Horizon Coal Corporation

MINING PERMIT
FOR
HORIZON MINES NO. 1 & 2

Archive

C/007/0020

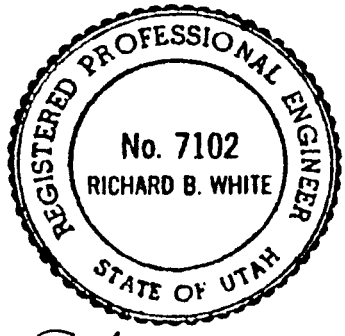
JUNE 1992

REVISED MAY 1995

APPENDIX 7-4

DESIGN CALCULATIONS

APPENDIX 6E
CALCULATIONS



Richard B White
29 May 1992

DETERMINATION OF PEAK FLOWS FOR UNDISTURBED DRAINAGES AROUND BLUE BLAZE MINES.

DETERMINATION OF DRAINAGE AREAS FOR UNDISTURBED AREA DIVERSION DITCHES (TAKEN FROM PLATE 7-4)

WATERSHED I.D.	DRAINAGE AREA (IN^2)	AREA (AC)
UD-1	2.17	12.45
UD-2	1.31	7.54
UD-3	1.99	11.42
UD-4	0.61	3.50
UD-5 (DRAINAGE AREA ABOVE MINE SITE)	24.86	142.68
NORTH FORK OF GORDON CREEK	61.35	352.10

DETERMINATION OF HYDRAULIC LENGTH FOR UNDISTURBED DRAINAGES (TAKEN FROM PLATE 7-4)

WATERSHED I.D.	HYDRAULIC LENGTH (IN)	(FT)
UD-1	3.90	1950
UD-2	3.10	1550
UD-3	3.50	1750
UD-4	1.30	650
UD-5	8.40	4200
NORTH FORK	11.60	5800

DETERMINATION OF CURVE NUMBERS FOR UNDISTURBED WATERSHEDS.

WATERSHED I.D.	COVER* + SOIL TYPE	HYDROLOGIC CONDITION	SOIL GROUP	CURVE** NUMBER	AREA (AC)	WEIGHTED CN VALUE	CURVE NUMBER USED
UD-1	OAK-ASPEN CURECANTI	FAIR	B	48	12.45	48	70
UD-2	OAK-ASPEN CURECANTI	FAIR	B	48	7.54	48	70
UD-3	OAK-ASPEN CURECANTI	FAIR	B	48	11.42	48	70
UD-4	PINYON-JUNIPER SENCHERT	FAIR	C	73	3.30	73	75
UD-5	OAK-ASPEN CURECANTI	FAIR	B	48	81.53	59	70
	PINYON-JUNIPER SENCHERT	FAIR	C	73	61.15		
NORTH FORK	OAK-ASPEN CURECANTI	FAIR	B	48	239.43	56	70
	PINYON-JUNIPER SENCHERT	FAIR	C	73	112.67		

* COVER TYPE
- OAK-ASPEN MOUNTAIN BRUSH MIXTURE OF OAK BRUSH, ASPEN, MOUNTAIN MAHOGANY, BITTER BRUSH, MAPLE & OTHER BRUSH.
- PINYON-JUNIPER PINYON, JUNIPER, OR BOTH WITH A GRASS UNDER STORY.

** CURVE NUMBER VALUES TAKEN FROM SCS-TR-55 2ND ED. (1986) TABLE 2.2d (ATTACHED)

Table 2-2d.—Runoff curve numbers for arid and semiarid rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

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COMPUTED TJS DATE 5/2/92
CHECKED DATE

DETERMINATION OF AVERAGE WATERSHED SLOPES FOR UNDISTURBED WATERSHEDS.

$$Y = \frac{0.25(\text{MAX. EL.} - \text{MIN. EL.})(CL_{25} + CL_{50} + CL_{75})}{\text{AREA } (FT^2)}$$

