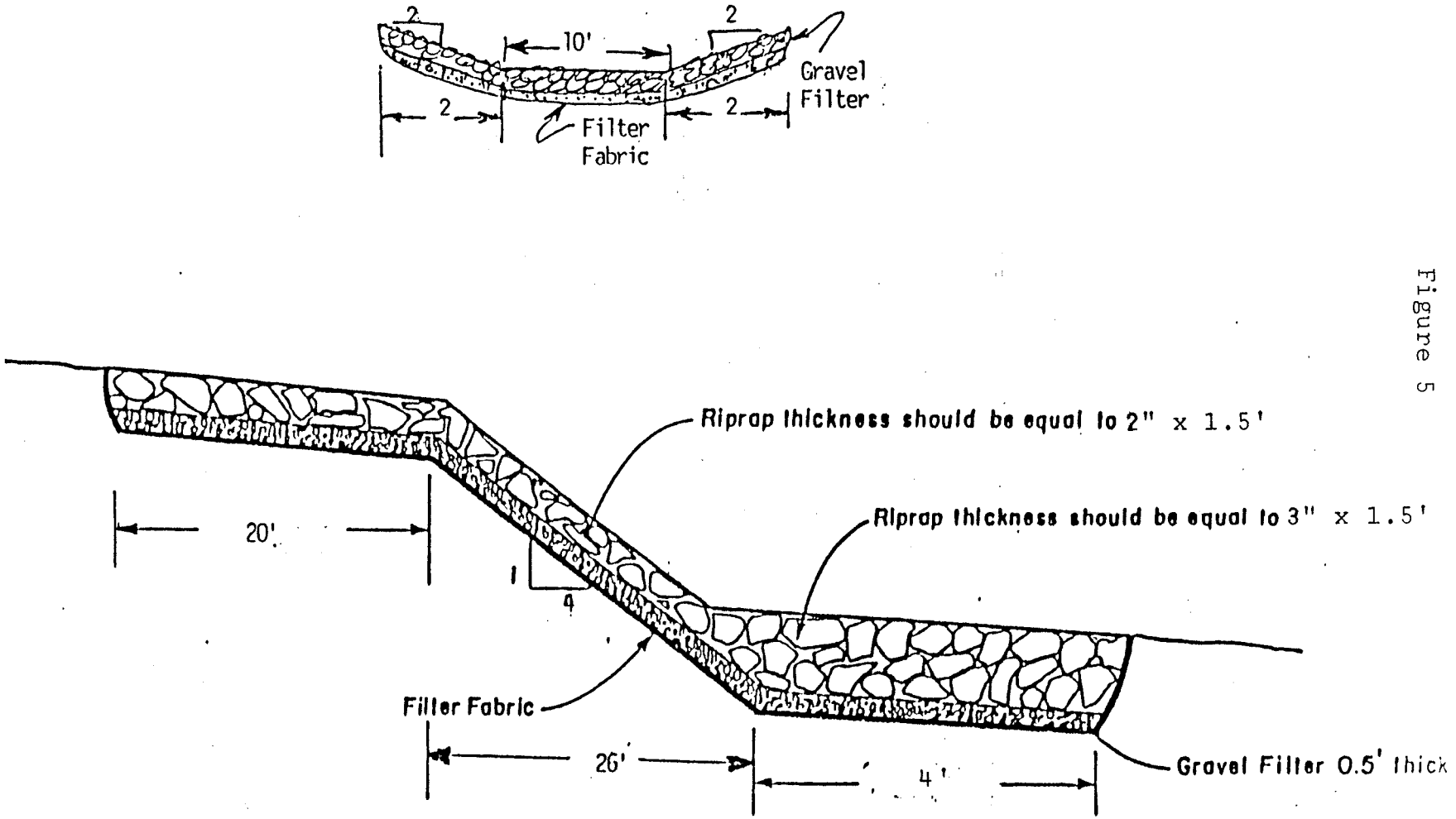


Figure 5

Figure 7-5 design of riprap drop structures.

intermittent and ephemeral streams that have a potential to be affected by mine discharge and surface disturbance. Two additional sampleing points were set in on the Beaver Creek in July 1991 by the Division. These sample points are No. 7 and No. 8.

In addition, after installation of sedementation ponds, discharge from the NPDES monitoring point, No. 3 will be sampled monthly for flow, pH, TDS, TSS, Iron, Manganese, Oil and Grease, according to NPDES monitoring requirements.

A discussion of surface water monitoring locations, type, frequency and flow device may be found on attached table. A map of the monitoring locations is provided on Plate 7-1. Sample points 2-3-W and 2-4-W are continuous stream gaging stations located on Beaver Creek at upstream points for Beaver Creek Coal Co. The gauges are operated through the flow season from about May through November. The stream and stilling wells are frozen throughout the winter. The gauges are serviced monthly at which time the water is analyzed in the field for pH, temperature and specific conductance.

The monitoring of stream flow and spring flows in the Beaver Creek Drainage provides information to assess possible effects of mining subsidence on the hydrologic balance of Beaver Creek and contributing springs.

7.2.7 Alluvial Valley Floor Assessment

A reconnaissance investigation for Alluvial Valley Floor (AVF) assessment was performed in accordance with State and OSM Regulations. On the basis of these regulations, the first consideration in the AVF investigation is the identification of unconsolidated stream-laid deposits (alluvial deposits). Furthermore, these deposits should be located within the valley floor and should not include isolated high terraces, alluvial fans, or landslide deposits. Once alluvial valley floor deposits are identified, then the capability to support flood irrigated or subirrigated agricultural activities must be assessed. Identification of locations were unconsolidated stream-laid deposits occur was performed using a suficial geology map of this area. Furthermore, an analysis of aerial photographs of the mine permit site and adjacent areas was conducted in order to identify possible alluvial deposits that were not included in the suficial geology map. A break in valley side slopes producing an identifiable valley floor served as the primary criteria for selecting these possible alluvial deposits. Aerial photo analyses revealed two small locations along Beaver Creek where possible alluvial deposits exist.

From a geomorphic standpoint, the rugged mountainous terrain of the permit site has resulted in drainages still in a youthful stage of development. The streams are confined in narrow, steep-sided, V-shaped valleys with generally steep channel gradients. Meanders normally associated with AVF development are absent except in a few isolated locations along Beaver Creek. The site along Beaver Creek that was designated as possible alluvium in the aerial photograph analysis exhibits stream meandering and numerous beaver ponds. A field visit to the site confirmed the photo analysis. Soils in the valley were still flooded or water logged. The other site designated as possible alluvium is on a tributary to Beaver Creek in the southwest corner of Section 7, T13S, R8E. This small deposit occurs at the mouth of the tributary and probably consists of alluvial and debris flow materials. The site was partically flooded and the soils were water logged during a field visit to the site.

The valley floor along Beaver Creek and its tributary in Section 7 would be incapable of supporting agricultural activities without proper drainage. Even with adequate drainage, agricultural development would be restricted to grasses and pasture because of the high elevations and short growing seasons. Possible alluvial deposits were also identifleed at the mouth of Bryner Canyon and

continuing downstream along the Gordon Creek. The alluvial deposits at this location are below the coal outcrop and thus, could not be directly impacted by mine subsidence. The soils investigation showed the upper reaches of this alluvial deposit to be disturbed and consisting of about 90 percent fill material. Disturbance results from road cuts and coal waste. Included in the area are small areas of Patmos and Podo soils as well as areas of rock outcrops. Even before disturbance, the site had limited range and wildlife capability. The valley floor is quite narrow along this reach of Gordon Creek.

Agriultural developments are not found along Gordon Creek or Beaver Creek in the vicinity of the mine. The agricultural potential of the valley floors in the area is limited by the soil capability and the short growing season. The narrow valleys are occupied by the stream and the road and both break up the narrow valley so that development of hay meadows or improved pasture is impractical. See figure 7-14

BLUE BLAZE COAL CO.
P.O. Box 784
Price, Utah 84501

updated
12-30-91

December 21, 1991

Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Dear Ms. Grabaugh-Littig:

Enclosed is additional information requested in the Technical Review dated October 1991.

These enclosures are the change requests on Page 6 and 7 (724.200 and 731.600) and some additional change requests by Tom Munson.

Sincerely,

William R. Skaggs

William R. Skaggs

Enclosures

APPENDIX 1

Filed Water Rights

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
*257	Surface	Cattle	Utah Department of Fish & Game	9.75
317	Underground Mine Tunnel	Railroad	Utah Railway Company	
318	"	"	"	
330	Underground Mine	Mining	Sweets Coal Company	
348	Surface	Cattle and Horses	Pete Frandsen Tooele, Utah	
353	Spring	Domestic and Mining	"	
*398	Surface	Cattle	Utah Deparment of Fish & Game	9.75
487	"	Sheep and Horses	John Marakis Price, Utah	
* 488	"	Sheep and Horses	"	22.68
777	Surface	Cattle and Irrigation	Utah Department of Fish & Game	
778	"	"	"	
1401	"	Sheep, Cattle and Horses; Domestic	Clarence Anderson Price, Utah	
1402	"	"	"	

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
1404	Spring	Sheep and Horses; Domestic	Helper State Bank Helper, Utah	
1405	"	"	"	
1406	Surface	"	"	
1407	"	Sheep and Horses	"	
1413	"	Sheep and Horses; Domestic	"	
1414	"	Sheep and Horses	"	
1464	Spring	Sheep, Cattle and Horses	Catherine Jewkes Price, Utah	
1465	"	"	Margaret P. Grant Price, Utah	
1466	"	"	Peggy Ann Peirce Price, Utah	
1467	Surface	"	Catherine Jewkes Price, Utah	
1468	"	"	Margaret P. Grant Price, Utah	
1469	"	"	Peggy Ann Peirce Price, Utah	

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
1470	Spring	Sheep, Cattle and Horses	Catherine Jewkes Price, Utah	
1471	"	"	Margaret P. Grant Price, Utah	
1472	"	"	Peggy Ann Peirce Price, Utah	
1473	Surface	"	E.E. Peirce, Jr. Price, Utah	
*1675	"	Sheep and Horses	Helen Marakis Price, Utah	22.68
*1676	Spring	"	John Marakis Estate	22.68
1926	Surface	Sheep, Cattle and Horses	Margaret P. Grant Price, Utah	
1927	"	"	Peggy Ann Peirce Price, Utah	
1928	"	"	Catherine Jewkes Price, Utah	
1929	Spring	"	Margaret P. Grant Price, Utah	
1930	"	"	Peggy Ann Peirce Price, Utah	
1931	"	"	Catherine Jewkes Price, Utah	

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
1932	Spring	Sheep, Cattle and Horses	Margaret P. Grant Price, Utah	
1933	"	"	Peggy Ann Peirce Price, Utah	
1934	"	"	Catherine Jewkes Price, Utah	
1935	"	"	Margaret P. Grant Price, Utah	
1936	"	"	Peggy Ann Peirce Price, Utah	
1937	"	"	Catherine Jewkes Price, Utah	
1938	"	"	Margaret P. Grant Price, Utah	
1939	"	"	Peggy Ann Peirce Price, Utah	
1940	"	"	Catherine Jewkes Price, Utah	
1941	"	"	Margaret P. Grant Price, Utah	
1943	"	"	Peggy Ann Peirce Price, Utah	
1944	"	"	Catherine Jewkes Price, Utah	

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
1945	Spring	Sheep, Cattle and Horses	Margaret P. Grant Price, Utah	
1946	"	"	Peggy Ann Peirce Price, Utah	
1947	"	"	Catherine Jewkes Price, Utah	
1948	"	"	Margaret P. Grant Price, Utah	
1949	"	"	Peggy Ann Peirce Price, Utah	
1950	"	"	Catherine Jewkes Price, Utah	
1954	Surface	"	Margaret P. Grant Price, Utah	
1955	"	"	Peggy Ann Peirce Price, Utah	
1956	"	"	Catherine Jewkes Price, Utah	
2664	"	Cattle and Horses	H.B. & Della Simonson Price, Utah	
2697	"	Sheep and Horses	John Marakis Estate Price, Utah	
3506	"	"	Calvin K. Jacob Pleasant Grove, Utah	

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
3612	Surface	Cattle and Horses	Della Simonson Price, Utah	
3613	Spring	"	"	
3616	"	"	"	
3617	"	"	"	
3618	"	"	"	
3619	"	"	"	
3669	Spring	Sheep and Horses	Helen Marakis Price, Utah	
3670	"	"	"	
3671	"	"	"	
3672	"	"	"	
3681	Surface	Sheep and Horses	Calvin K. Jacob Pleasant Grove, Utah	
3682	"	Stock	R.L. Bird Company Salt Lake City, Utah	-
3683	"	"	Milton A. Oman Salt Lake City, Utah	-
3686	"	Cattle and Sheep	Bureau of Land Management	
*3687	"	Sheep and Horses	Calvin K. Jacob Pleasant Grove, Utah	36.26 -

FILED WATER RIGHTS
IN THE
GORDON CREEK AREA

File No.	Class	Use	Owner	Quantity
3688	Surface	Sheep, Cattle and Horses	E.E. Peirce, Jr. Price, Utah	
3689	"	Cattle and Horses	Dea W. Thayn Wellington, Utah	
3881	Spring	Sheep and Horses	Helen Marakis Price, Utah	-
4095	"	"	Calvin K. Jacob Pleasant Grove, Utah	-
4096	"	"	"	-

TOTAL = 123.8 ac. ft.

* Rights that could possibly be impacted by the Gordon Creek No. 2 Mine Operation.

INPUT SPECIFICATIONS FOR RECLAMATION
SEDIMENTATION POND

The runoff of the complete watershed area will be directed directly to the sedimentation pond until two years after the last augmented seeding and will be maintained until the removal is authorized by the Division.

	North Fork Area	Above Mine Area	Area A	Area B	Area C
Area - acres	346	140	3.88	9.88	2.24
Curve number	55.95	58.17	48	48	73
Slope length (ft.)	4725	3600	850	1050	400
Slope (%)	20	.31	.38	.53	.53
Time of concentration (hrs.)	.7866	.4806	.1770	.1775	.043
100-yr. 6-hr. Precipitation Results					
Precipitation (in.)	1.8	1.8	1.8	1.8	1.8
Peak discharge (cfs.)	1.80	1.16	0.0	0.0	.43
Total runoff (ac.ft.)	.63	.47	0	0	.06

	Area D	Area E	Area F	Area G
Area - acres	4.73	7.58	15.14	10.3
Curve number	48	48	48	80
Slope length (ft.)	500	650	500	1860
Slope (%)	.32	.37	.60	.65
Time of concentration (hrs.)	.1261	.0193	.2913	.3552
100-yr. 6-hr. Precipitation Results				
Precipitation (in.)	1.8	1.8	1.8	1.8
Peak discharge (cfs.)	0	0	0	2.86
Total runoff (ac.ft.)	0	0	0	0

Total runoff directed to the sedimentation pond during the reclamation period will be 1.16 acre feet. The sedimentation pond is sized to handle 2.38 acre feet to the bottom of the spillway.

determined using the curve number procedure. The 100-yr, 24-hr rainfall was obtained from NOAA (1973) "Precipitation Frequency Atlas of the Western United States". The rainfall obtained for this type of storm is 2.6 inches.

Those storage requirements are designated on the Depth Capacity Table for the Sedimentation Pond provided in Table 7-6. Total capacity below the invert of the spillway is 2.38 acre-feet.

The spillway for the insized sedementation pond is designed to safely pass the runoff from a 25-yr. 6-hr. peak precipitation event. A cross section drawing of the overflow for the pond is provided in Plate 7-6 and Figure 7-5. The spillway will have a depth of 1 ft. and a width of 10 ft. with a slope of 3% for a length of 10 ft. The discharge capability of this structure is 57.13 cfs with a velocity of 5.71 cfs. This structure will contain angular rip rap grouted with cement from the exit of the pond to where it intersects the main drainage below the disturbed area at diversion ditch U-5.

The angle of enterence into the stream will be 25% slope with 1.5 inch rip rap cemented into place so no erosion can take place will be used in this design.

Inlet rip rap will be on a 50% slope and will also be of 1.5 inch rip rap cemented into place so no erosion to the impoundment will occur.

The impound will have a pipe decant that has a locking valve at the end of the pipe at the outlet. This valve will used to drain the excess water from the sedimentation pond 24 hours after any storm to allow settleing of the sediment from the impound. The decant will be 24 inches above the 60% sediment clean out level. See decant design on Plate 7-6

The use of a Sediment Marker will be placed at the edge of the pond which will indicate when cleaning of the pond is necessay. See Figure 7-6

Culverts to be installed will be equipped with a trash rack similar to the one in Figure 7-7.

A Culvert Nomograph is included to show the flows, culvert size, and headwater depth. Also, shown are formulas for water calculations. See Figures 7-8, 7-9 and 7-10 and drainage diversions previously mentioned.

Sedimentation control structures are located on Plate 7-6, this shows the design of the sedimentation pond and the siltation structure. The siltation structure location is on Plate 7-5. All areas where siltation structures are installed are shown on plate a 7-5 and described. All runoff from disturbed areas will be

directed to the sedimentation pond with exception of the access road located below the sedimentation pond. Silt fences will be placed along the road ditches to control the erosion.

Drainage ditch cross sections and designs are are located in Figure 7-4a.