WATESHED I.D.	MAX ELEV.	MIN. ELEV.	CL 25	CL 50	CL 75	AREA (AC)	Y (%)
UD-1	7905	7540	550	1050	875	12.45	41.6
UD-2	8105	7650	625	375	150	7.54	39.8
UD-3	8170	7690	450	400	375	11.42	29.6
UD-4	7875	7755	350	500	525	3.50	27.1
UD-5	8905	7750	5050	3375	1450	142.68	45.9
NORTH FORK	8900	7650	7900	8100	5300	352.10	43.4

DETERMINATION OF TIME OF CONCENTRATION FOR UNDISTURBED WATERSHEDS

WATERSHED I.D.	HYDRAULIC LENGTH	CURVE NUMBER	AVE. U.S. SLOPE	TIME OF CONCENTRATION
UD-1	1950	70	41.6	0.19
UD-2	1550	70	39.8	0.16
UD-3	1750	70	29.6	0.20
UD-4	650	75	27.1	0.08
UD-5	4200	70	45.9	0.33
NORTH FORK	5800	70	43.4	0.44

PRECIPITATION DEPTHS FOR VARIOUS RETURN PERIODS @ BLUE BLAZE SITE AREA

RETURN PERIOD	PRECIP. DEPTH * (IN)
10yr - 24hr	1.8
10yr - 6 hr	1.5
25yr - 6 hr	1.6
100yr - 6 hr	1.8

* DEPTH VALUES DETERMINED FROM NOAA, "PRECIPITATION FREQUENCY ATLAS OF WESTERN UNITED STATES", VOLUME II - UTAH (1973).

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: UD-1 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 12.45 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.190 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	0.36	cfs	(0.02868 iph)
at time	3.572	hrs	

INPUT FOR: UD-2 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 7.54 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.160 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	0.22	cfs	(0.02913 iph)
at time	3.541	hrs	

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: UD-3 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 11.12 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.200 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	0.33	cfs	(0.02857 iph)
at time	3.573	hrs	

INPUT FOR: UD-4 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 3.50 acres
Depth = 1.50 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.080 hrs

OUTPUT SUMMARY

Runoff depth	0.16667	inches	
Initial abstr	0.66667	inches	
Peak flow =	0.38	cfs	(0.10690 iph)
at time	2.528	hrs	

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: UD-5 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 112.60 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.330 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	3.91	cfs	(0.02715 iph)
at time	3.652	hrs	

INPUT FOR: North Fork of Gordon Creek - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 392.10 acres
Depth = 1.50 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.440 hrs

OUTPUT SUMMARY

Runoff depth	0.08385	inches	
Initial abstr	0.85714	inches	
Peak flow =	9.33	cfs	(0.02629 iph)
at time	3.755	hrs	

DETERMINATION OF UNDISTURBED AREA DIVERSION DITCH SIZING

UD-1

BOTTOM WIDTH - 1 FT

LT & RIGHT SIDE SLOPE - 2H:1V

MANNING'S n - 0.030 (GRADED LOAM)

CHANNEL SLOPE - 0.08 FT/FT

DISCHARGE = - 0.36 CFS

MAX. DEPTH SECTION

DEPTH OF FLOW = 0.11 FT OK < 1FT

FLOW AREA = 0.13 FT^2

VELOCITY = 2.77 FPS

MAX. VELOCITY SECTION

DEPTH 0.09 FT OK < 1FT

FLOW AREA 0.11 FT^2

VELOCITY 3.42 FPS OK < MPV OF 5 FPS

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-1

Comment: Blue Blaze UD-1 - Maximum Depth Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0800 ft/ft
Discharge.....	0.36 cfs

Computed Results:

Depth.....	0.11 ft
Velocity.....	2.77 fps
Flow Area.....	0.13 sf
Flow Top Width...	1.43 ft
Wetted Perimeter.	1.48 ft
Critical Depth...	0.14 ft
Critical Slope...	0.0283 ft/ft
Froude Number....	1.62 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-1

Comment: Blue Blaze UD-1 - Maximum Velocity Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1500 ft/ft
Discharge.....	0.36 cfs

Computed Results:

Depth.....	0.09 ft
Velocity.....	3.42 fps
Flow Area.....	0.11 sf
Flow Top Width...	1.36 ft
Wetted Perimeter.	1.40 ft
Critical Depth...	0.14 ft
Critical Slope...	0.0283 ft/ft
Froude Number....	2.16 (flow is Supercritical)

ND-2

BOTTOM WIDTH = 1 FT

SIDE SLOPE = 2H:1V

MANNING'S n = 0.03 (GRADED LOAM)

MIN. CHANNEL SLOPE = 0.05 FT/FT

MAX. CHANNEL SLOPE = 0.09 FT/FT

DISCHARGE = 0.22 CFS

MAXIMUM DEPTH SECTION

FLOW DEPTH = 0.09 FT < 1 FT OK

FLOW AREA = 0.11 FT^2

VELOCITY = 2.01 FPS

MAXIMUM VELOCITY SECTION

FLOW DEPTH = 0.08 FT < 1 FT OK

FLOW AREA = 0.09 FT^2

VELOCITY = 2.45 FPS < 5 FPS OK

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-2

Comment: Blue Blaze UD-2 - Maximum Depth Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	0.22 cfs

Computed Results:

Depth.....	0.09 ft
Velocity.....	2.01 fps
Flow Area.....	0.11 sf
Flow Top Width...	1.37 ft
Wetted Perimeter.	1.41 ft
Critical Depth...	0.11 ft
Critical Slope...	0.0306 ft/ft
Froude Number....	1.25 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-2

Comment: Blue Blaze UD-2 - Maximum Velocity Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0900 ft/ft
Discharge.....	0.22 cfs

Computed Results:

Depth.....	0.08 ft
Velocity.....	2.45 fps
Flow Area.....	0.09 sf
Flow Top Width...	1.31 ft
Wetted Perimeter.	1.35 ft
Critical Depth...	0.11 ft
Critical Slope...	0.0306 ft/ft
Froude Number....	1.64 (flow is Supercritical)

UD-3

Bottom Width =	1 FT
Side Slope =	2H:1V
Manning's n =	0.03 (Graded Loam)
Min. Channel Slope:	0.07 FT/FT
Max. Channel Slope:	0.10 FT/FT
Discharge =	0.33 CFS

Maximum Depth Section

Flow Depth =	0.11 FT	< 1 FT OK
Flow Area =	0.13 FT^2	
Velocity =	2.57 FPS	

Maximum Velocity Section

Flow Depth =	0.10 FT	
Flow Area =	0.11 FT^2	
Velocity =	2.90 FPS	< 5 FPS OK

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-3

Comment: Blue Blaze UD-3 - Maximum Velocity Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1000 ft/ft
Discharge.....	0.33 cfs

Computed Results:

Depth.....	0.10 ft
Velocity.....	2.90 fps
Flow Area.....	0.11 sf
Flow Top Width...	1.38 ft
Wetted Perimeter.	1.43 ft
Critical Depth...	0.14 ft
Critical Slope...	0.0287 ft/ft
Froude Number....	1.78 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-3

Comment: Blue Blaze UD-3 - Maximum Depth Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0700 ft/ft
Discharge.....	0.33 cfs

Computed Results:

Depth.....	0.11 ft
Velocity.....	2.57 fps
Flow Area.....	0.13 sf
Flow Top Width...	1.42 ft
Wetted Perimeter.	1.47 ft
Critical Depth...	0.14 ft
Critical Slope...	0.0287 ft/ft
Froude Number....	1.51 (flow is Supercritical)

UD-4

BOTTOM WIDTH = 1 FT
SIDE SLOPE = 2H:1V
MANNING'S n = 0.03 (GRADED LOAM)
MIN. CHANNEL SLOPE = 0.05 FT/FT
MAX. CHANNEL SLOPE = 0.10 FT/FT
DISCHARGE = 0.38 CFS

MAXIMUM DEPTH SECTION

FLOW DEPTH = 0.13 FT < 1FT OK
FLOW AREA = 0.16 FT^2
VELOCITY = 2.40 FT/SEC

MAXIMUM VELOCITY SECTION

FLOW DEPTH = 0.10 FT
FLOW AREA = 0.13 FT^2
VELOCITY = 3.04 FT/SEC < 5 FPS OK

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-4

Comment: Blue Blaze UD-4 - Maximum Depth Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	0.38 cfs