The sediment pond is located in a area below all mine disturbed areas therefore disturbed area water will be directed towards the sedimentation pond and cannot enter the main stream. The sedimentation pond is located in an area of level configuration and the stream does not have a definate channel. By insizing the sedimentation pond instead of constructing a dam type pond, and building a positive channel for the stream that can handle the water flow under extreme conditions, and locating this channel a safe distance from the sedmentation pond. There will be no chance of the undisturbed stream water from entering the pond or the water from the sedimentation pond from entering the stream before it is treated. See Plate 7-5

State Engineer of Water Rights in Price, Utah, Blue Blaze Coal Co. estimates a maximum cumulative impact of 19.085 acre feet of water rights. This maximum figure assumes that all existing water rights (including surface and ground water) that could be affected at the same time (which is highly improbable). Even if such an impact could occur, the 404.5 acre ft. of water being purchased would be more than adequate to replace water shown to be lost as a result of the Blue Blaze No. 1 and No. 2 Mine Operations. Also additional water could be purchased and diverted across a channel from the Beaver Creek drainage into the Gordon Creek drainage.

Water for mining in this area will be purchased prior to the need for water in the mining operation.

A complete list of filed water rights and a map showing locations is included in Appendix 1 of this M.R.P. Copies of water users claims are on file in the Division of Water Rights office and the State Engineer's office in Price, Utah.

Diversions will be established to direct flow from disturbed areas to the sedimentation ponds. Water encountered during mining operations will also flow to the sedimentation ponds.

An NPDES permit number UT-0023761 is for the No. 1 and No. 2 Mines. Any discharges of water from underground workings will be treated in the sedimentation ponds to meet effluent limitations before it is released.

Calculations from the area engineer for water rights show there are 19.085 acre feet of water that could be affected due to mining in this area. His figures for the water rights holders is located in Appendix 1.

APPENDIX 5

SOIL SURVEY OF
Carbon Area, Utah

United States Department
of Agriculture

Soil Conservation Service
(1989)

72—Pathead-Curecanti family association. This map unit is on mountain slopes. It is in the Spring Canyon and Gordon Creek areas, west of Helper. Slopes are 50 to 70 percent, 300 to 400 feet long, and convex. Elevation is 6,800 to 9,000 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 40 percent Pathead extremely stony loam, 50 to 70 percent slopes; 30 percent Curecanti family loam, 50 to 70 percent slopes; and 30 percent other soils and miscellaneous areas. The Pathead soil is on ridges and shoulders, and the Curecanti family soil generally has north aspects and is in drainageways.

Included in this unit are about 8 percent Podo cobbly loam, 7 percent Midfork family soils, and small areas of Pathead extremely bouldery fine sandy loam, Podo very bouldery sandy loam, Senchert loam, and Rock outcrop.

The Pathead soil is moderately deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The present vegetation is mainly Salina wildrye, low gray sage, and winterfat. Typically, the surface layer is brown extremely stony loam about 3 inches thick. The underlying material is pale brown very cobbly loam to a depth of 26 inches. Sandstone is at a depth of 20 to 40 inches.

Permeability of the Pathead soil is moderate. Available water capacity is about 1 to 2 inches. Water supplying capacity is 3.5 to 6.5 inches. Effective rooting depth is 20 to 40 inches. The organic matter content of the surface layer is 1 to 3 percent. Runoff is rapid, and the hazard of water erosion is high.

The Curecanti family soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The present vegetation is mainly Gambel oak, snowberry, Kentucky bluegrass, and aspen peavine. Typically, the upper part of the surface layer is dark grayish brown loam about 7 inches thick and the lower part is brown very stony loam about 8 inches thick. The subsurface layer is very pale brown very stony loam about 5 inches thick. The subsoil to a depth of 60 inches or more is pale brown very stony loam.

Permeability of the Curecanti family soil is moderate. Available water capacity is about 5.0 to 6.5 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as wildlife habitat and rangeland.

The potential plant community on the Pathead soil is 60 percent grasses, 15 percent forbs, and 25 percent shrubs. Among the important plants are Salina wildrye, prairie junegrass, bluegrass, and snowberry.

This soil is not grazeable by livestock because of the steepness of slope and the hazard of erosion.

The potential plant community on the Curecanti family soil is 35 percent grasses, 10 percent forbs, and 55 percent shrubs. Among the important plants are Gambel oak, snowberry, serviceberry, and bluegrass.

This soil is not grazeable by livestock because of the steepness of slope.

This map unit is in capability subclass VIIe, nonirrigated. The Pathead soil in the Mountain Very Steep Loam (Saline Wildrye) range site, and the Curecanti family soil is in the Mountain Very Steep Loam (Oak) range site.

Pathead-Curecanti family

Moderately deep to very deep, well drained, very steep soils; on mountain slopes and canyonsides

This map unit is in the northwestern part of the survey area, west of Castle Gate, and in the north-central part. Slope is 50 to 70 percent. The vegetation on the Pathead soils is mainly big sagebrush, Salina wildrye, curlleaf mountainmahogany, Utah juniper, and pinyon. The vegetation on the Curecanti family soils is mainly Gambel oak, snowberry, Salina wildrye, and slender wheatgrass. Elevation is 6,800 to 9,000 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit makes up about 4 percent of the survey area. It is about 45 percent Pathead and similar soils and 25 percent Curecanti family soils. The remaining 30 percent is components of minor extent.

Pathead soils are on mountain slopes and canyonsides. These soils are moderately deep and well drained. They formed in residuum and colluvium derived dominantly from sandstone and shale. The surface layer is brown extremely stony loam. Below this to a depth of 26 inches the soils are pale brown very cobbly loam. Unweathered sandstone is at a depth of 20 to 40 inches.

Curecanti family soils are on mountain slopes. These soils are very deep and well drained. They formed in colluvium derived dominantly from sandstone and shale. The surface layer is dark grayish brown loam. The subsurface layer is very pale brown very stony loam. The subsoil to a depth of 60 inches or more is very pale brown very stony loam.

Of minor extent in this unit are Rabbitex, Rottulee, Midfork family, Doney family, Senchert, and Podo soils and Rock outcrop.

Most areas of this unit are used as wildlife habitat. A few areas are used as rangeland and woodland.

Pathead Series

The Pathead series consists of moderately deep, well drained, moderately permeable soils on benches, ridges, canyonsides, and mountain slopes. These soils formed in colluvium and residuum derived dominantly from sandstone and shale. Slope is 15 to 70 percent. Elevation is 5,900 to 9,000 feet. Average annual precipitation is 14 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are loamy-skeletal, mixed (calcareous), frigid Typic Ustorthents.

Typical pedon of a Pathead extremely stony loam in an area of Pathead-Curecanti family association, about 2 miles north and 4 miles west of Helper, about 1,100 feet north and 400 feet west of the southeast corner of sec. 6, T. 13 S., R. 9 E.

A1—0 to 3 inches; brown (10YR 5/3) extremely stony loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; 5 percent pebbles, 15 percent cobbles, 40 percent stones, and 5 percent boulders; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1—3 to 14 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; many very fine pores; 20 percent pebbles and 5 percent cobbles; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.8); clear smooth boundary.

C2—14 to 26 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine pores; 20 percent pebbles, 25 percent cobbles, and 5 percent stones; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.8); clear smooth boundary.

R—26 inches; sandstone.

Bedrock is at a depth of 20 to 40 inches. The particle-size control section is 35 to 60 percent rock fragments.

A horizon: Value is 5 or 6 when dry and 3 to 5 when moist, and chroma is 2 or 3. Texture is gravelly loam, cobbly loam, extremely stony fine sandy loam, extremely stony loam, or extremely bouldery fine sandy loam. Reaction is moderately alkaline or strongly alkaline.

C horizon: Hue is 10YR or 2.5Y, value is 6 or 7 when dry and 3 to 5 when moist, and chroma is 2 to 4. Texture is very cobbly loam, extremely cobbly loam, or very stony fine sandy loam. Clay content is 18 to 27 percent. Calcium carbonate equivalent is 11 to 28 percent. Reaction is moderately alkaline or strongly alkaline.

Curecanti Family

The Curecanti family consists of very deep, well drained, moderately permeable soils on mountain slopes. These soils formed in colluvium derived dominantly from sandstone and shale. Slope is 50 to 70 percent. Elevation is 6,800 to 9,000 feet. Average annual precipitation ranges from 16 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are loamy-skeletal, mixed Typic Argiborolls.

Reference pedon of a Curecanti family loam in an area of Curecanti family-Pathead complex, about 7 miles west and 3 miles north of Helper, 200 feet south and 700 feet east of the northwest corner of sec. 12, T. 13 S., R. 8 E.

A11—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; 10 percent pebbles; neutral (pH 6.6); clear wavy boundary.

A12—7 to 15 inches; brown (10YR 5/3) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; hard, very firm, sticky and slightly plastic; few very fine and fine roots and common medium and coarse roots; few very fine pores; 15 percent pebbles, 10 percent cobbles, and 30 percent stones; neutral (pH 6.6); clear wavy boundary.

A2—15 to 20 inches; very pale brown (10YR 7/3) very stony loam, brown (10YR 5/3) moist; moderate coarse subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few very fine and fine roots and common medium and coarse roots; many very fine and few fine pores; 20 percent pebbles, 5 percent cobbles, and 30 percent stones; slightly acid (pH 6.4); clear wavy boundary.

B21t—20 to 27 inches; pale brown (10YR 6/3) very stony loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots and common medium roots; common very fine pores; few thin and moderately thick clay films on ped faces and in pores; 10 percent pebbles, 15 percent cobbles, and 30 percent stones; neutral (pH 6.6); clear wavy boundary.

B22t—27 to 60 inches; pale brown (10YR 6/3) very stony loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few very fine and fine roots and common medium roots; common very fine pores; common thin and moderately thick clay films on ped faces and in pores; 10 percent pebbles, 15 percent cobbles, and 30 percent stone; slightly acid (pH 6.4).

The solum is 40 to 60 inches thick. The mollic epipedon is 12 to 15 inches thick.

A1 horizon: Value is 3 to 5 when dry and 2 or 3 when moist, and chroma is 2 or 3.

A2 horizon: Value is 5 to 7 when dry and 3 to 5 when moist, and chroma is 2 or 3.

B2t horizon: Value is 4 or 5 when moist, and chroma is 2 to 4. Clay content is 18 to 27 percent.

TABLE 1.--TEMPERATURE AND PRECIPITATION--Continued

[Recorded during the period 1951-80 at Hiawatha, UT; elevation 7,230 feet]

Month	Temperature			Precipitation	
	Mean daily maximum	Mean daily minimum	Mean	Mean	Mean snowfall
	°F	°F	°F	In	In
January	32.4	13.7	23.1	1.05	12.9
February	37.0	17.6	27.3	1.03	13.0
March	43.9	22.1	33.0	1.04	10.6
April	54.2	30.3	42.3	1.01	2.9
May	64.6	39.2	51.9	1.19	2.5
June	75.5	49.1	62.3	.95	0
July	83.3	56.1	69.7	1.07	0
August	79.3	54.2	66.8	1.72	0
September	71.6	46.4	59.0	1.26	.4
October	59.7	36.4	48.1	1.12	1.0
November	43.3	23.8	33.6	.89	7.6
December	34.7	16.1	25.4	1.18	12.6
Year	56.6	33.8	45.2	13.51	63.50

TABLE 2.--ESTIMATED PAN EVAPORATION

Month	Reporting Station			
	Clear Creek	Hiawatha	Scofield Dam	Sunnyside
	In	In	In	In
May	6.53	7.96	7.59	8.36
June	7.41	8.10	7.24	8.95
July	7.93	9.38	8.06	10.11
August	6.33	9.03	6.57	7.99
September	4.67	5.20	4.83	5.78
October	3.34	5.46	3.24	5.92
Total	36.21	45.13	37.53	47.11

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Carbon County	Emery County	Total--	
		Acres	Acres	Area Acres	Extent Pct
66	Mivida gravelly fine sandy loam, 3 to 8 percent slopes	740	0	740	0.1
67	Mivida very stony fine sandy loam, 1 to 3 percent slopes	2,081	0	2,081	0.2
68	Moffat fine sandy loam, 3 to 6 percent slopes	3,889	0	3,889	0.4
69	Moffat-Persayo complex	917	0	917	0.1
70	Nelman-Travessilla-Rock outcrop complex	5,418	0	5,418	0.6
71	Pathead extremely bouldery fine sandy loam, 40 to 70 percent slopes	13,898	0	13,898	1.6
72	Pathead-Curecanti family association	24,131	0	24,131	2.7
73	Penoyer Variant loam, 1 to 3 percent slopes	818	0	818	0.1
74	Penoyer Variant loam, 3 to 6 percent slopes	399	0	399	*
75	Perma family, 15 to 40 percent slopes	2,622	0	2,622	0.3
76	Perma family-Datino complex	8,250	0	8,250	0.9
77	Persayo loam, 3 to 8 percent slopes	8,743	0	8,743	1.0
78	Persayo very cobbly clay loam, 3 to 15 percent slopes	1,824	0	1,824	0.2
79	Persayo-Badland complex	3,452	0	3,452	0.4
80	Persayo-Chipeta complex	18,571	0	18,571	2.1
81	Persayo-Greybull complex	4,454	0	4,454	0.5
82	Podo gravelly sandy loam, 1 to 8 percent slopes	8,263	0	8,263	0.9
83	Podo-Cabba family complex	30,654	0	30,654	3.5
84	Podo-Rock outcrop complex	19,319	0	19,319	2.1
85	Rabbitex silt loam, 15 to 50 percent slopes	4,071	0	4,071	0.5
86	Rabbitex-Doney family-Midfork family complex	5,085	0	5,085	0.6
87	Rabbitex-Pathead complex	6,148	0	6,148	0.7
88	Rabbitex family-Datino Variant complex	1,797	0	1,797	0.2
89	Rafael silty clay loam	345	0	345	*
90	Ravola loam, 1 to 3 percent slopes	11,131	0	11,131	1.2
91	Ravola loam, 1 to 6 percent slopes, eroded	11,756	0	11,756	1.3
92	Ravola-Gullied land complex	4,947	326	5,273	0.6
93	Ravola-Slickspots complex	8,143	0	8,143	0.9
94	Riverwash	853	0	853	0.1
95	Rock outcrop	2,079	69	2,148	0.2
96	Rock outcrop-Rubbleland-Travessilla complex	10,045	2,422	12,467	1.4
97	Rottulee family-Trag complex	16,580	0	16,580	1.8
98	Sagers silty clay loam	587	0	587	0.1
99	Saltair silty clay loam	710	0	710	0.1
100	Senchert loam, 3 to 15 percent slopes	13,639	0	13,639	1.5
101	Senchert loam, 30 to 50 percent slopes	12,972	0	12,972	1.4
102	Senchert-Senchert family complex	2,527	103	2,630	0.3
103	Senchert-Toze family complex	11,594	0	11,594	1.3
104	Senchert family, 3 to 15 percent slopes	8,253	0	8,253	0.9
105	Senchert family-Senchert complex	3,552	0	3,552	0.4
106	Sheepcan-Podo-Rock outcrop complex	2,225	0	2,225	0.2
107	Shupert-Winetti complex	7,080	0	7,080	0.8
108	Silas loam	1,214	0	1,214	0.1
109	Silas-Brycan loams	1,759	0	1,759	0.2
110	Stormitt gravelly sandy clay loam, 3 to 10 percent slopes	4,675	0	4,675	0.5
111	Stormitt-Minchey complex	1,575	0	1,575	0.2
112	Strych very bouldery fine sandy loam, 3 to 20 percent slopes	1,159	0	1,159	0.1
113	Strych very stony loam, 3 to 15 percent slopes	27,505	9,526	37,031	4.2
114	Strych very stony loam, dry, 3 to 30 percent slopes	11,395	263	11,658	1.3
115	Trag stony loam, 30 to 60 percent slopes	6,532	0	6,532	0.7
116	Trag-Beje-Rottulee family complex	3,948	0	3,948	0.4
117	Trag-Beje-Senchert complex	10,033	0	10,033	1.1
118	Trag-Croydon complex	7,144	0	7,144	0.8
119	Travessilla sandy loam, 1 to 8 percent slopes	4,975	211	5,186	0.6
120	Travessilla-Rock outcrop complex	5,547	0	5,547	0.6
121	Travessilla-Rock outcrop-Gerst complex	40,483	0	40,483	4.5
122	Travessilla-Travessilla family-Rock outcrop complex	8,103	0	8,103	0.9
123	Travessilla family, 1 to 8 percent slopes	3,915	0	3,915	0.4
124	Uinta family-Podo association	7,388	0	7,388	0.8
125	Uinta-Toze families complex	22,138	0	22,138	2.6