Computed Results:

Depth.....	0.13 ft
Velocity.....	2.40 fps
Flow Area.....	0.16 sf
Flow Top Width...	1.50 ft
Wetted Perimeter.	1.56 ft
Critical Depth...	0.15 ft
Critical Slope...	0.0281 ft/ft
Froude Number....	1.31 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-4

Comment: Blue Blaze UD-4 - Maximum Velocity Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1000 ft/ft
Discharge.....	0.38 cfs

Computed Results:

Depth.....	0.10 ft
Velocity.....	3.04 fps
Flow Area.....	0.13 sf
Flow Top Width...	1.41 ft
Wetted Perimeter.	1.46 ft
Critical Depth...	0.15 ft
Critical Slope...	0.0281 ft/ft
Froude Number....	1.80 (flow is Supercritical)

UD-5

Bottom Width =	3 FT	
Side Slopes =	1.5H : 1V	
Manning's n =	0.03	(Graded Loam)
Min. Channel Slope =	0.04 FT/FT	
Max. Channel Slope =	0.06 FT/FT	
Discharge =	3.91 CFS	

Maximum Depth Section

Flow Depth =	0.29 FT	< 2 FT OK
Flow Area =	1.00 FT^2	
Velocity =	3.90 FPS	

Maximum Velocity Section

Flow Depth =	0.26 FT	
Flow Area =	0.88 FT^2	
Velocity =	4.46 FPS	< 5.0 FPS Good

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-5

Comment: Blue Blaze UD-5 - Maximum Depth Section

Solve For Depth

Given Input Data:

Bottom Width.....	3.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0400 ft/ft
Discharge.....	3.91 cfs

Computed Results:

Depth.....	0.29 ft
Velocity.....	3.90 fps
Flow Area.....	1.00 sf
Flow Top Width...	3.87 ft
Wetted Perimeter.	4.05 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0208 ft/ft
Froude Number....	1.35 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UD-5

Comment: Blue Blaze UD-5 - Maximum Velocity Section

Solve For Depth

Given Input Data:

Bottom Width.....	3.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0600 ft/ft
Discharge.....	3.91 cfs

Computed Results:

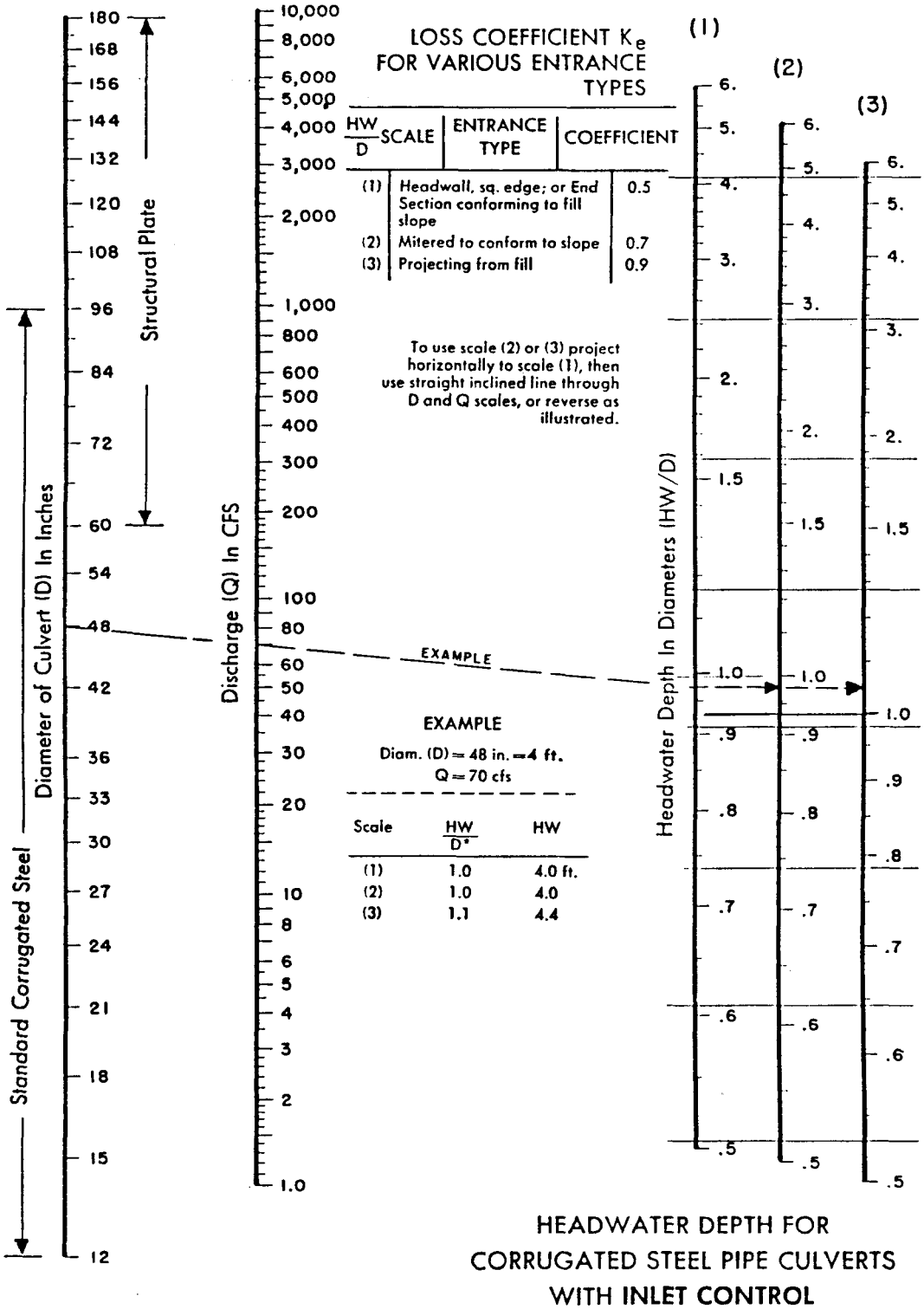
Depth.....	0.26 ft
Velocity.....	4.46 fps
Flow Area.....	0.88 sf
Flow Top Width...	3.78 ft
Wetted Perimeter.	3.93 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0208 ft/ft
Froude Number....	1.63 (flow is Supercritical)

DETERMINATION OF CULVERT SIZING TO BYPASS UNDISTURBED AREA RUNOFF.

CULVERT I.D.	WATERSHEDS BY PASSED THRU CULVERT	PEAK FLOW (CFS)	REQUIRED CULVERT SIZE (FT)
UC-1	UD-4	0.38	
	UD-5	3.91	
		4.29	1.5 *
UC-2	UD-3	0.33	1.0 *
UC-3	UC-1	4.29	
	UC-2	0.33	
		4.62	1.5 **
UC-4	UD-2	0.22	
	NORTH FORK	9.33	
		9.55	2.0 * USE 3.0
UC-5	UC-3	4.62	
	UC-4	9.55	
		14.17	2.0 ** USE 3.0

* BASED ON INLET CONTROL FOR PROJECTING INLET CMP CULVERT. NOMOGRAPH ATTACHED.

** BASED ON OPEN CHANNEL FLOW IN CLOSED CONDUIT. CALCULATIONS DETERMINED USING FLOW MASTER PROGRAM FROM HAESTED METHODS (1991). OUTPUT ATTACHED.