TABLE 4.--RANGELAND AND WOODLAND UNDERSTORY PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Grazing site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
70*: Rock outcrop.					
71---------- Pathead	Mountain Very Steep Stony Loam (Curlleaf Mountainmahogany).	Favorable Normal Unfavorable	1,100 800 600	Curlleaf mountainmahogany---------- Salina wildrye---------- Utah serviceberry---------- Snowberry---------- Indian ricegrass---------- Wheatgrass----------	30 20 5 5 5 5
72*: Pathead----------	Mountain Very Steep Loam (Saline Wildrye).	Favorable Normal Unfavorable	1,400 1,200 1,000	Salina wildrye---------- Snowberry---------- Bluegrass---------- Bluebunch wheatgrass---------- Needlegrass---------- Prairie junegrass---------- Birchleaf mountainmahogany---- Antelope bitterbrush---------- Utah serviceberry---------- Indian ricegrass----------	35 10 5 5 5 5 5 5 5 5
Curecanti---------	Mountain Very Steep Loam (Oak).	Favorable Normal Unfavorable	1,400 1,000 600	Gambel oak---------- Bluegrass---------- Snowberry---------- Wheatgrass---------- Serviceberry---------- Mountain big sagebrush--------	30 10 10 5 5 5
73, 74---------- Penoyer Variant	Desert Loam----------	Favorable Normal Unfavorable	700 500 300	Indian ricegrass---------- Shadscale---------- Galleta---------- Globemallow---------- Bud sagebrush---------- Winterfat----------	20 20 10 5 5 5
75*---------- Perma	Mountain Stony Loam (Browse)--	Favorable Normal Unfavorable	1,600 1,200 900	Birchleaf mountainmahogany---- Serviceberry---------- Bluegrass---------- Salina wildrye---------- Elk sedge---------- Mountain big sagebrush-------- Gambel oak---------- Snowberry----------	25 20 5 5 5 5 5 5
76*: Perma----------	Mountain Very Steep Stony Loam (Browse).	Favorable Normal Unfavorable	1,300 1,000 800	Birchleaf mountainmahogany---- Serviceberry---------- Bluegrass---------- Salina wildrye---------- Elk sedge---------- Mountain big sagebrush-------- Gambel oak---------- Snowberry----------	25 20 5 5 5 5 5 5
Datino----------	Mountain Very Steep Stony Loam (Douglas-fir)**.	Favorable Normal Unfavorable	700 500 400	Salina wildrye---------- Snowberry---------- Slender wheatgrass---------- Elk sedge---------- Indian ricegrass---------- Birchleaf mountainmahogany---- Rocky Mountain juniper--------	15 15 10 5 5 5 5

TABLE 5.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
68---------- Moffat	Slight----------	Slight----------	Moderate: slope.	Slight.
69*: Moffat----------	Slight----------	Slight----------	Moderate: slope.	Slight.
Persayo----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, depth to rock.	Moderate: slope.
70*: Nelman----------	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.
Travessilla----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Rock outcrop.				
71---------- Pathead	Severe: slope, small stones.	Severe: slope, small stones.	Severe: large stones, slope, small stones.	Severe: large stones, slope.
72*: Pathead----------	Severe: slope, small stones.	Severe: slope, small stones.	Severe: large stones, slope, small stones.	Severe: large stones, slope.
Curecanti----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
73, 74---------- Penoyer Variant	Slight----------	Slight----------	Moderate: slope, dusty.	Severe: erodes easily.
75*---------- Perma	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
76*: Perma----------	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
Datino----------	Severe: slope, large stones, small stones.	Severe: slope, large stones, small stones.	Severe: large stones, slope, small stones.	Severe: large stones, slope, small stones.
77---------- Persayo	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: erodes easily.
78---------- Persayo	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, depth to rock.	Slight.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
57---------- Hunting	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
58. Juva Variant------	Very poor.	Very poor.	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
59, 60---------- Killpack	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
61---------- Libbings	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Good	Very poor.	Very poor.	Fair	Very poor.
62*: Midfork----------	Very poor.	Very poor.	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Good.
Comodore----------	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
63*: Midfork----------	Very poor.	Very poor.	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Good.
Podo----------	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
64---------- Minchey	Very poor.	Very poor.	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Good.
65---------- Mivida	Very poor.	Very poor.	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
66---------- Mivida	Very poor.	Very poor.	Fair	Poor	Fair	Poor	Very poor.	Poor	Fair	Very poor.	Fair.
67---------- Mivida	Very poor.	Very poor.	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
68---------- Moffat	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
69*: Moffat----------	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
Persayo----------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor
70*: Nelman----------	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Travessilla-------	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Rock outcrop.											
71---------- Pathead	Very poor.	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
72*: Pathead----------	Very poor.	Very poor.	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.

See footnote at end of table.

TABLE 6.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
72*: Curecanti	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
73--- Penoyer Variant	Very poor.	Very poor.	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
74--- Penoyer Variant	Very poor.	Very poor.	Poor	Very poor.	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
75*--- Perma	Very poor.	Very poor.	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
76*: Perma	Very poor.	Very poor.	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Datino	Very poor.	Very poor.	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
77--- Persayo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.
78--- Persayo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
79*: Persayo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Persayo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Badland.											
80*: Persayo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Chipeta	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
81*: Persayo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.
Greybull	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
82--- Podo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
83*: Podo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Cabba	Very poor.	Very poor.	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
84*: Podo	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Rock outcrop.											

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
63*: Midfork	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
Podo	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer.
64--- Minchey	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
65--- Mivida	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
66--- Mivida	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
67--- Mivida	Slight	Slight	Slight	Slight	Moderate: frost action.	Severe: large stones.
68--- Moffat	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
69*: Moffat	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
Persayo	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: thin layer.
70*: Nelman	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: small stones slope.
Travessilla	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: thin layer.
Rock outcrop.						
71--- Pathead	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: small stones slope.
72*: Pathead	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: small stones slope.
Curecanti	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
73--- Penoyer Variant	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
74--- Penoyer Variant	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
75*--- Perma	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones slope.

See footnote at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
63*:					
Podo	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
64 Minchey	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
65, 66, 67 Mivida	Slight	Severe: seepage.	Slight	Slight	Good.
68 Moffat	Slight	Severe: seepage.	Slight	Slight	Poor: thin layer.
69*:					
Moffat	Slight	Severe: seepage.	Slight	Slight	Poor: thin layer.
Persayo	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
70*:					
Nelman	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Travessilla	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Rock outcrop.					
71 Pathead	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
72*:					
Pathead	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Curecanti	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.	Poor: large stones, slope.
73, 74 Penoyer Variant	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
75* Perma	Severe: slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: small stones, slope.
76*:					
Perma	Severe: slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
62*: Comodore	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, slope.
63*: Midfork	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Podo	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
64 Minchey	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
65 Mivida	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
66, 67 Mivida	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
68 Moffat	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
69*: Moffat	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Persayo	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
70*: Nelman	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Travessilla	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Rock outcrop.				
71 Pathead	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, slope.
72*: Pathead	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, slope.
Curecanti	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, area reclaim, slope.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation
71--- Pathead	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.
72*: Pathead	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.
Curecanti	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.
73--- Penoyer Variant	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily.
74--- Penoyer Variant	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.
75*--- Perma	Severe: seepage, slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.
76*: Perma	Severe: seepage, slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.
Datino	Severe: seepage, slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.
77--- Persayo	Severe: depth to rock.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.
78--- Persayo	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.
79*: Persayo	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.
Persayo	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.
Badland.				
80*: Persayo	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.
Chipeta	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.
81*: Persayo	Severe: depth to rock.	Severe: piping.	Deep to water	Depth to rock, slope.

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	> 3 inches	4	10	40	200		
	In				Pct					Pct	
71---------- Pathead	0-4	Extremely bouldery fine sandy loam.	GM-GC, GM, GP-GM	A-2, A-1	65-80	40-55	35-50	25-45	10-35	20-30	NP-10
	4-38	Extremely cobbly loam, very cobbly loam, very stony fine sandy loam.	GM-GC, SM-SC	A-2, A-4	40-65	35-80	30-75	25-50	15-40	20-35	5-10
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
72*: Pathead----------	0-3	Extremely stony loam.	GM-GC, GM, GP-GM	A-2, A-1	65-80	40-55	35-50	25-45	10-35	20-30	NP-10
	3-26	Extremely cobbly loam, very cobbly loam, very stony fine sandy loam.	GM-GC, SM-SC	A-2, A-4	40-65	35-80	30-75	25-50	15-40	20-35	5-10
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Curecanti--------	0-7	Loam----------	CL-ML	A-4	0	85-95	80-90	65-75	50-60	20-30	5-10
	7-60	Very stony loam, very cobbly loam very cobbly sandy clay loam.	SC, SM-SC, GC, GM-GC	A-6, A-4	45-50	60-80	55-75	50-60	35-45	25-35	5-15
73, 74---------- Penoyer Variant	0-9	Loam----------	CL-ML	A-4	0	100	100	85-95	60-75	25-30	5-10
	9-60	Stratified very fine sandy loam to silt loam.	ML, CL-ML	A-4	0	100	100	95-100	75-90	20-30	NP-10
75*---------- Perma	0-7	Very stony sandy loam.	SM	A-2	40-45	75-85	70-80	45-55	25-30	---	NP
	7-35	Cobbly sandy loam very cobbly sandy loam.	SM-SC, GM-GC	A-2	25-30	60-80	55-75	35-50	20-30	20-30	5-10
	35-60	Very stony sandy loam.	SM-SC, GM-GC	A-2	45-50	60-70	55-65	35-45	20-25	25-30	5-10
76*: Perma----------	0-7	Very stony sandy loam.	SM	A-2	40-45	75-85	70-80	45-55	25-30	---	NP
	7-35	Cobbly sandy loam very cobbly sandy loam.	SM-SC, GM-GC	A-2	25-30	60-80	55-75	35-50	20-30	20-30	5-10
	35-60	Very stony sandy loam.	SM-SC, GM-GC	A-2	45-50	60-70	55-65	35-45	20-25	25-30	5-10
Datino----------	0-9	Extremely stony fine sandy loam.	GM-GC, SM-SC	A-1, A-2	45-60	50-70	30-50	20-40	10-25	20-30	5-10
	9-16	Very stony loam	GM-GC	A-4	40-45	65-75	60-70	50-60	40-50	20-30	5-10
	16-60	Very stony fine sandy loam.	GM-GC, SM-SC	A-2, A-4	50-60	65-80	60-75	45-55	30-40	20-30	5-10
77---------- Persayo	0-5	Loam----------	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	5-15
	5-12	Loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	70-90	25-35	5-15
	12	Weathered bedrock	---	---	---	---	---	---	---	---	---
78---------- Persayo	0-4	Very cobbly clay loam.	GC	A-6, A-7	30-35	55-65	50-60	45-55	35-45	35-45	15-25
	4-11	Loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	70-90	25-35	5-15
	11	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	G/cm	In/hr	In/in	pH	mmhos/cm					Pct
72*:												
Pathead	0-3	13-21	1.20-1.35	0.6-6.0	0.04-0.06	7.9-8.4	<2	Low	0.05	1	8	1-3
	3-26	18-27	1.35-1.45	0.6-2.0	0.05-0.08	7.9-9.0	<2	Low	0.10			
	26	---	---	---	---	---	---	---	---			
Curecanti	0-7	15-18	1.25-1.30	0.6-2.0	0.14-0.16	6.6-7.3	<2	Low	0.28	1	5	3-5
	7-60	18-27	1.25-1.30	0.6-2.0	0.08-0.10	6.1-7.3	<2	Low	0.10			
73, 74	0-9	16-18	1.15-1.20	0.6-2.0	0.13-0.17	7.9-8.4	<2	Low	0.43	5	4L	1-2
Penoyer Variant	9-60	13-18	1.15-1.20	0.6-2.0	0.18-0.20	7.9-8.4	<2	Low	0.49			
75*	0-7	5-10	1.30-1.35	2.0-6.0	0.06-0.08	6.6-7.3	<2	Low	0.10	5	8	3-5
Perma	7-35	13-18	1.30-1.35	2.0-6.0	0.06-0.08	6.6-7.3	<2	Low	0.10			
	35-60	13-18	1.30-1.35	2.0-6.0	0.05-0.07	6.6-7.3	<2	Low	0.10			
76*:												
Perma	0-7	5-10	1.30-1.35	2.0-6.0	0.06-0.08	6.6-7.3	<2	Low	0.10	5	8	3-5
	7-35	13-18	1.30-1.35	2.0-6.0	0.06-0.08	6.6-7.3	<2	Low	0.10			
	35-60	13-18	1.30-1.35	2.0-6.0	0.05-0.07	6.6-7.3	<2	Low	0.10			
Datino	0-9	12-18	1.25-1.35	0.6-2.0	0.06-0.09	7.4-7.8	<2	Low	0.02	1	8	3-5
	9-16	18-26	1.20-1.30	0.6-2.0	0.09-0.11	7.4-8.4	<2	Low	---			
	16-60	16-25	1.30-1.40	2.0-6.0	0.06-0.10	7.4-8.4	<2	Low	---			
77	0-5	18-27	1.20-1.30	0.6-2.0	0.15-0.17	8.5-9.0	<8	Moderate	0.37	1	4L	.5-1
Persayo	5-12	20-30	1.10-1.20	0.2-0.6	0.16-0.18	8.5-9.0	<8	Moderate	0.49			
	12	---	---	---	---	---	---	---	---			
78	0-4	27-35	1.20-1.30	0.2-0.6	0.09-0.11	8.5-9.0	<8	Low	0.10	1	8	.5-1
Persayo	4-11	20-30	1.10-1.20	0.2-0.6	0.16-0.18	8.5-9.0	<8	Moderate	0.49			
	11	---	---	---	---	---	---	---	---			
79*:												
Persayo	0-5	18-27	1.20-1.30	0.6-2.0	0.15-0.17	8.5-9.0	<8	Moderate	0.37	1	4L	.5-1
	5-12	20-30	1.10-1.20	0.2-0.6	0.16-0.18	8.5-9.0	<8	Moderate	0.49			
	12	---	---	---	---	---	---	---	---			
Persayo	0-4	27-35	1.20-1.30	0.2-0.6	0.09-0.11	8.5-9.0	<8	Low	0.10	1	8	.5-1
	4-11	20-30	1.10-1.20	0.2-0.6	0.16-0.18	8.5-9.0	<8	Moderate	0.49			
	11	---	---	---	---	---	---	---	---			
Badland.												
80*:												
Persayo	0-3	18-27	1.20-1.30	0.6-2.0	0.15-0.17	8.5-9.0	<8	Moderate	0.37	1	4L	.5-1
	3-12	20-30	1.10-1.20	0.2-0.6	0.16-0.18	8.5-9.0	<8	Moderate	0.49			
	12	---	---	---	---	---	---	---	---			
Chipeta	0-5	28-47	1.15-1.25	0.06-0.2	0.11-0.16	7.4-8.4	8-16	Moderate	0.43	1	4L	<2
	5-17	35-45	1.15-1.25	0.06-0.2	0.11-0.16	7.4-9.0	8-16	Moderate	0.43			
	17	---	---	---	---	---	---	---	---			
81*:												
Persayo	0-2	20-27	1.20-1.30	0.6-2.0	0.08-0.10	8.5-9.0	<8	Low	0.10	1	8	.5-1
	2-11	20-30	1.10-1.20	0.2-0.6	0.16-0.18	8.5-9.0	<8	Moderate	0.49			
	11	---	---	---	---	---	---	---	---			
Greybull	0-3	19-22	1.20-1.30	0.6-2.0	0.14-0.17	7.9-8.4	<2	Low	0.37	3	4L	.5-1
	3-34	19-24	1.20-1.30	0.6-2.0	0.14-0.17	7.9-9.0	<2	Low	0.43			
	34	---	---	---	---	---	---	---	---			
82	0-2	15-24	1.15-1.25	2.0-6.0	0.11-0.14	7.9-8.4	<2	Low	0.15	1	8	1-3
Podo	2-11	13-27	1.35-1.45	2.0-6.0	0.11-0.14	7.9-8.4	<2	Low	0.17			
	11	---	---	---	---	---	---	---	---			

See footnote at end of table.

TABLE 13.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding		High water table			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
				Ft			In		In				
62*:													
Midfork	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	High	Low.
Comodore	D	None	---	>6.0	---	---	10-20	Hard	---	---	Moderate	Moderate	Low.
63*:													
Midfork	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	High	Low.
Podo	D	None	---	>6.0	---	---	8-20	Hard	---	---	Moderate	Moderate	Low.
64--- Minchey	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	High	Moderate.
65, 66, 67--- Mivida	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	High	Moderate.
68--- Moffat	B	None	---	>6.0	---	---	>60	---	---	---	Low	High	Moderate.
69*:													
Moffat	B	None	---	>6.0	---	---	>60	---	---	---	Low	High	Moderate.
Persayo	D	None	---	>6.0	---	---	10-20	Soft	---	---	Low	High	Moderate.
70*:													
Welman	C	None	---	>6.0	---	---	20-40	Hard	---	---	Low	High	Moderate.
Travessilla	D	None	---	>6.0	---	---	7-20	Hard	---	---	Moderate	High	Low.
Rock outcrop.													
71--- Pathead	C	None	---	>6.0	---	---	20-40	Hard	---	---	Moderate	High	Moderate.
72*:													
Pathead	C	None	---	>6.0	---	---	20-40	Hard	---	---	Moderate	High	Moderate.
Curecanti	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	Moderate	Low.
73, 74--- Penoyer Variant	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	High	Low.
75*--- Perma	B	None	---	>6.0	---	---	>60	---	---	---	Moderate	Moderate	Low.

TABLE 14.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Atrac	Fine-loamy, mixed, mesic Ustollic Camborthids
Beje	Loamy, mixed Lithic Argiborolls
Billings	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents
Brycan	Fine-loamy, mixed Cumulic Haploborolls
Cabba family	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Casmos	Loamy, mixed (calcareous), mesic Lithic Torriorthents
Chipeta	Clayey, mixed (calcareous), mesic, shallow Typic Torriorthents
Chupadera	Coarse-loamy, mixed, mesic Ustollic Calciorthids
Comodore	Loamy-skeletal, mixed Lithic Haploborolls
Croydon	Fine-loamy, mixed Argic Cryoborolls
Curecanti family	Loamy-skeletal, mixed Typic Argiborolls
Datino	Loamy-skeletal, mixed Typic Haploborolls
Datino Variant	Loamy-skeletal, mixed Typic Haploborolls
Doney family	Fine-loamy, mixed, frigid Typic Ustochrepts
Falcon	Loamy, mixed Lithic Haploborolls
Ferron	Coarse-silty, mixed (calcareous), mesic Typic Fluvaquents
Frandsen	Fine-loamy, mixed (calcareous), frigid Typic Ustorthents
Gerst	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Glenberg family	Coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Green River	Coarse-loamy, mixed (calcareous), mesic Aquic Ustifluvents
Greybull	Fine-loamy, mixed (calcareous), mesic Typic Torriorthents
Grobutte family	Loamy-skeletal, mixed (calcareous), frigid Ustic Torriorthents
Guben	Loamy-skeletal, mixed Typic Calciborolls
Haverdad	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Hernandez family	Fine-loamy, mixed, mesic Ustollic Calciorthids
Hunting	Fine-silty, mixed (calcareous), mesic Aquic Ustifluvents
Juva Variant	Coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents
Killpack	Fine-silty, mixed (calcareous), mesic Typic Torriorthents
Libbings	Fine, mixed, mesic Typic Salorthids
Midfork family	Loamy-skeletal, mixed Typic Cryoborolls
Minchey	Fine-loamy, mixed, mesic Typic Calciorthids
Mivida	Coarse-loamy, mixed, mesic Ustollic Calciorthids
Moffat	Coarse-loamy, mixed, mesic Typic Calciorthids
Nelman	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Pathead	Loamy-skeletal, mixed (calcareous), frigid Typic Ustorthents
Penoyer Variant	Coarse-silty, mixed (calcareous), mesic Typic Torriorthents
Perma family	Loamy-skeletal, mixed Typic Haploborolls
Persayo	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
Podo	Loamy, mixed (calcareous), frigid Lithic Ustorthents
Rabbitex	Fine-loamy, mixed Typic Calciborolls
Rabbitex family	Fine-loamy, mixed Typic Calciborolls
Rafael	Fine-silty, mixed (calcareous), mesic Typic Haplaquepts
Ravola	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents
Rottulee family	Fine-loamy, mixed Typic Haploborolls
Sagers	Fine-silty, mixed (calcareous), mesic Typic Torriorthents
Saltair	Fine-silty, mixed, mesic Typic Salorthids
Senchert	Fine-loamy, mixed Argic Pachic Cryoborolls
Senchert family	Fine-loamy, mixed Argic Pachic Cryoborolls
Sheepcan	Fine-loamy, mixed (calcareous), frigid Typic Ustorthents
Shupert	Fine-loamy, mixed (calcareous), frigid Typic Ustifluvents
Silas	Fine-loamy, mixed Cumulic Cryoborolls
Stormitt	Loamy-skeletal, carbonatic, mesic Ustollic Calciorthids
Strych	Loamy-skeletal, mixed, mesic Ustollic Calciorthids
Toze family	Fine-loamy, mixed Calcic Pachic Cryoborolls
Trag	Fine-loamy, mixed Typic Argiborolls
Travessilla	Loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents
Travessilla family	Loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents
Uinta family	Fine-loamy, mixed Typic Cryoboralfs
Winetti	Loamy-skeletal, mixed (calcareous), frigid Typic Ustifluvents
Winetti Variant	Sandy-skeletal, mixed (calcareous), mesic Ustic Torriorthents

* U.S. GOVERNMENT PRINTING OFFICE : 1988 O - 183-510

Section 8

SOIL RESOURCES

8.1 Scope

A soil inventory of the Blue Blaze No. 1 and 2 Mines was conducted to provide soil resource information to meet the requirements of the Utah Division of Oil, Gas and Mining and the Office of Surface Mining. The soil survey was performed by Richard A. ~~Foster, Soil~~ Scientist, (USDA Soil Conservation Service) in February 13 1990. (See in this section). This is in addition to the soil survey which was performed by George Cook, (Range Conservationist), Earl Jensen, (Soil Scientist) and Gary Moreau, (District Conservationist) in May 1980. (See Appendices 5)

P8-10 stated NOV. 3 1990

8.2 Methodology

Soil mapping of the Blue Blaze No. 1 and 2 mine (Plate 8-1) is a refinement of USDA Soil Conservation Service manuscript mapping. The Soils Mapping was done by Patrick D. Collins (Botanist/Reclamation Specialist) using the information supplied by the Soil Conservation Service as to the locations, types of soil and to what depths they exist. This was done with the report of George Cook, (Range Conservationist).

George Cook (Range Conservationist), and Richard A. Foster used the same method of pit digging to estimate to what depths the soil extends and the quality of the soil. Detailed pedon descriptions are described to depths of 60 inches or more, or until bedrock, whichever was shallowest. These pits were made extending from below the No. 1 Mine area up the canyon where all disturbance will occur also locating all of the disturbed land areas which were previously disturbed.

The soils which are going to be saved for future reclamation were tested at a approved laboratory under the Divisions guidelines. The parameters tested were pH, electrical conductivity, saturation percent, particle size, soluble Ca, Mg & Na, Total N, Nitrate-N, Organic carbon, Available water capacity, Rock fragments above 2mm size, and soil color. Where a high pH was indicated, these tests were preformed for Selenium and Boron.

P+P. Statement ?

Present and potential uses of the soils of the site have been evaluated based on SCS Soil Survey Interpretation information. The soils have no potential as cropland or pasture land. The soils have also been evaluated for the potential production as rangeland and their capability groups are given.

Contradicts statement on 8-12

Soil names and classification given in this report are tentative. The soils in this report are names for ~~similar soils that are presently being mapped by~~ the SCS in the area. The soils have been correlated by the SCS. Classifications are based on

There statements are contradictory!

No way

morphology as described in the field, and to a lesser degree on the analytical data. Where analytical data do not support the field description the soils are classified according to the field description.

8.3 Soil Resource Information for the Mine Plan Area

8.3.1 Soils Identification

The soils at the Blue Blaze No. 1 and 2 Mines were initially examined by on sight identification. This allowed the consultant to determine slopes, land forms, and vegetation patterns (See Section 8.2). The soil descriptions were compared with recorded characteristics of the soils in adjacent areas and in the official Soil Conservation Service (SCS) series descriptions. Map units are comprised of soil series and inclusions found within an area to make them site specific. The comparison of the previous symbols of the Soil Conservation Service report located in Appendix 4 used in this PAP to the new Soil Conservation Service dated June 1988 located on the Soils Map 8-1, and changes are as follows:

FIA	=	Shupert
GIG	=	Curecanti
HIG	=	Senchert
JIB	=	Brycan Loam
DM	=	Mine Dumps (Previous Disturbed Area)

Soil #1 Hubert SCS: Typic Ustifluvents

Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvents

Colors are for dry soil unless otherwise noted.

A -- 0 to 6 inches (0 to 15.2cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate thin platey structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine, many very fine roots; many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C1 -- 6 to 12 inches (15.2 to 30.5cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; few fine, common very fine roots; common fine, many very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C2 -- 12 to 26 inches (30.5 to 66 cm); light brownish gray (10YR 6/2) silty clay loam, dark [illegible] brown (10YR 4/2) moist; weak coarse [illegible] blocky structure; hard, firm, [illegible] and very fine roots; comm [illegible] m tubular pores; moderately [illegible] ted; strongly alkaline (p[illegible]

Fearean
this goes in the
unupdated Blue Blaze
plan.
Thanks
Kenny

C3 -- 26 to [illegible] ale brown (10YR 6/3) sandy c[illegible] (10YR 4/2) moist; massive; sli[illegible] sticky and slightly pla[illegible] fine, common very fine random [illegible] areous, lime is disseminated; [illegible] clear smooth boundary.

C4 -- 40 to 5[illegible] pale brown (10YR 6/3) loam, ve[illegible] 2) moist; many fine distinct [illegible] slightly hard, friabl[illegible] ightly plastic; few very fine roots; few fin[illegible] very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

2C -- 57 to 65 inches (144.8 to 165.1 cm); very pale brown (10YR 7/4) loamy fine sand, brown (10YR 5/3) moist; common fine distinct (10YR 5/8) mottles; massive; soft, very friable, nonsticky and nonplastic; few very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (ph 8.5).

The C2 horizon has thin strata of material like the C3 horizon. The C3 horizon has thin strata of material like the C4 horizon.

Soil #1 Hubert SCS: Typic Ustifluvents

Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvents

Colors are for dry soil unless otherwise noted.

A -- 0 to 6 inches (0 to 15.2cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate thin platey structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine, many very fine roots; many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C1 -- 6 to 12 inches (15.2 to 30.5cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; few fine, common very fine roots; common fine, many very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C2 -- 12 to 26 inches (30.5 to 66 cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; hard, firm, sticky and plastic; few fine and very fine roots; common fine, many very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C3 -- 26 to 40 inches (66 to 101.6 cm); pale brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine, common very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C4 -- 40 to 57 inches (101.6 to 144.8 cm); pale brown (10YR 6/3) loam, very dark grayish brown (10YR 3/2) moist; many fine distinct (10YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine and very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

2C -- 57 to 65 inches (144.8 to 165.1 cm); very pale brown (10YR 7/4) loamy fine sand, brown (10YR 5/3) moist; common fine distinct (10YR 5/8) mottles; massive; soft, very friable, nonsticky and nonplastic; few very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (ph 8.5).

The C2 horizon has thin strata of material like the C3 horizon. The C3 horizon has thin strata of material like the C4 horizon.

Soil #2 sHubert

Loamy-skeletal, mixed (calcareous), frigid Ustic Torrifluvents

Colors are for dry soil unless otherwise noted. Moist colors are darker in the upper three horizons due to the presence of coal. This is a disturbed site.

C1 -- 0 to 6 inches (0 to 15.2 cm); pale brown (10YR 6/3) sandy loam, very dark gray (10YR 3/1) moist; moderate thin platey structure parting to weak fine and very fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few coarse and medium, many fine and very fine roots; few medium and fine, many very fine random tubular pores; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4); clear smooth boundary.

C2 -- 6 to 19 inches (15.2 to 48.3 cm); pale brown (10YR 6/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and fine, many very fine roots; few medium and fine, many very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear wavy boundary.

C3 -- 19 to 34 inches (48.3 to 86.4 cm); light yellowish brown (10YR 6/4) extremely gravelly sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few medium, fine, and very fine roots; few fine, common very fine random tubular pores; 10 percent cobble, 50 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C4 -- 34 to 47 inches (86.4 to 119.4 cm); pale brown (10YR 6/3) extremely gravelly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine and very interstitial pores; 20 percent cobble, 50 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.3); gradual wavy boundary.

C5 -- 47 to 60 inches (119.4 to 152.4cm); light yellowish brown (10YR 6/4) extremely cobbly sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; many fine and very fine interstitial pores; 10 percent stone, 55 percent cobble, 10 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4).

Soil #3 Curecanti SCS Loamy-skeletal, mixed Typic Argiborolls

Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents

Colors are for dry soil unless otherwise noted.

A -- 0 to 5 inches (0 to 12.7 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to moderate fine and very fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few coarse, common medium, many fine and very fine roots; common medium and fine, many very fine random tubular pores; 25 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4); clear wavy boundary.

Bk1 -- 5 to 20 inches (12.7 to 50.8 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, common fine, many very fine roots; common fine, many very fine random tubular pores; 20 percent gravel; moderately calcareous, lime is disseminated and in thin coatings on rock fragments; moderately alkaline (pH 8.4); gradual wavy boundary.

Bk2 -- 20 to 45 inches (50.8 to 114.3 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, common fine and very fine roots; few fine, many very fine random tubular pores; 5 percent cobble, 20 percent gravel; moderately calcareous, lime is disseminated and in thin coatings on rock fragments; strongly alkaline (pH 8.5); clear wavy boundary.

Bk3 -- 45 to 51 inches (114.3 to 129.5 cm); yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; few fine, common very fine random tubular pores; 5 percent cobble, 40 percent gravel; moderately calcareous, lime is disseminated and in thin coatings on rock fragments; strongly alkaline (pH 8.5); clear wavy boundary.

Bk4 -- 51 to 70 inches (129.5 to 177.8 cm); brown (10YR 5/3) gravelly loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, fine, and very fine roots; few fine and very fine random tubular pores; 25 percent gravel; moderately calcareous, lime is disseminated and in few fine veins and thin coatings on rock fragments; strongly alkaline (pH 8.5).

Soil #4 Hubert

Loamy-skeletal, mixed (calcareous), frigid Ustic Torriorthents

Colors are for dry soi unless otherwise noted. Moist colors are darker due to the presence of coal.

A -- 0 to 10 inches (0 to 25.4 cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and fine, many very fine roots; common medium, many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); clear smooth boundary.

C1 -- 10 to 17 inches (25.4 to 43.2 cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium, common fine and very fine roots; few medium, common fine and very fine random tubular pores; 10 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C2 -- 17 to 35 inches (43.2 to 88.9 cm); pale brown (10YR 6/3) very cobbly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 10 percent stone, 15 percent cobble, 15 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C3 -- 35 to 60 inches (88.9 to 152.4 cm); light yellowish brown (10YR 6/4) extremely cobbly sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine and very fine random tubular pores; 10 percent stone, 20 percent cobble, 30 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5).

Soil #5

Hubert

Fine-loamy, mixed Pachic Haploborolls

Colors are for dry soil unless otherwise noted. Less than 5 percent stone and cobbles on the surface.

A1 -- 0 to 8 inches (0 to 20.3 cm); dark brown (10YR 4/3) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium, common fine, many very fine roots; few medium, common fine, many very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear smooth boundary.

A2 -- 8 to 18 inches (20.3 to 45.7 cm); dark brown (10YR 4/3) gravelly loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and fine, common very fine roots; common medium and fine, many very fine random tubular pores; 20 percent gravel; noncalcareous; moderately alkaline (pH 8.2); gradual wavy boundary.

A3 -- 18 to 43 inches (45.7 to 109.2 cm); dark brown (10YR 4/3) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C -- 43 to 60 inches (109.2 to 152.4 cm); pale brown (10YR 6/3) very cobbly loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine and very fine random tubular pores; 20 percent cobble, 30 percent gravel; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.2).

Soil #6

Fenchert SCS: Fine-loamy, mixed Argic Pachic Cryoborolls

Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents

Colors are for dry soil unless otherwise noted.

A -- 0 to 5 inches (0 to 12.7 cm); pale brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common coarse, medium, fine, and very fine roots; common medium, many fine and very fine random tubular pores; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.2); clear wavy boundary.

C1 -- 5 to 14 inches (12.7 to 35.6 cm); pale brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; few medium, common fine, many very fine random tubular pores; 5 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.2); clear wavy boundary.

C2 -- 14 to 18 inches (35.6 to 45.7 cm); pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few medium and fine, common very fine roots; few medium and fine, many very fine random tubular pores; 5 percent gravel; slightly calcareous, lime is disseminated; strongly alkaline (pH 8.6); clear wavy boundary.

C3 -- 18 to 28 inches (45.7 to 71.1 cm); pale brown (10YR 6/3) very gravelly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine, common very fine roots; few fine, common very fine random tubular pores; 40 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C4 -- 28 to 48 inches (71.1 to 121.9 cm); pale brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 10 percent gravel with thin lenses of 50 percent gravel; moderately calcareous, lime is disseminated; strongly alkaline (pH 8.5); gradual wavy boundary.

C5 -- 48 to 60 inches (121.9 to 152.4 cm); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.4).

Soil #7

Bryan SCS: Fine-loamy, mixed Cumulic Haploboroll

Fine-loamy, mixed Pachic Haploborolls

Colors are for dry soil unless otherwise noted.

A1 -- 0 to 10 inches (0 to 25.4 cm); brown (10YR 5/3) loam, very dark brown (10YR 2/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse and medium, common fine and very fine roots; few medium, common fine, many very fine random tubular pores; 5 percent gravel; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.2); clear wavy boundary.

A2 -- 10 to 17 inches (25.4 to 43.2 cm); brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear wavy boundary.

A3 -- 17 to 34 inches (43.2 to 86.4 cm); pale brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse, medium, and fine, common very fine roots; few fine, common very fine random tubular pores; 5 percent gravel; noncalcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C1 -- 34 to 52 inches (86.4 to 132.1 cm); pale brown (10YR 6/3) clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, firm, sticky and plastic; few fine and very fine roots; few fine, common very fine random tubular pores; noncalcareous; moderately alkaline (pH 8.2); abrupt wavy boundary.

C2 -- 52 to 60 inches (132.1 to 152.4 cm); light yellowish brown (10YR 6/4) clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; few fine and very fine random tubular pores; slightly calcareous, lime is disseminated; moderately alkaline (pH 8.2).