HEADWATER DEPTH FOR CORRUGATED STEEL PIPE CULVERTS WITH INLET CONTROL

Fig. 4-18. *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommend keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Blue Blaze UC-3

Comment: Blue Blaze UC-3 - Bypass Culvert

Solve For Actual Depth

Given Input Data:

Diameter.....	1.50 ft
Slope.....	0.0900 ft/ft
Manning's n.....	0.024
Discharge.....	4.62 cfs

Computed Results:

Depth.....	0.53 ft
Velocity.....	8.21 fps
Flow Area.....	0.56 sf
Critical Depth....	0.83 ft
Critical Slope....	0.0192 ft/ft
Percent Full.....	35.54 %
Full Capacity.....	17.07 cfs
QMAX @.94D.....	18.36 cfs
Froude Number.....	2.31 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Blue Blaze UC-5

Comment: Blue Blaze UC-5 - Bypass Culvert

Solve For Actual Depth

Given Input Data:

Diameter.....	2.00 ft
Slope.....	0.0500 ft/ft
Manning's n.....	0.024
Discharge.....	14.17 cfs

Computed Results:

Depth.....	1.02 ft
Velocity.....	8.80 fps
Flow Area.....	1.61 sf
Critical Depth....	1.36 ft
Critical Slope....	0.0208 ft/ft
Percent Full.....	51.01 %
Full Capacity.....	27.40 cfs
QMAX @.94D.....	29.47 cfs
Froude Number.....	1.73 (flow is Supercritical)

Open Channel Flow Module, Version 3.2 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

DETERMINATION OF RIPRAP PROTECTION REQUIRED AT DISCHARGE END OF HC-5 CULVERT & SED. POND SPILLWAY

VELOCITY AT OUTLET = 8.80 FPS

CHANNEL SHAPE:

BOTTOM WIDTH = 5'

SIDE SLOPE = 1.5H:1V

MANNING'S n = 0.0381 = 0.8 FT D_{50} *

CHANNEL SLOPE = 0.05 FT/FT

DEPTH OF FLOW = 0.52 FT

FLOW AREA = 2.98 FT^2

VELOCITY = 5.01 FPS

* BASED ON U.S.A.C.E. (1970), PLATE 29 - D_{50} REQUIRED TO RESIST FLOW. MANNING'S n DETERMINATION:

$$n = 0.0395 (D_{50})^{1/6}$$

$$= 0.0395 (0.8)^{1/6}$$

$$= 0.0381$$

RIP RAP GRADATION

D_{100}	= D_{50} x 1.5	=	1.2 FT	= 1.2 FT
D_{85}	= D_{50} x 1.25	=	1.0 FT	= 1.0 FT
D_{50}	= D_{50} x 1.0	=	0.8 FT	= 0.8 FT
D_{15}	= D_{50} x 0.1	=	0.03 FT	= 0.1 FT

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze UC-5 OL

Comment: Blue Blaze UC-5 Outlet Channel

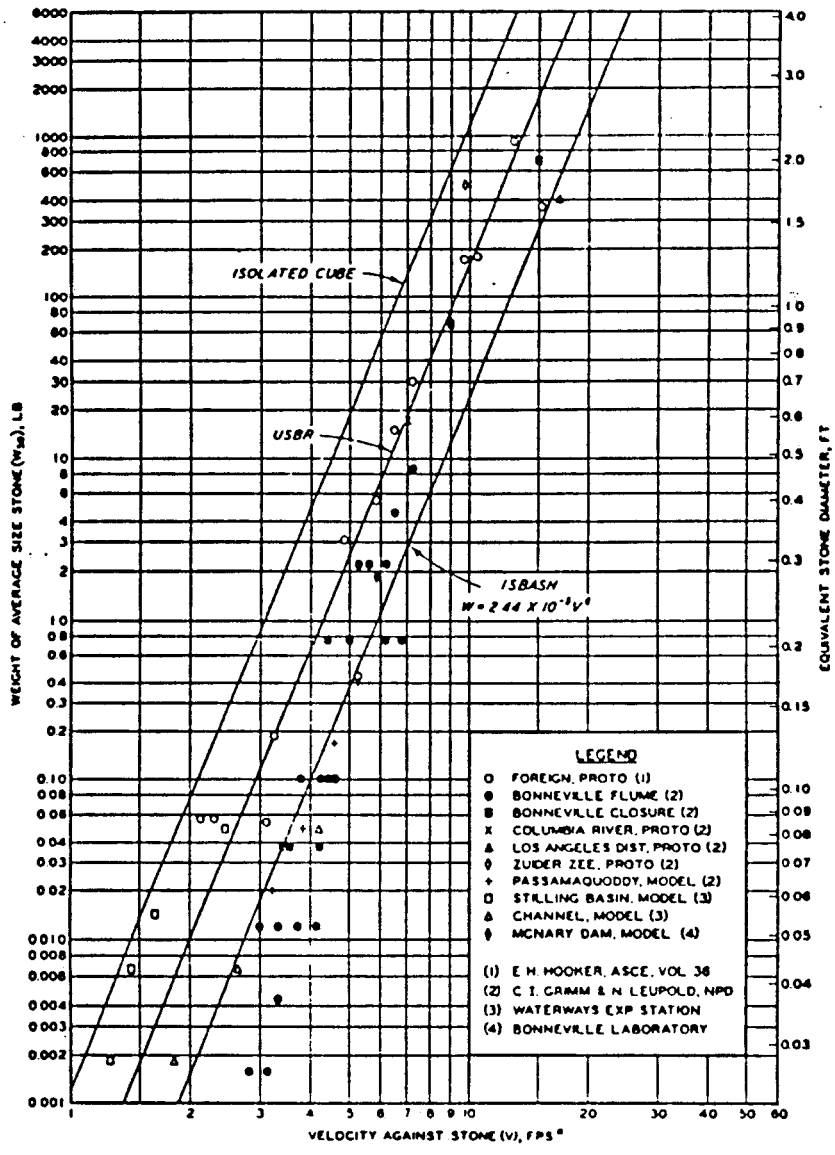
Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.038
Channel Slope....	0.0500 ft/ft
Discharge.....	14.91 cfs

Computed Results:

Depth.....	0.52 ft
Velocity.....	5.01 fps
Flow Area.....	2.98 sf
Flow Top Width...	6.55 ft
Wetted Perimeter.	6.86 ft
Critical Depth...	0.61 ft
Critical Slope...	0.0279 ft/ft
Froude Number....	1.31 (flow is Supercritical)



NOTE: SPECIFIC WEIGHT OF ROCK = 165 LB/CU FT
*FOR STONE PROTECTION BELOW ENERGY DISSIPATORS USE AS AVERAGE VELOCITY ACROSS END SILL

VELOCITY VS STONE WEIGHT

SEE TEXT PAGE 36

Plate 29

DETERMINATION OF PEAK FLOWS FOR DISTURBED DRAINAGES

DETERMINATION OF DRAINAGE AREA FOR DISTURBED AREA WATERSHEDS

WATERSHED I.D.	DRAINAGE AREA (IN^2)	(AC)
D-1	347.92	19.97*
D-2	33.15	1.90
D-3	37.35	2.14
DIRECT SED POND + ADJACENT AREAS	67.09	3.85
SEDIMENT POND	452.33	25.96

* D-1 INCLUDES D-2 AREA

WATERSHED I.D.	HYDRAULIC LENGTH (IN)	(FT)
D-1	36.7	1835
D-2	10.8	540
D-3	22.5	1125
SEDIMENT POND	36.7	1835

DETERMINATION OF CURVE NUMBERS FOR DISTURBED AREA WATERSHEDS

WATERSHED I.D.	COVER TYPE	HYDROLOGIC SOIL GROUP	CURVE NUMBER	AREA (AC)
D-1	BARE SOIL	B+C	89	7.43*
	CHAPARRAL	B	70	12.54
D-2	BARE SOIL	B+C	89	1.90
D-3	BARE SOIL	B+C	89	2.14
SED POND + ADJACENT AREA	DIRECT PRECIP CHAPARRAL	B	100 70	0.78 3.07

DETERMINATION OF RUNOFF VOLUME TO SEDIMENT POND.