Disturbed Land Material

The disturbed land material consists of generally deep, nearly level to nearly vertical, moderately well-drained materials. These materials are fill derived from sandstone, shale, and coal from previous mining operations. The annual precipitation is 16 to 20 inches. The mean annual air temperature ranges from 38 degrees F. to 45 degrees F. and the frost free period is 60 to 120 days. The native vegetation has been disturbed in the mine area.

The availale water capacity is moderate to low and permeability is moderate. These soils were used for previous mining activities. A description of disturbed land fill material, comprises most of the area for the proposed mine.

what?

Soils are identified by four different catagories and are mapped as such. Depths and types of soil were identified by SCS also the area which they cover allows the amount of topsoil that can be saved for reclamation. (See Plate 8-1 and Section 8.2 for Methodology.

Presentive soil survey is questionable therefore it is not proper to base topsoil salvage volume on the survey

You mean Plate 8-2

A complete survey of the soil area was completed on November 3, 1990. The new results were entered on Plate 8-2 and with the use of a planimeter the following amounts of soil were calculated.

Soil Type	Number	Depth to be Stored	Area Sq. Ft.	Volume Cubic Yard
Shupert	1	42" 3.5 ft	10,050	1,302.8
Shupert	2	42" 3.5	9,500	1,231.5
Curecanti	3	78" 6.5	15,375	3,701.4
Shupert	4	18" 1.5	15,625	868.1
Shupert	5	60" 5.0	19,475	3,606.5
Senchert	6	18" 1.5	4,725	262.5
Brycan Loam	7	60" 5.0	46,325	6,384.3 8578.7

Total cubic yard recoverable ----------17,356.9

Cubic yards required in reclamation new disturbance at 7.4 acres coverage at 12" deep ----------11,938.6

the disturbance created during mining activities (approx 10 acres) is the true area affected.

Total Dist. in Plan

This will leave extra cubic yards of soils that can be used in additional areas or extend the depth in the areas to be reclaimed.----------5418.3

Soil will be put in three different stockpiles so that the soil can be spread over a larger area to allow better control over soil nutrients. See Plate 8-2 and Table 8-1

Table 8-1

Depth calculations for 3 soil stockpiles

Feet	Area A cu.yds.	Area B cu.yds.	Area C cu.yds.	Total cu.yds.
0	0	0	0	0
1	1466.7	916.2	900.0	3282.7
2	2854.2	1784.0	1754.4	6392.6
3	4183.8	2604.5	2564.3	9332.6
4	5379.8	3378.9	3331.0	12089.7
Total Amount Required For Reclamation ----------				11938.6
5	5637.1	4108.4	4055.6	14701.1
6	7620.0	4794.2	4739.3	17153.5
7	8629.8	5437.5	5383.3	19450.6
8	9567.6	6039.5	5988.8	21505.9
Total Amount of Savable Soil----------				17356.9

Soil Stockpiles will be surveyed after they are in place to verify the amounts of soil are sufficient for reclamation.

Mapping Legend

The following is the soil legend showing the soil symbol and soil mapping unit name. These symbols are used on the soils map.

Soil Symbol	Soil Mapping Unit Name
FIA - Shupert	FIA loam, 0 to 1% slopes
GIG - Curecanti	Marcar Variant, very bouldery loam, 55-65% slopes
HIG - Senchert	HI silt loam, 50-70% slopes
JIB - Brycan Loam	Brycan loam, 4-6% slopes
DM - Mine Dumps	Previous Disturbed Areas

The numbered soil classifications, that are located on the map are in correspondence with the number on the following soil descriptions. Also included on the mapping is an isopach as to what depths soils can be saved.

Additional points which were sampled on the surface soils and correspond to numbers on the soils map are for C & W Coal which will not be in the disturbed area are located in (Appendices 5).

8.3.3 Present and Potential Uses Crops and Pasturelands

None of the soils mapped at the site have potential for crops or pastureland.

The U.S. Department of Agriculture has the authority to identify farmlands of national, state, or local importance. These farmlands are referred to as prime farmlands, farmlands of statewide importance, and unique farmlands. The SCS has determined that there are no prime farmlands of statewide importance, or unique farmlands in the permit area. (See Figure 8-1)

Rangelands

The soils of the site area have been used as rangeland in the past. Data on predicted forage production for rangeland soils during favorable, normal, and unfavorable years for various sites are not available. The principle limitations are erosion and shallowness. Capability units show, in a general way, the ability of soils can't support cultivated crops according to the SCS. Soils incapability have very severe limitations that restrict their use largely to grazing, woodland or wildlife.

What Capability units?

8.4 Prime Farmland Investigation and Determination

In June 1980, C & W Coal Producers now (Blue Blaze Coal) requested that SCS personnel in Price, Utah review all the soils present within the Blue Blaze No. 1 and 2 Mine property to determine if any qualified as prime farmland. At that time, the SCS made a field reconnaissance to confirm soil types. The field information was then checked against the State listing on prime farmland soils. At this time the State Soil Scientist determined there are no prime farmlands on Blue Blaze's No. 1 or No. 2 Mine areas. (See Figure 8-1)

Figure 8-1

PO Box 11350
Salt Lake City, UT 84147

September 12, 1990

William R. Skaggs
Blue Blaze Coal Company
PO Box 784
Price, UT 84501

Dear Mr. Skaggs:

In response to your request August 14, 1990, we have made a review of Sections 7, 8, 17, 18, and 20, T. 13S., R8E., SLM for Important Farmlands determination.

None of these areas qualified as Important Farmland soils: steep slopes, stoney, or bouldry surfaces and soil disturbance from previous construction work are factors that eliminate these sects from categories of Important Farmlands.

Sincerely,

FERRIS P. ALLGOOD
State Soil Scientist

cc:
Price Field Office/Jan Anderson

11/25/90

8.5 Soils, Physical and Chemical Properties of Soils and Results of Analysis

Method of Evaluation

The criteria for evaluating soil as a plant growth media area are given in Table 8-2. The criteria include sodium absorption ration (SAR), electrical conductivity or salinity (EC), toxic materials, soil reaction (pH), available water hold capacity (AWMC), erosion factor (K), wind erosion group, texture and percent coarse fragments.

Criteria are given for good, fair or poor sources of reconstruction material (Table 8-2). A good rating means vegetation is relatively easy to establish and maintain, the surface is stable and resists erosion, and the reconstructed soil has good potential productivity. Material rated fair can be vegetated and stabilized by modifying one or more properties. Top dressing with better material or application of soil amendments may be necessary for satisfactory performance. Material rated poor has such severe problems that revegetation and stabilization is very difficult and costly. Top dressing with better material may be necessary to establish and maintain vegetation (USDA, 1978).

Table 8-2

Soil Reconstruction Material for Drastically Disturbed Areas

Property	Limits			Restrictive Feature
	Good	Fair	Poor	
1. Sodium Adsorption Ratio (SAR)	5	5-12	12	Excess Sodium
2. Salinity (MMHOS/CM)	8	8-16	16	Excess Salt
3. Toxic Materials	Low	Medium	High	Toxicity
4. Soil Reaction (pH)[a]	5.6-7.8	4.5-5.5	4.5	Too Acid
5. Soil Reaction (pH)	7.9	7.9-8.4	.05	Excess Lime
6. Available Water Capacity (IN/IN)[2]	.10	.05-.10	.05	Droughty
7. Erosion Factor (K)	.37	.37	---	Erodes Easily
8. Wind Erod. Group	3	3	1, 2	Soil Blowing
9. USDA Texture	---	SCL, CL SICL	C[b] SIC[b] SC	Too Clayey
10. USDA Texture	---	LCOS, LS LFS, LVFS	COS. S FS, VFS	Too Sandy
11. Coarse Frag. (WT PCT) 3-10 in. (7.6-25.4 cm)	15	15-35	35	Large Stones
10 in. (725.4 cm)	3	3-10	10	Large Stones

[a] Layers with high potential acidity should be rated poor.

[b] If in kaolinitic family, rate one class better if experience confirms.

From National Soils Handbook, NSH - Part II [403.6(2)], 1978.

Soil Chemistry and Physical Properties

Chemical and physical data for project area soils were collected to evaluate the soils as reconstruction material for disturbed lands. Soil chemical and physical data from analysis by Agricultural Consultants are reported in Table 8-2. The parameters tested were under the Divisions guidelines; pH, electrical conductivity, saturation percentage, particle size, soluble Ca, Mg & Na, sodium absorption ratio, total N, nitrate-N, organic carbon, available water capacity, rock fragments, and soil color. If the pH ran high the samples were tested for selenium and boron.

Suitability as a Source Material for Reclamation of Disturbed Lands

Table 8-3 contains a chemical evaluation of the soils in the undisturbed area and the area to be redisturbed. This evaluation shows if the soils are rated good, fair or poor sources of reconstruction material. The overall rating given for each horizon is the rating for the most limiting criteria, and no horizon can be rated better than an overlying horizon.

Vegetation is difficult to establish on soils with high SAR which indicates potential instability of water transmission problems (USDA, 1978). All of the soils of the site were rated good for SAR.

Electrical conductivity is a measure of soil salinity. Excessive salts restrict plant growth, create problems in establishing vegetation and therefore also influence erosion and the stability of the surface (USDA, 1978). All of the soils of the site were rated good for EC.

Excessively high or low pH causes problems in establishing vegetation and as a result influences erosion and stability of the surface (USDA, 1978). The substratum of the soils are rated good for pH.

The available water holding capacity (AWHC) also is important in establishing vegetation. Soils with low available water capacity may require irrigation for establishment of vegetation (USDA, 1978). AWHC was estimated based on field texture and percent coarse fragments (U.S. Forest Service, 1974). The soils are rated good for AWHC.

The stability of the soil depends upon its erodibility by water and wind and its strength. Water erodibility is indicated by the K factor; wind erodibility is rated according to the wind erodibility group. K values for soils of the project area are from the best data available in the SCS Soil Survey Interpretation Records (USDA, 1978). Soils of the site are rated good for erodibility. Wind erodibility is based on SCS Soil Survey

Interpretation Records for the surface horizons. Wind erodibility data area available for only the surface soils of the site (USDA, 1978). The surface layers of the Pathead and Curecanti soils are rated good for wind erodibility.

USDA texture also influences available water capacity and erodibility by wind or water. Texture influences soil structure, consistence, water intake rate, runoff, fertility, workability, and trafficability. Potential slippage hazard is related to soil texture, and although other factors also contribute, the ratings of soil texture represent one important factor (USDA, 1978). Soil texture for soils of the site are rated fair to poor, but are generally not considered the limiting factors. The fill textures for soils of the site were described in the field and the evaluations are based on the field determinations.

Coarse fragments influence the ease of excavation, stockpiling and respreading, and suitability for the final use of the land. A certain amount of coarse fragments can be tolerated depending upon the size and intended use of the reclaimed area. If the size of rock fragments exceeds 10 inches (25 cm) the problems are more severe. Coarse fragments are evaluated based on pedon descriptions for soils of project areas. Coarse fragments are the limiting factor for most of the project area soils.

Table 8-3
Soil Chemical and Physical Properties

Sample Depth (cm)	pH	mmhos/cm Ec	Sat%	Partical Size%	meq/l Ca	meq/l Mg	meq/l Na	SAR	Rock Fragments	N%	Nitrate N mg/kg	Organic Carbon	Selenium mg/kg	Boron mg/kg	Available Water Capacity
Pit #1															
0-15	7.9	0.6	82.4	%Sand 0 %Silt 56 %Clay 44	3.42	2.45	0.89	0.52	34.0%	0.35	13.2	3.58%	<0.1	1.24	33.5 @1/3 16.0 @ 15
15-30	8.0	0.5	79.6	%Sand 2 %Silt 56 %Clay 42	2.94	2.56	0.81	0.48	46.1%	0.31	15.2	3.23%	<0.1	0.86	32.0 @1/3 15.9 @ 15
30-45	8.0	0.7	29.6	%Sand 27 %Silt 40 %Clay 33	3.60	2.50	1.54	0.88	40.0%	0.27	0.4	1.44%			32.3 @1/3 15.2 @ 15
45-75	7.8	1.2	26.2	%Sand 51 %Silt 33 %Clay 16	4.93	3.33	0.46	0.23	70.5%	0.25	0.3	2.65%			29.2 @1/3 14.5 @ 15
76-106	7.8	1.1	28.8	%Sand 54 %Silt 33 %Clay 13	5.99	3.90	2.72	1.22	61.3%	0.19	0.36	2.80%			27.5 @1/3 12.7 @ 15
Pit #2															
0-15	7.8	0.7	54.9	%Sand 27 %Silt 55 %Clay 18	2.74	2.47	0.59	0.37	20%	0.50	11.6	8.90%	<0.1	0.63	26.9 @1/3 11.6 @ 15
15-30	7.8	0.4	50.2	%Sand 33 %Silt 50 %Clay 17	2.68	2.02	0.73	0.48	20.1%	0.22	2.40	5.66%	<0.1	0.55	22.3 @1/3 9.7 @ 15
30-45	7.7	1.0	24.5	%Sand 81 %Silt 6 %Clay 13	3.05	1.94	0.75	0.47	6.2%	0.06	0.07	9.83%			17.2 @1/3 9.8 @ 15
45-75	7.7	0.7	25.0	%Sand 61 %Silt 31 %Clay 8	4.05	1.50	2.93	1.76	12.4%	0.23	0.05	6.95%			17.9 @1/3 9.4 @ 15
76-106	7.8	0.7	26.2	%Sand 68 %Silt 27 %Clay 5	4.32	1.49	0.90	0.53	12.1%	0.15	0.05	17.91%			11.2 @1/3 6.7 @ 15
Pit #3															
0-15	8.0	0.6	36.7	%Sand 46 %Silt 37 %Clay 17	3.90	0.73	0.91	0.60	30.2%	0.18	2.4	3.42%	<0.1	3.04	17.0 @1/3 7.4 @ 15
15-30	8.0	0.9	41.7	%Sand 43 %Silt 39 %Clay 18	6.72	1.33	0.62	0.31	14.5%	0.19	2.0	2.04%	<0.1	3.16	19.9 @1/3 7.7 @ 15
30-45	8.0	.08	38.9	%Sand 51 %Silt 34 %Clay 15	6.10	1.31	0.96	0.50	26.7%	0.14	0.0	1.60			14.4 @1/3 6.3 @ 15
45-75	8.0	0.6	36.1	%Sand 52 %Silt 34 %Clay 14	4.74	1.25	0.92	0.53	28.5%	0.18	0.0	1.25			14.6 @1/3 5.8 @ 15
76-106	8.0	0.7	40.8	%Sand 43 %Silt 39 %Clay 18	5.09	1.59	1.03	0.56	18.0%	0.10	0.0	1.68			16.5 @1/3 7.4 @ 15
106-137	8.0	0.6	35.1	%Sand 52 %Silt 33 %Clay 15	4.17	1.07	1.07	0.66	32.2%	0.12	10.0	1.59			15.2 @1/3 6.2 @ 15
137-167	8.0	0.4	32.4	%Sand 50 %Silt 34 %Clay 16	2.70	1.03	0.78	0.57	21.6%	0.09	7.8	1.26			15.3 @1/3 6.1 @ 15
167-198	8.0	0.4	33.9	%Sand 50 %Silt 33 %Clay 17	2.47	1.42	0.80	0.57	26.7%	0.11	8.8	1.91			15.4 @1/3 6.0 @ 15
Pit #4															
0-15	7.9	0.5	53.2	%Sand 32 %Silt 51 %Clay 17	2.94	1.96	0.95	0.60	21.3%	0.24	<0.1	4.47	<0.1	1.48	22.2 @1/3 9.3 @ 15
15-30	7.7	1.0	33.2	%Sand 53 %Silt 33 %Clay 14	4.80	4.65	1.40	0.64	22.5%	0.11	2.0	2.77	<0.1	1.48	13.7 @1/3 5.6 @ 15
30-45	8.1	0.7	36.4	%Sand 48 %Silt 39 %Clay 13	5.18	2.74	1.00	0.50	23.7%	0.17	0.7	3.14			17.0 @1/3 7.2 @ 15

(Cont.)

Table 8-3
Soil Chemical and Physical Properties

Sample Depth (cm)	pH	mmhos/cm Ec	Sat%	Partical Size%	meq/l Ca	meq/l Mg	meq/l Na	SAR	Rock Fragments	N%	Nitrate N mg/kg	Organic Carbon	Selenium mg/kg	Boron mg/kg	Available Water Capacity
								Pit #5							
0-15	7.2	0.4	36.7	%Sand 47 %Silt 38 %Clay 15	2.04	0.53	0.73	0.65	14.7%	0.17	<0.01	1.95	<0.1	1.20	16.6 @1/3 6.7 @ 15
15-30	7.2	0.4	35.1	%Sand 41 %Silt 41 %Clay 18	2.46	0.51	0.74	0.60	11.9%	0.15	<0.01	1.84	<0.1	1.36	15.2 @1/3 8.1 @ 15
30-45	7.2	0.5	32.1	%Sand 49 %Silt 38 %Clay 13	4.07	1.62	0.60	0.36	17.9%	0.16	0.06	1.99			16.5 @1/3 7.9 @ 15
45-75	8.1	0.6	23.8	%Sand 57 %Silt 36 %Clay 7	3.17	0.86	0.57	0.40	24.1%	0.16	0.05	1.99			16.7 @1/3 7.3 @ 15
75-106	7.8	0.6	34.7	%Sand 52 %Silt 33 %Clay 17	2.70	1.00	0.76	0.56	21.0%	0.09	7.8	1.26			15.3 @1/3 7.3 @ 15
106-137	8.0	0.6	31.5	%Sand 54 %Silt 33 %Clay 13	2.90	1.49	0.78	0.53	20.3%	0.11	7.6	2.20			15.2 @1/3 6.2 @ 15
137-152	8.0	0.6	30.2	%Sand 32 %Silt 51 %Clay 17	2.90	1.95	0.93	0.52	20.2%	0.10	7.2	2.00			15.2 @1/3 8.1 @ 15
								Pit #6							
0-15	7.9	0.6	33.5	%Sand 49 %Silt 34 %Clay 17	4.79	0.75	0.77	0.46	2.3%	0.13	0.40	2.16	<0.1	0.67	12.3 @1/3 6.6 @ 15
15-30	8.0	0.5	30.2	%Sand 58 %Silt 28 %Clay 14	3.72	0.75	0.70	0.47	1.0%	0.08	0.96	1.44	<0.1	0.87	10.5 @1/3 5.6 @ 15
30-45	7.8	0.6	29.4	%Sand 56 %Silt 31 %Clay 13	4.88	0.92	0.58	0.34	26.9%	0.11	0.47	2.03			12.2 @1/3 6.3 @ 15
								Pit #7							
0-15	7.8	0.7	37.2	%Sand 50 %Silt 34 %Clay 16	4.24	0.93	0.72	0.45	14.9%	0.29	1.68	8.34	<0.1	1.92	16.7 @1/3 7.7 @ 15
15-30	7.7	0.5	35.6	%Sand 49 %Silt 34 %Clay 17	3.82	0.64	0.68	0.46	33.2%	0.24	0.84	6.97	<0.1	2.24	17.6 @1/3 7.9 @ 15
30-45	7.6	0.6	32.4	%Sand 43 %Silt 38 %Clay 19	3.75	0.78	0.74	0.49	36.4%	0.14	1.68	2.38			18.1 @1/3 7.7 @ 15
45-75	7.5	0.4	34.7	%Sand 43 %Silt 39 %Clay 18	2.53	0.67	0.63	0.49	21.6%	0.14	2.68	1.47			17.8 @1/3 7.2 @ 15
75-106	7.6	0.4	37.5	%Sand 36 %Silt 43 %Clay 21	2.61	0.74	0.61	0.47	17.5%	0.12	2.20	1.63			20.1 @1/3 8.6 @ 15
106-137	7.6	0.5	39.8	%Sand 33 %Silt 43 %Clay 24	3.32	1.04	0.66	0.45	24.3%	0.04	5.60	0.09			21.0 @13 9.0 @ 15
137-152	7.8	0.5	42.1	%Sand 43 %Silt 36 %Clay 21	2.66	1.03	0.93	0.68	16.0%	0.02	7.20	0.00			17.2 @1/3 7.2 @ 15

(Cont.)

Table 8-3
Soil Chemical and Physical Properties

Sample Depth (in.)	pH	mmhos/cm Ec	Sat%	Partical Size	meq/l Ca	meq/l Mg	meq/l Na	SAR	Rock Fragment N%	Nitrate N mg/kg	Organic Carbon	Selenium mg/kg	Boron mg/kg	Available Water Capacity
Pit #8														
Rock Embankment at Enterance to Canyon														
0-12	7.9	1.8	32.4	%Sand 67 %Silt 21 %Clay 12	11.78	7.04	1.71	0.55	3.0%	0.59	7.20	28.41	<0.1	4.80	15.6 01/3 7.7 @ 15
120-132	8.0	0.4	38.5	%Sand 67 %Silt 21 %Clay 12	2.66	0.78	0.93	0.69	5.4%	0.64	0.16	32.25	<0.1	5.19	15.6 01/3 8.9 @ 15
Pit #9A														
3 Feet Above the Hiawatha Seam														
0-36	7.3	1.9	57.4	%Sand 30 %Silt 51 %Clay 19	4.72	10.16	5.43	1.98	9.7%	0.09	2.32	3.5	<0.1	1.61	14.7 01/ 6.7 @ 15
Pit #9B														
3 Feet Below the Hiawatha Seam														
0-36	7.9	7.6	31.5	%Sand 53 %Silt 36 %Clay 11	22.05	89.88	7.79	1.04	9.7%	0.05	0.8	3.95	<0.1	<0.1	11.1 01/ 3.8 @ 15
Pit #10A														
3 Feet Above the Castlegate "A" Seam														
0-36	8.2	0.4	57.6	%Sand 0 %Silt 63 %Clay 37	1.63	2.32	1.29	0.91	8.0%	0.09	0.64	3.72	<0.1	<0.1	23.7 01/3 12.4 @ 15
Pit #10B														
3 Feet Below the Castlegate "A" Seam														
0-36	8.2	0.3	30.3	%Sand 57 %Silt 30 %Clay 13	1.31	0.74	1.33	0.52	8.8%	0.04	1.2	0.71	<0.1	<0.1	11.8 01/3 4.8 @ 15

ACID BASE POTENTIAL

Pit #8

0-12	Neutralization Potential	129.8 tons CaCO3 equivalent/1000 tons
	Maximum Acid Potential	3.1 tons CaCO3 equivalent/1000 tons
	Net Acid Base Potential	126.7 tons CaCO3 equivalent/1000 tons
120-132	Neutralization Potential	70.4 tons CaCO3 equivalent/1000 tons
	Maximum Acid Potential	7.9 tons CaCO3 equivalent/1000 tons
	Net Acid Base Potential	62.5 tons CaCO3 equivalent/1000 tons

Pit #9A
0-3 Feet Above the Hiawatha Seam

0-36	Neutralization Potential	134.40 tons CaCO3 equivalent/1000 tons
	Maximum Acid Potential	.01 tons CaCO3 equivalent/1000 tons
	Net Acid Base Potential	134.39 tons CaCO3 equivalent/1000 tons

Pit #9B
0-3 Feet Below the Hiawatha Seam

0-36	Neutralization Potential	76.4 tons CaCO3 equivalent/1000 tons
	Maximum Acid Potential	3.3 tons CaCO3 equivalent/1000 tons
	Net Acid Base Potential	73.1 tons CaCO3 equivalent/1000 tons

Pit #10A
0-3 Feet above the Castlegate "A" Seam

0-36	Neutralization Potential	59.46 tons CaCO3 equivalent/1000 tons
	Maximum Acid Potential	.03 tons CaCO3 equivalent/1000 tons
	Net Acid Base Potential	59.43 tons CaCO3 equivalent/1000 tons

Pit #10B
0-3 Feet below the Castlegate "A" Seam

0-36	Neutralization Potential	6.00 tons CaCO3 equivalent/1000 tons
	Maximum Acid Potential	.03 tons CaCO3 equivalent/1000 tons
	Net Acid Base Potential	5.97 tons CaCO3 equivalent/1000 tons

Depths of Suitable Topsoil Available for Reclamation

The depths of suitable topsoil are located in Section 8.3.2. This section shows the soil types, the depths of soils, as well as the recommended depth of stripping. Volumes of soil available for storage are also indicated.

Much of the site is mapped as disturbed land. The fill material has variable properties, but the main restrictive features are coarse fragments and slope. The chemistry of the fine earth fraction is fair. The fill material is the only readily available reconstruction material in the mapped area. Included in the map unit DM (Mine Dumps) are areas of excessive large stones, rock outcrops, coal and rock dumps from previous mining. These coal wastes will be removed and disposed of properly. Due to the already disturbed area a limited amount of topsoil can be salvaged for storage.

All disturbance was conducted prior to enactment of regulations requiring salvaging of topsoil. The only surface disturbance that will take place is that which is on the permitting map.(See Plate 3-1)

Soils will be removed to the proper depth by use of an island method and replaced by the use of wooden stakes with depth marks on them to assure equal distribution.

8.6 Use of Selected Overburden Materials or Substitutes

No substitute soils will be needed if enough top soil can be salvaged and stored for final reclamation.(See Section 8.3.2) It is estimated that there will be more than enough topsoil to re-distribute over the 7.4 acres of disturbed land at the rate of 12" deep. These soils will be of a suitable material for a seedbed. See Table 8-4

The locations of soil removal shown on Plate 8-2 are the only areas within the project area where a sufficient amount of useable soil can be collected. The additional areas located on the map were previously disturbed by eariler mines in this same location.

A removal of all coal waste greater than 50% fines and oil or grease, or contaminated material before replacing the saved top soil. This will help add to production of a vegetative cover equal or exceeding that of the original area.

Table 8-4

Seedbed Quality Material Standards for Reclamation

Property	Limits			Restrictive Feature
	Good	Fair	Poor	
1. Sodium Adsorption[a] Ratio (SAR)	6	6-10	10-15	Excess Sodium
2. Salinity(EC) mmhos/cm[a]	0-4	4-8	8-16	Excess Salt
3. Saturation Percentage [a]	25	80	80 25	
4. Soil Reaction (pH)[a]	6.0-8.4	8.4-8.8	8.8-9.0	Excess Lime
5. USDA Texture[a]		Sl, Sil, Vfsl, Fsl Lfs	Cl, S	Too Clayey
6. Zinc and Boron [b]				
7. Coarse Frag. (wt %)[a]				
3-10 in. (7.6-25.4 cm)	0-15	15-25	25-35	Large Stones
10 in. (725.4 cm)	0-3	3-10	7-10	Large Stones

[a] From Wyoming Department of Environmental Quality - Guideline No. 1.

[b] Will vary according to soil type or various environmental factors.

8.7 Removal, Storage, and Protection of Soil Plan

It is proposed to remove the soil using the island method to insure the proper depth of the soil being removed. The soil will be transported to an area shown on Plate 8-1. The soil will then be contured at a rate of not more than 2:1 then contured cut to prevent erosion. After this is accomplished the soil will be hydroseeded using the seed mix listed in Table 3-1 for temporary reclamation. Signs will be placed in this area indicating "Top Soil Storage" also the area will be fenced to prevent livestock from entering the area. A berm will be placed around the stockpile to prevent erosion of the stockpile from entering the water coarses in the area without being treated first.

Fert. and mulching required!

8.8 Plans for Redistribution of Soils

Soil will be redistributed using the wooden stake method, where a stake is marked to the depth of fill then the soils material added to that depth. The depth is estimated at 12" for the complete area. The soil will then be harrowed to break up the cloddy surface then the area will be hydroseeded using the seed mix listed in Table 3-3, plus mulch and a tactifer where the grades are to steep to retain the seed.

- Regraded soils must first be tested to determine the extent of AHFM.
- Regraded areas must be scarified prior to T.S. placement
- Must commit to a roughened regraded and Good seed soil contact

mulch is required for all rec

8.9 Nutrients and Soil Ammendments

Soil tests will be taken of materials to be used for final reclamation in order to evaluate the need for soil amendments and nutrients. Soil testing will be performed by a qualified laboratory which uses accepted analytical procedures. Commercial fertilizers will be added to replenish soil nutrients to enhance successful revegetation, based on soil test efforts.

8.10 Effects of Mining Operations on Soils, Nutrients and Soil Ammendments to be Used

The disturbed land fill which has been impacted by mining operations has some inherit problems that will be addressed prior to reclamation. These include large stones, and compacted zones. The large stones will be removed by standard earth moving equipment and/or commercial rock-picker implements. Compacted zones will be eliminated by deep chiseling, prior to final reclamation. Fertilizer application will be based on soil test analysis as discussed in Section 8.9.

8.11 Mitigation and Control Plans

No additional surface disturbance involving soils will be required for the surface facilities. Therefore, stripping and stockpiling soils will be only to the extent of what soils can be saved from around the disturbed area.

8.12 Bibliography

Black, C.A. 1965. Methods of Soil Analysis. American Society Agronomy No. 9 parts 1 and 2. Madison. Wisconsin. 1572 pgs.

USDA, Soil Conservation Service. Soil Survey Staff 1975. Soil Taxonomy - a basic system of soil classification for marking and interpreting soil surveys, USDA Agricultural Handbook No. 436.

USDA, 1978 Soil Conservation Service, National Soils Handbook (Compedium of SCS in-house memos, various dates) Part II (403.6[a]).

USDA, Soil Survey Staff, 1951, Soil Survey Manual, USDA Agricultural Handbook No. 18.

USDA, Forest Service, 1974; Branch of Soils, Division of Watershed Management, Rocky Mountain Region, Guidelines for Making Soil Interpretations.

USDA, Soil Conservation Service, June 1988, Soil Survey of Carbon Area, Utah.

BLUE BLAZE COAL CO.
P.O. Box 784
Price, Utah 84501
Ph. (801) 472-3786

September 24, 1991

Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Dear Ms. Grubaugh-Littig:

Enclosed are the correction copies requested by Jesse Kelley.

Sincerely,

William R. Skaggs

Enclosure

358.500	-	Section 10.4, 10.5
358.510	-	Section 10.4, 10.5, 10.5.1.2
(358.520 - 530)	-	Section 10.5
R614-301-400	-	Land Use and Air Quality
R614-301-410	-	Section 4.4, 5.3, 5.4, 5.5, 6.3, 6.4, 6.5, 7.1.2, 7.1.3, 7.2.2, 7.3, 8.3, 8.4, 8.5, 9.3, 9.4, 11.1
R614-301-411	-	Environmental Description
411.100	-	Section 4.4, 9.3, 10.3.1
411.110	-	Section 4.4, Plate 3-6
411.120	-	Section 4.4, 5.3, 5.4, 5.5, 6.3, 6.4, 6.5, 7.1.2, 7.1.3, 7.2.2, 7.3, 8.3, 8.4, 8.5, 9.3, 9.4, 11.1
411.130	-	Section 4.4.2, Figure 4.4
411.140	-	Section 5.4, Appendix 2
411.141	-	Plate 4-1
411.141.1	-	Section 5.7, Figure 5-1
411.142	-	Section 3.4.2.1, Figure 5-1
(411.200 - 250)	-	Section 3.2.1, 4.4.2, Plate 4-1
R614-301-412	-	Reclamation Plan
412.100	-	Section 3.4.1, 4.5
(412.110 - 200)	-	Section 3.5.5.4, 9.6, 9.7, 9.8
412.300	-	Section 8.5, 8.10
R614-301-413	-	Performance Standards
(413.100 - 220)	-	Section 4.4, 4.5
(413.300 - 334)	-	Section 4.5
R614-301-420	-	Air Quality, Section 11
R614-301-421 - 422	-	Section 3.3.5.3, 3.4.7, 11.2.2, Figure 3-6
R614-301-423 - 200	-	Section 3.4.7.2, 11.2.2, Figure 3-6
R614-301-500	-	Engineering
R614-301-513.400	-	Section 3.3.2.6
513.500	-	Section 3.3.1.2, 3.5.3.1
513.800	-	Section 3.3.5, 3.3.5.3
R614-301-514	-	Inspections
514.100	-	Section 3.3
R614-301-515	-	Reporting and Emergency Procedures
515.100	-	Section 3.3.2.5
515.310	-	Section 3.3.6.4, 3.3.7
R614-301-520	-	Operation Plan Section 3.3
R614-301-521	-	General, See list of Plates
521.124	-	Plate 8-1 & 8-2
521.125	-	Plate 7-5 & 7-6
521.130	-	Figures 4-1, 4-2, 4-3
521.131	-	Table 4-1 & 4-2, Figure 4-1 & 4-2
521.132	-	Section 4.3.4, Figure 4-3

3.2.11 Total Area for Surface Disturbance During Permit Term

The total area to be involved in surface disturbance during the permit term is 10.3 acres of disturbance. No other disturbance is estimated at this period.

3.2.12 Additional Areas for Surface Disturbance for Life of Mine

There are no plans to disturb any additional surface area for the life of the operation.

3.2.13 Detailed Construction Schedule

A detailed reclamation schedule is shown in Section 3.5.17.

3.3 Operation Plan

General

The Blue Blaze No. 1 Mine is located in the Hiawatha seam (lower) and No. 2 Mine is located some 150 feet above in the Castlegate "A" seam. Coal will be mined by continuous miners, loaded into shuttle cars and hauled to the feeder breaker. The feeder breaker will reduce the coal to an 8" top size and fed onto a rope hung conveyor which will carry it to the surface. The coal will be further reduced in size then transfered by conveyor to the raw coal storage pile. From here, it will be loaded into coal trucks with a short belt or front-end loader and taken to the preparation plant.

The opening of the No. 1 mine will be first, at approximately 220,000 to possibly 360,000 tons per year. No. 2 mine will be opened later with about the same production rate per year over the life of the mine.

All development and non-coal waste rock will be disposed of in underground "gob" areas which consist of entries and cross-cuts no longer needed for the operation of the mine with the approval of the Division and MSHA. No surface storage will be used, however should this become necessary, an area will be proposed for consideration for waste rock storage. Prior to using this area, complete plans and waste material characteristics will be submitted to the Division for approval. Since the material that may be placed here is unknown, details will have to be submitted after such material is encountered and a decision is made to store the material on the surface.

3.3.2.4 Outcrop Protection

A protective barrier pillar of approximately 100 ' wide will be left when advancing toward or along an outcrop.

3.3.2.5 Other

At any time a slide occurs which may have a potential adverse affect on public property, health, safety or the environment persons conducting the underground coal mining operations will notify the Division by the fastest available means and comply with any remedial measures required by regulations.

3.3.2.6 Underground Development Waste

Top and bottom samples will be taken at 2,000 ft. intervals throughout the mine and be tested according to the Divisions requirements. Any underground development waste will either be left underground in "gob" storage areas or loaded out with the coal. If it is loaded out, it will be taken to a preparation plant where it will be washed and the reject compacted in a refuse pile. No surface storage of underground development waste is estimated.

The plan for storage of excess rock produced in the process of driving faults is to leave this material in abandond workings or areas of development for this material. Any material that will be stored will be tested to make sure it is non toxic and non acid forming before it will be stored. The placement of this material will be above any water producing areas within the mine. One hundred percent of this waste rock will be disposed of underground and will not appear at the surface.

3.3.2.7 Return of Coal Processing Waste to Underground

Coal processing is not going to be performed at this mine site, therefore, there will be no return of processing waste underground.

Excess spoil that is located at test pit #8 from previous mining consists of 9,718 cu. yds. The results of the test are located on page 8-20a. These show that there are no harmful chemicals in this waste. This waste will be disposed of by blending with coal that is mined and sending it to a preparation plant outside the mine area.

3.3.3 Conservation of Coal Resource

It is in the best interest of Blue Blaze Coal Company to extract the coal safely to the maximum extent possible and all functions of engineering, production and supervision will be geared toward this end. The BLM is to be involved in and approve any changes in resource recovery or abandonment, including portal sealing.

Water lines will also be equipped with required outlets and fire hoses at regular intervals.

There will be no open burning on the surface. All garbage and flammable wastes will be contained in a temporary storage bin and hauled to an approved disposal site. All flammable materials (oil, etc.) will be stored in fire-proof containers.

Security

Locked gates and signs will be installed and maintained at the road entrance to the permit area when the mine is idle. In addition, a guard will be employed and will inspect the mine site during off-hours and weekends to ensure security.

3.3.5.1 Signs

Specifications

All signs will be of a standard design that can be seen and read easily and will be made of a durable material (treated/painted wood or metal) and supported by metal or wooden posts.

Identification Signs

Signs will be placed as required at the mine area. (see Figure 3-3 and 3-3a). Signs will show name, business address, telephone number, ID Number and Permit Number. Signs will not be removed until after release of all bonds.

Buffer Zone Markers

Buffer zone signs will be placed along the Gordon Creek Diversion to prevent disturbance, even though this is an ephemeral drainage (see Figure 3-4a).

Blasting Signs

No surface blasting will be employed at this site. If blasting is needed, proper signs will be placed at all entrances to areas in the permit area and from public roads or highways, stating: "Warning: Explosives in Use".

Snow Storage Signs

Signs will be placed to designate Snow Storage Areas (see Figure 3-4c).

Topsoil Markers

Topsoil will be stored on the mine site. Topsoil storage piles will be marked with a sign as shown on Figure 3-4b.

Perimeter Marker

Perimeter markers will be placed around the perimeter of the disturbed area. These will be steel fence posts with a silver portion on the top 6". The posts also will carry signs at critical points, with the designation "Disturbed Area Perimeter Marker".

3.3.5.2 Fences and Gates

Small stock fences will be employed at the canyon mouths to keep livestock off the property.

There will be gates at each access road into the permit area located at the permit boundary. These gates will be open during normal work hours and will be kept locked otherwise.

General Notes
for
Construction
of
Dams, Berms, and Overflows

1. In areas where any fill material is to be placed, the natural ground will be removed for at least 12" below the base of the structure.

2. Compaction of all fill material shall be at least 95%. Native material will be used wherever practical. Fill will be placed in lifts not to exceed 12", and compacted prior to placing next lift.

3. Rip-rap will be placed on the water side of all fills to prevent scouring. Inside slopes shall be 2:1 minimum.

4. Dams shall be constructed to overflow at least 1 foot below the top.

5. The sediment pond dam shall have a minimum top width of 10'.

6. Overflows shall have a minimum depth of 1 foot and a minimum width of 3 feet or equivalent culvert size. They shall be constructed with an oil-skimmer, and shall discharge into an energy dissipator to prevent scouring.

7. All construction of sedimentation ponds will be performed under the direction of a qualified professional.

*Reference: Hawkins, R.H. and K.H. Marshall (1979). "Storm Hydrograph Program".

Maintenance and Monitoring

The pond discharge will be monitored as per the requirements of the NPDES Permit No. UT-0023761.

The sedimentation pond shall be inspected after each major storm and the sediment cleaned as necessary. Sediment removal shall be immediately taken to a refuse site away from the project area. — No!

Ditches, culverts and other drainage controls shall be inspected after each major storm, and cleaned as necessary. The pond embankments will be revegetated with the temporary weed mix described in Section 3.5.5.2. Any areas where revegetation is not successful or where rills and gullies develop will be repaired and revegetated accordingly.

7.2.4 Effects of Mining on Surface Water

North Fork Gordon Creek contains the only stream that may be directly impacted by surface disturbance associated with Blue Blaze No. 1 and No. 2 mining operations. Most of the surface disturbance is pre-existing. Disturbed areas such as road cuts will be revegetated in order to minimize surface erosion. Diversions and sediment ponds have been designed to control runoff and to improve water quality characteristics of discharge from disturbed areas.

The effects of subsidence on surface waters will likely be minimal. The Gordon Creek and lower reaches of the North Fork Gordon Creek are below coal or are not above areas to be mined. The upper branches of North Fork Gordon Creek only flow during the snowmelt season, and dry up during the mid summer. It is unlikely that subsidence will alter snowmelt runoff process. It is possible that spring flows could be altered by subsidence fracturing. It is difficult to predict whether the spring flows will be decreased, increased or unaffected by subsidence fracturing. However, since the magnitude of spring flows in North Fork Gordon Creek is small and they do not maintain stream flow, any impacts will be insignificant.

Beaver Creek is the only perennial stream that could possible be impacted by mining subsidence. The Beaver Creek channel is at least 600 feet above the Castlegate "A" coal seam. Subsidence fractures are unlikely to affect the surface that far above the coal seam to be subsided. Furthermore, most of the coal below Beaver Creek was previously mined. Thus, subsidence is not expected in the vicinity where the Blue Blaze Mine expects to undermine the Beaver Creek. This will be accomplished by the use of buffer zones beneath the stream.

BLUE BLAZE COAL CO.
P.O. Box 784
Price, Utah 84501
Ph. (801) 472-3786

October 1, 1991

Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Dear Ms. Grubaugh-Littig:

Enclosed are the changes and additions that were requested by Tom Munson.

contents removed + new replaced updated 10/4/91

Sincerely,

William R. Skaggs

Enclosures

LIST OF PLATES

R614-301-724	-	Baseline Information
724.100	-	Section 7.1.3, 11.1.1, Appendix 1, Plate 7-3
724.200	-	Section 7.1.3, Appendix 1
724.300	-	Section 3.4.3, 3.4.8, 6.2, 6.3, 6.4, 7.1.2.2
724.310	-	Section 7.1.6, 3.4.3.1
724.320	-	Section 3.4.3.1, 3.4.3.2, 3.4.8.2, 3.4.8.4, 7.2.5
724.400	-	Section 11
(724.410 - 413)	-	Section 11.1.1
724.500	-	Section 3.4.3.2, 7.1.3, 7.2.6, Appendix 1, Plate 7-3
724.600	-	Section 3.4.8
R614-301-(725-726)	-	Section 3.4.3.1, 7.1.3, 7.2.4
R614-301-728	-	Probable Hydrologic Consequences
(728.100 - 340)	-	Section 3.4.3.1, 7.1.3, 7.1.6, 7.2.4
R614-301-729	-	Cumulative Hydrologic Impact Assessment
(729.100 - 200)	-	Section 3.4.3.2, 7.1.3, 7.2.4
R614-301-730	-	Operation Plan
R614-301-731	-	Section 3.3, 3.4, 3.5, 7.2.3.2
(731.100 - 122)	-	Section 3.3, 3.4, 3.4.3, 3.5, 3.5.4.2, 3.5.4.3, 7.1.6, 7.2.3.2, 7.2.5
(731.200 - 210)	-	Section 7.1.8, 7.2.6
(731.211 - 212)	-	Section 7.1.3, 7.2.6
731.213	-	Section 7.1.2, Plate 7-3
731.214.1	-	Section 3.4.3, 3.4.3.1, 3.4.3.2, 3.4.8.4, 7.1.6, 7.1.7
(731.214.2 - 220)	-	Section 7.2.6
(731.221 - 222)	-	Section 7.1.3, 7.2.6
(731.222.1 - 222.2)	-	Section 7.2.6
731.223	-	Section 3.4.3, 3.4.8.4, 7.2.3, 7.2.6
731.224	-	Section 7.2.6
731.224.1	-	Section 3.4.3, 3.5.4.2, 3.5.4.3, 7.1.6, 7.1.7, 7.2.5
731.225	-	Section 7.2.6
(731.300 - 522)	-	Section 3.3, 3.3.5, 3.4.3, 3.5.4.2, 3.5.4.3, 7.1.6, 7.2.5
731.600	-	Section 3.4.3.2, 7.2.5
731.610	-	Section 3.4.3.1
731.611	-	Section 3.4.3, 7.2.5
731.612	-	R614-301-742.300
731.620	-	Section 3.4.3, 7.2.5
731.700	-	Cross Sections & Maps
731.710	-	Section 3.2.3 (j) - (o), 3.2.6, Plate 3-1
731.720	-	Plate 3-1
731.730	-	Plate 7-1, Appendix 1
731.740	-	Plate 3-1, 7-5, 8-1, 8-2, 9-2
731.750	-	Plate 7-6
731.760	-	See list of Plates (Table of Contents)
731.800	-	Section 3.4.3, Appendix 1
R614-301-732	-	Sediment Control Measures
732.100	-	Section 3.5.4.3, 7.2.3.2, Plate 7-6
732.200	-	Section 7.2.3.2, Plate 7-6
732.210	-	Section 3.5.3.3, 7.2.3.2, Plate 7-6
732.300	-	Section 7.2.3
732.400	-	Section 7.2.3, Plate 3-2, 7-5

Figure 7-1

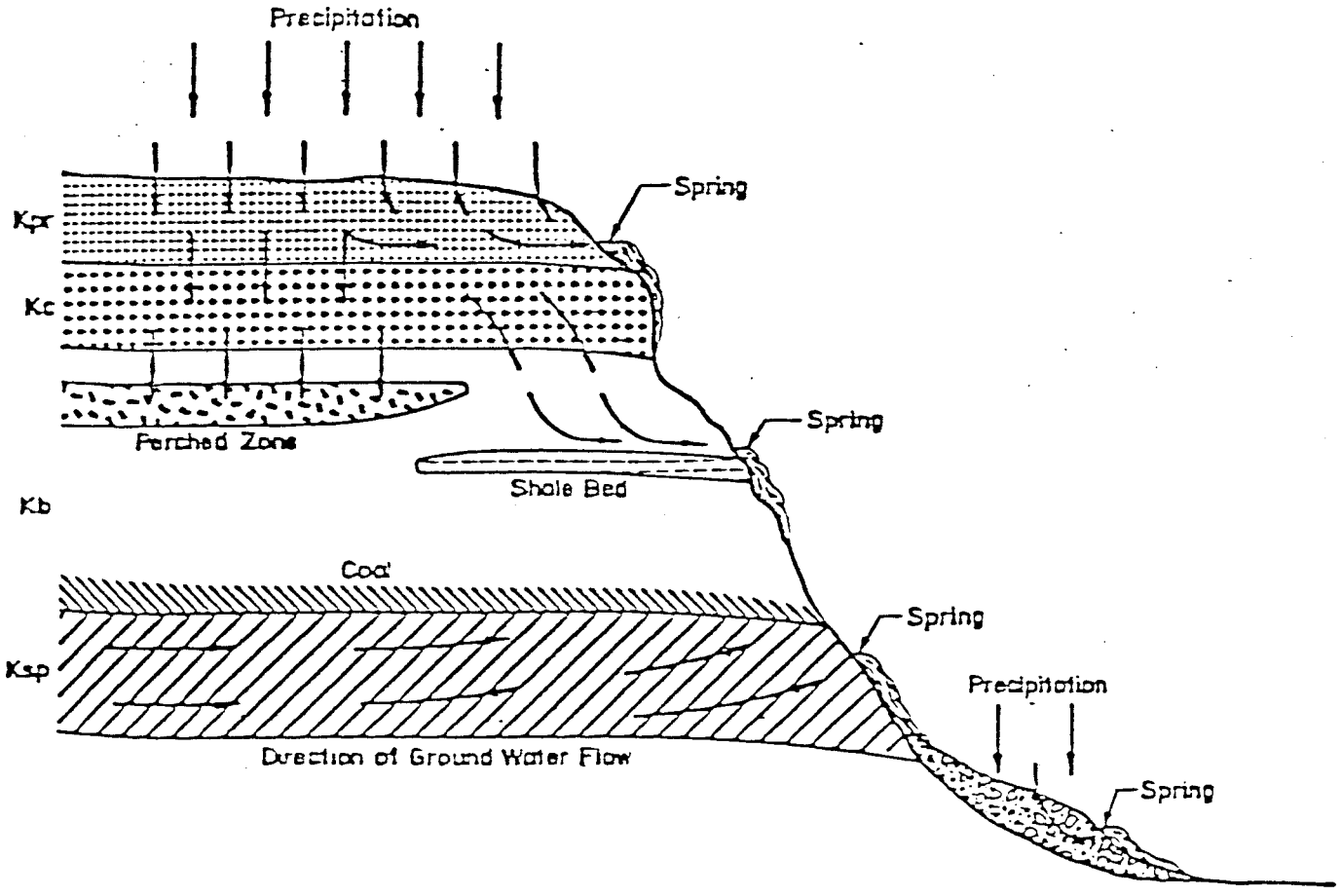


FIGURE 7-1: Schematic diagram of ground water occurrence and movement through Upper Cretaceous strata in the Wasatch Plateau.

7.1.2.2 Mine Plan Area Aquifers

Water was encountered during the mining operations in the adjacent mines. After removal of the Castlegate "A" coal seam, water occasionally seeped into the mine from the roof or more rarely, from the floor. Generally, minor amounts of water were encountered when mining took place beneath a fluvial sandstone channel. The channels behave as perched aquifers that are confined by associated flanking shales. Water production diminished rapidly and does not pose a significant problem for the Blue Blaze Mining operations. Most of the water that is encountered will be used within the mine for dust suppression.

Because the Blackhawk formation is not significant as an aquifer, little work has been done to determine its hydraulic characteristics. (Price and Arnow 1974), in general, characterize all the upper Cretaceous sediments as having low hydraulic conductivities on low specific yield (0.2 to 0.7 percent). Two pump tests conducted in the basal part of the Blackhawk in the Eccles Canyon show that this formation is a very poor aquifer (Vaughn Hansen, 1979). Transmissivities determined were 21.0 and 16.3 gpd/ft. from these pump tests. Recovery tests on these same two wells resulted in transmissivities of 16.6 and 17.9 gpd/ft. respectively.

Drill hole data shows that water was encountered in several zones. Plate 7-1 shows available hydrologic data from drill holes in the area. A Gama Ray probe was used by Century Geophysical Corporation in the LMC drill holes to check for fluid in impervious layers (See Plate 7-3). These drill holes are not accessible at this time for any future checks. In most instances, the amount of water appeared insignificant and not all test holes in the area encountered water as they were drilled through the Blackhawk Formation. In drill holes where water was encountered, most of the production appeared to originate from the same depths which coincide with the areas in which the springs occur in the permit area. These hydraulic interconnections are among the various sandstone units. Beneath the Castlegate Sandstone and above the Blackhawk unit is the location of the underground water that is being monitored by the Divisions requirements. Seasonal differences in head can be seen on. See Table 7-1, Plate 7-1. Due to the discontinuous and lenticular nature of the sandstone units and inter-bedded impervious shales in the area, it is difficult to generate a piezometric surface map. By relating features on Plate 7-1 with Plate 6-6, the water that occures on the project site is generated from the Castlegate Sandstone area. Also see Plate 7-2, that was generated using what data that is available.

The Price River Formation, which has similar lithologies to that of the Blackhawk does not have much significance as an aquifer. Laboratory tests on sandstone from the

PERMIT NUMBER 898-5588

ITEM 1.13 page 1 of 3

Complete this item whenever a business entity (rather than an individual) is listed in items 1.9, 1.10, 1.11, 1.12, or 1.13. Check the box below which corresponds to the item number in which the entity is found.

Check appropriate box [ ] 1.9 [X] 1.10 [ ] 1.11 [ ] 1.12 [ ] 1.13

Name of entity Quaker Coal Company, Inc.
List below the owners and controllers of parent entity. If any person listed is a business entity and not an individual, also complete an item 1.13 for that entity.

Name Donn Chickering
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. [redacted]
Employer ID No. [redacted]
Ownership/Control relationship to parent entity Owns 100% of voting stock
Location in organizational structure Director and CEO
Percent of ownership 100%
Official title within organization Director and CEO
Beginning date of ownership 10-9-75
Beginning date of affiliation 10-9-75

Name Scott Kiscaden
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. [redacted]
Employer ID No. [redacted]
Ownership/Control relationship to parent entity President - no ownership
Location in organizational structure President
Percent of ownership 0%
Official title within organization President
Beginning date of ownership N/A
Beginning date of affiliation 2/15/93

Name Robert Mayfield
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. [redacted]
Employer ID No. [redacted]
Ownership/Control relationship to parent entity Vice President-No Ownership
Location in organizational structure Vice President of Operations
Percent of ownership 0%
Official title within organization Vice President
Beginning date of ownership N/A
Beginning date of affiliation 2/15/93

PERMIT NUMBER 898-5588

ITEM 1.13 page 2 of 3

Complete this item whenever a business entity (rather than an individual) is listed in items 1.9, 1.10, 1.11, 1.12, or 1.13. Check the box below which corresponds to the item number in which the entity is found.

Check appropriate box [ ] 1.9 [X] 1.10 [ ] 1.11 [ ] 1.12 [ ] 1.13

Name of entity Continued
List below the owners and controllers of parent entity. If any person listed is a business entity and not an individual, also complete an item 1.13 for that entity.

Name Michael Castle
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. [redacted]
Employer ID No. [redacted]
Ownership/Control relationship to parent entity Vice President of Finance/Sec./Tres.
Location in organizational structure V.P./Sec./Tres.
Percent of ownership 0%
Official title within organization V.P./Sec./Tres.
Beginning date of ownership N/A
Beginning date of affiliation 2-15-93

Name Quaker Holding Company, Inc.
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. N/A
Employer ID No. Applied For
Ownership/Control relationship to parent entity Owns 100% of Quaker Coal Company
Location in organizational structure Owns 100% of Quaker Coal Company
Percent of ownership 100%
Official title within organization N/A
Beginning date of ownership 2-15-93
Beginning date of affiliation 2-15-93

Name
Mailing Address
If P.O. Box, indicate Street Address
City State Zip
Telephone No. (___) Social Security No.
Employer ID No.
Ownership/Control relationship to parent entity
Location in organizational structure
Percent of ownership
Official title within organization
Beginning date of ownership
Beginning date of affiliation

PERMIT NUMBER 898-5588

ITEM 1.13 page 3 of 3

Complete this item whenever a business entity (rather than an individual) is listed in items 1.9, 1.10, 1.11, 1.12, or 1.13. Check the box below which corresponds to the item number in which the entity is found.

Check appropriate box [ ] 1.9 [ ] 1.10 [ ] 1.11 [ ] 1.12 [X] 1.13

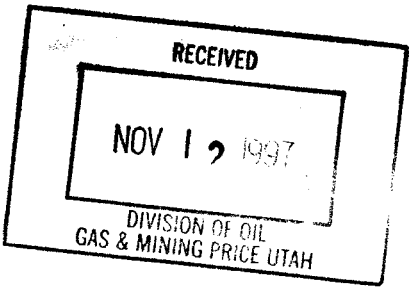
Name of entity Quaker Holding Company, Inc.
List below the owners and controllers of parent entity. If any person listed is a business entity and not an individual, also complete an item 1.13 for that entity.

Name Donn Chickering
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. [redacted]
Employer ID No. [redacted]
Ownership/Control relationship to parent entity Owns 100% of voting stock
Location in organizational structure President
Percent of ownership 100%
Official title within organization President
Beginning date of ownership 2-15-93
Beginning date of affiliation 2-15-93

Name Scott Kiscaden
Mailing Address 148 South Lake Drive
If P.O. Box, indicate Street Address
City Prestonsburg State Kentucky Zip 41653
Telephone No. (606) 886-6300 Social Security No. [redacted]
Employer ID No. [redacted]
Ownership/Control relationship to parent entity Sec./Tres
Location in organizational structure Sec./Tres.
Percent of ownership 0%
Official title within organization Sec./Tres
Beginning date of ownership N/A
Beginning date of affiliation 2/15/93

Name
Mailing Address
If P.O. Box, indicate Street Address
City State Zip
Telephone No. ( ) Social Security No.
Employer ID No.
Ownership/Control relationship to parent entity
Location in organizational structure
Percent of ownership
Official title within organization
Beginning date of ownership
Beginning date of affiliation

Horizon Coal Corporation
P.O. Box 599
Helper, UT 84526



November 5, 1997

Mr. Bill Malensick
Utah Division of Oil, Gas & Mining
451 East 400 North
Price, UT 84501

Subject: Extension of Notice of Violation No. N97-26-7-1

Dear Bill,

The date specified in Notice of Violation No. N97-26-7-1 for the completion of the undisturbed diversion cannot be met. The plan submitted has not yet been reviewed or approved by a UDOGM hydrologist. We request that the completion date be extended to December 8, 1997, however if you feel the internal processing may take longer or that weather may interfere with the implementation of the plan please feel free to extend the time beyond the 8th.

Sincerely,

Vicky S. Bailey

Vicky S. Bailey
Permitting Consultant, EarthFax Engineering, Inc.

Horizon Coal Corporation
P.O. Box 599
Helper, UT 84526

September 18, 1997

Mr. Bill Malencik
Utah Division of Oil, Gas and Mining
451 East 400 North
Price, UT 84501

Subject: Notice of Violation No. 97-26-7-1 - Horizon Coal Corporation, Carbon County, Utah

Dear Bill,

We would like to request an extension of the abatement deadline for Item No. 1, "to submit plans on modifying the undisturbed diversion for Division approval". Due to the time required to comply with a request for revisions to an amendment submittal, the plans for modifying the undisturbed diversions will not be complete in time to meet the September 22, 1997 deadline. With your approval we would request the deadline be extended to September 29, 1997.

Joe Helfrich was verbally notified of this request today during a meeting concerning Horizon Coal Corporation.

If you are comfortable with this extension or if you have any questions please call me at (801) 561-1555.

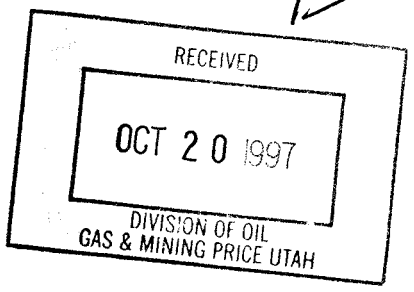
Sincerely yours,

Vicky

Vicky Bailey
EarthFax Engineering, Inc.

Horizon Coal Corporation
P.O. Box 599
Helper, UT 84526

Extension Granted



October 14, 1997

Mr. Robert Davidson
Utah Division of Oil, Gas and Mining
1594 West North Temple
Suite 1210
Salt Lake City, UT 84114-5801

Subject: Extension of Submittal Date, Notice of Violation N97-45-1-1,
Permit No. ACT/007/020
Horizon Coal Corporation, Carbon County, Utah

Dear Robert,

We request an extension for the submittal of the data requested in Notice of Violation N97-45-1-1 from October 15, 1997 to November 3, 1997.

While compiling the survey data to make the new base map, discrepancies have been discovered concerning the placement of the Consumer/Clear Creek Road. Additional data needs to be collected next week to address these discrepancies.

We are attempting to resolve the discrepancies through conversations with personnel on the site, but are not currently comfortable with the information.

Thank you for your assistance in this extension.

Sincerely yours,

Vicky Bailey

Vicky Bailey

cc: Joe Helfrich
Bill Malencik
Michael Gipson
Larry Jones

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 630-953-9300 FAX: 630-953-9306

SINCE 1908®

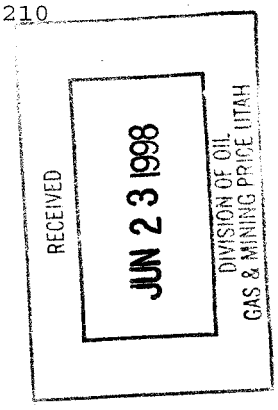
SGS Member of the SGS Group (Société Générale de Surveillance)

1908-1998 *90 Years Committed To Excellence*

ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020
HUNTINGTON, UT 84528
TEL: (435) 653-2311
FAX: (435) 653-2436

June 15, 1998

DIVISION OF OIL, GAS & MINING
1594 WEST N. TEMPLE-SUITE 1210
P.O. BOX 145801
SALT LAKE CITY, UTAH 84114



Sample identification by
DIVISION OF OIL, GAS & MINING

Kind of sample reported to us Water

Sample taken at HORIZON MINE

Sample taken by DOGM

Date sampled May 26, 1996

Date received May 27, 1998

3 SAMPLES HORIZON MINE OUTFALL 001

Rec'd 0830 hr.
Sampled 1330 hr.

NOTE: TSS Analyzed at Timpview Labs

Analysis report no. 59-18494

Parameter	Result	MRL	Units	Method	Analyzed Date/Time/Analyst
Iron, Dissolved	<0.1	0.1	mg/l	EPA 236.1	06-02-1998 0715 MK
Iron, Total	0.5	0.1	mg/l 1.0	EPA 236.1	06-02-1998 0715 MK
Oil & Grease	<2	2	mg/l 10	SM5520-B	06-05-1998 0800 SC
Solids, Settleable	<0.5	0.5	ml/l	EPA 160.5	05-27-1998 0900 MK
Solids, Total Dissolved	397	10	mg/l	EPA 160.1	05-27-1998 1200 RJ
Solids, Total Suspended	63	4	mg/l 70	EPA 160.2	05-29-1998 0836

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Larry Stout

Huntington Laboratory RO

MEMBER ACIL

Horizon Coal Corporation
P.O. Box 599
Helper, UT 84526

April 27, 1998

Mr. Bill Malensick
Utah Division of Oil, Gas & Mining
451 East 400 North
Price, UT 84501

Subject: Extension of Culvert UC-3, NOV 98-26-2-1.

Dear Bill,

The UC-3 Culvert Extension for the Horizon Mine was approved March 27, 1998, however the letter was not received by the resident agent Denise Dragoo until the 31st of March.

Clean copies of the amendment were delivered to the Salt Lake office of the Division of Oil, Gas and Mining on April 7, 1998, the amendment was stamped on the same day and mailed to the resident agent.

The abatement time associated with item (1) for NOV 98-26-2-1 was 30 days. The majority of the construction has been completed, however the topsoil stockpile has been too wet to access during the month of April. I have checked with the mine's surface manager weekly to determine access. We will attempt on Friday, May 1, 1998 to place the topsoil removed during the culvert extension on the current stockpile. We understand that the riparian topsoil must be segregated from the previously removed topsoil and signed as "riparian".

Horizon is requesting an extension to May 15, 1998, in order to complete item (1) associated with NOV 98-26-2-1 per our conversation. I will notify you if we complete item (1) prior to the extension date requested.

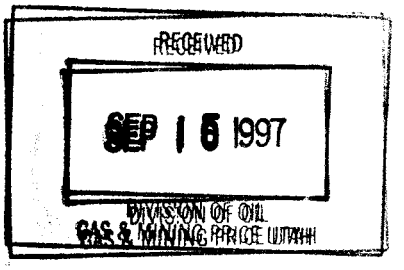
Thank you for your assistance in this matter.

Sincerely,

Vicky

Vicky S. Bailey
Permitting Consultant, EarthFax Engineering, Inc.

Horizon Coal Corporation
P.O. Box 599
Helper, UT 84526



September 12, 1997

Mr. Bill Malencik
Utah Division of Oil, Gas and Mining
451 East 400 North
Price, UT 84501

Subject: Notice of Violation No. 97-26-5-1 - Horizon Coal Corporation, Carbon County, Utah

Dear Bill,

The 15 feet of 36" culvert in Portal Canyon at the Horizon Mine was reconnected on September 10, 1997. The area was regraded and the ditch along the edge of the pad area repaired. The ditch was disturbed during the digging required to reconnect the culvert.

The disturbance for the installation of the temporary diversion has been regraded. The completion of these tasks should satisfy the requirements of Notice of Violation No. 97-26-5-1.

If you have any questions please call me at (801) 561-1555.

Sincerely yours,

Vicky

Vicky Bailey
EarthFax Engineering, Inc.

Horizon Coal Company
P.O. Box 599
Helper, Utah 84526

August 12, 1997

Mr. Bill Malencik
Utah Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

Subject: Notice of Violation N97-26-5-1 Deadline Extension

Dear Bill,

We wish to request an extension to the deadline for the Notice of Violation N97-26-5-1 (June 26, 1997) concerning the failure to maintain the 36" culvert under the disturbed area at Horizon Mine. Item No. 2 "replacement of the damaged culvert" originally had an abatement date of August 15, 1997. Due to changes in surface facilities construction we will need to realign the Portal Canyon culvert above and below the section of culvert to be replaced. The rain which has fallen at the site the past two weeks has saturated the soil and has not allowed proper conditions for culvert replacement.

We would like to retain the temporary diversion until the soil has had an opportunity to dry and the working conditions are more conducive to compaction and the use of heavy equipment.

Since rain has been forecast for the remainder of this week, we request an extension to September 10, 1997.

Would you please send us notification if you should find this extension acceptable.

Sincerely Yours,

Vicky

Vicky S. Bailey, EarthFax

Sunnyside Cogeneration Associates

P.O. Box 10, East Carbon, Utah 84520 • (801) 888-4476 • Fax (801) 888-2538

April 22, 1999

Bill Malencik, Reclamation Specialist
DIVISION OF OIL GAS & MINING
College of Eastern Utah
451 East 400 North
Price, Utah 84501

RE: Horizon Waste Coal Pile

Dear Mr. Malencik:

This is in response to your letter dated April 12, 1999, regarding the Horizon "Pile". In your letter you asked whether SCA is still interested in the Horizon "Pile". Yes, SCA is still interested, and is currently communicating with Horizon Coal Co. on this matter.

Bill, thank you for sharing the most recent analytical results with SCA, pertaining to the Horizon "Pile".

If any additional information is needed please contact me at (435)888-4476.

Thank You,
Sunnyside Operations Associates

Rusty Netz

Rusty Netz
Environmental Coordinator

cc: Gordon Strom, COSI
Plant File

Appendix 3-9, UC-3 Culvert Extension
Horizon Coal Corporation

January 27, 1998

C.O. Abatement Plan
Item 2: Small Culvert / Design

APPENDIX 3-9
ATTACHMENT A
UC-3 CULVERT EXTENSION

97F3

Appendix 3-9, UC-3 Culvert Extension
Horizon Coal Corporation

January 27, 1998

Attachment A

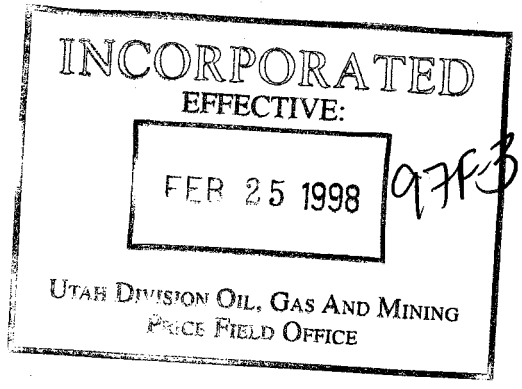
During the installation of the UC-3 culvert extension a length of 6" or larger diameter PVC pipe will be installed. This pipe will be installed to prevent future disturbance of the pad area if the decision is made in the future to discharge mine water directly into Jewkes Creek.

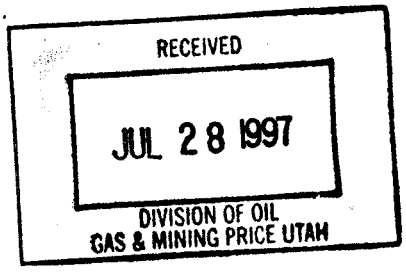
The pipe will be installed at the location noted on Drawing A. The pipe will be approximately 125 feet in length and be buried deep enough to protect the pipe from damage due to freezing (5 - 6 feet). The fill material to be placed atop the pipe will be placed and compacted to meet manufacturer and permit specifications.

The final plans for the discharge of mine water have not yet been completed or approved. Therefore, the pipe is not connected to any water source. The pipe will be capped on both ends permanently and abandoned in place, if a future approved plan allowing for its use is not developed.

Reclamation of the area in which the pipe is installed is discussed in Section 3.5 of this M&RP. The pipe will be reclaimed as described in the approved permit.

Since the intended fill material for the culvert extension area will come from lowering the upper pad area, this soil/fill has been included in the original mass balance calculations. Therefore, the material to be used for fill around the pipe has already been designated in the current approved permit for grading during reclamation in the current approved permit.





EarthFax

EarthFax
Engineering Inc.
Engineers/Scientists
7324 So. Union Park Ave.
Suite 100
Midvale, Utah 84047
Telephone 801-561-1555
Fax 801-561-1861

July 17, 1997

Mr. Bill Malencik
Utah Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

Subject: Notice of Violation N97-26-5-1 Deadline Extension

Dear Bill,

Per our conversation on July 16, 1997, we wish to extend the deadline on the Notice of Violation N97-26-5-1 (June 26, 1997) concerning the failure to maintain the 36" culvert under the disturbed area at Horizon Mine. Item No. 2 "replacement of the damaged culvert" originally had an abatement date of July 31, 1997. Due to a delay in the completion of concrete portal work, we need to request that the abatement date be extended until August 29, 1997.

The proposed fan portal parallels the culvert and the construction of the fan portal caused the original problem concerning the culvert. The fan portal construction was due to be completed by the 31st of July but we have encountered supply delays therefore construction will most likely not be completed until mid-August. We are concerned that if we remove the culvert and replace it now that we will create the problem again during the continued portal construction. We would like to retain the temporary diversion until the construction on the portal is finished.

Would you please send us notification if you should find this extension acceptable.

Sincerely Yours,

Vicky Bailey

Vicky S. Bailey, EarthFax