WATERSHED I.D.	CN	PRECIP (IN)	AREA (AC)	Q (IN)	VOL (AC-FT)
D-1	70	1.8	12.54	0.17	0.18
	89	1.8	5.53*	0.86	0.40
D-2*	89	1.8	1.90	0.86	0.14
D-3	89	1.8	2.14	0.86	0.15
SED. POND	100	1.8	0.78	1.80	0.12
ADJACENT AREA	70	1.8	3.07	0.17	0.04
			TOTAL =		1.03 AC-FT

D-2 DRAINAGE AREA INCLUDED IN D-1 DISTURBED DRAINAGE AREA

DETERMINATION OF AVERAGE WATERSHED SLOPES FOR DISTURBED AREA WATERSHEDS.

$$y = \frac{0.25(\text{MAX. EL.} - \text{MIN. EL.})(CL_{25} + CL_{50} + CL_{75})}{\text{AREA (FT}^2\text{)}}$$

WATERSHED I.D.	MAX. EL.	MIN EL.	CL 25	CL 50	CL 75	AREA (AC)	Y (%)
D-1	7860	7580	1365	1625	970	19.97	31.87
D-2	7630	7590	430	375	360	1.90	14.08
D-3	7590	7580	1800	1550	1300	2.14	12.47
SEDIMENT POND	7860	7580	1365	1625	975	25.96	24.51

DETERMINATION OF TIME OF CONCENTRATION FOR DISTURBED AREA WATERSHEDS.

WATERSHED I.D.	HYDRAULIC LENGTH	WEIGHTED* CURVE NUMBER	AVE. W.S. SLOPE	TIME OF CONCENTRATION
D-1	1835	76	31.87	0.17 hr
D-2	540	89	14.08	0.06 hr
D-3	1125	89	12.47	0.12 hr
SEDIMENT POND	1835	78	24.51	0.18 hr

* CN WEIGHTED BY AREA

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: D-1 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 19.97 acres
Depth = 1.50 inches	CN = 76.00
Duration = 6.00 hrs	Time conc.= 0.170 hrs

OUTPUT SUMMARY

Runoff depth	0.18731	inches	
Initial abstr	0.63158	inches	
Peak flow =	2.09	cfs	(0.10355 iph)
at time	2.584	hrs	

INPUT FOR: D-2 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 1.90 acres
Depth = 1.50 inches	CN = 89.00
Duration = 6.00 hrs	Time conc.= 0.060 hrs

OUTPUT SUMMARY

Runoff depth	0.63065	inches	
Initial abstr	0.24719	inches	
Peak flow =	1.16	cfs	(0.60696 iph)
at time	2.504	hrs	

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: D-3 - 10 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 2.14 acres
Depth = 1.50 inches	CN = 89.00
Duration = 6.00 hrs	Time conc.= 0.120 hrs

OUTPUT SUMMARY

Runoff depth	0.63065	inches	
Initial abstr	0.24719	inches	
Peak flow =	1.25	cfs	(0.57740 iph)
at time	2.528	hrs	

INPUT FOR: Sediment Pond - 25 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 25.96 acres
Depth = 1.60 inches	CN = 78.00
Duration = 6.00 hrs	Time conc.= 0.180 hrs

OUTPUT SUMMARY

Runoff depth	0.27826	inches	
Initial abstr	0.56410	inches	
Peak flow =	5.00	cfs	(0.19098 iph)
at time	2.568	hrs	

DETERMINATION OF DISTURBED AREA DIVERSION DITCH SIZING

D-1

BOTTOM WIDTH = 1 FT

LT + RT SIDESLOPES = 2H:1V

CHANNEL SLOPE (MIN) = 0.05 FT/FT

CHANNEL SLOPE (MAX) = 0.17 FT/FT

DISCHARGE = 2.09 CFS

MAX. DEPTH SECTION

FLOW DEPTH = 0.32 FT

FLOW AREA = 0.52 FT^2

VELOCITY = 3.98 FPS

MAX. VELOCITY SECTION

FLOW DEPTH = 0.23 FT

FLOW AREA = 0.34 FT^2

VELOCITY = 6.18 FPS

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze D-1

Comment: Blue Blaze D-1 - Maximum Depth Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0500 ft/ft
Discharge.....	2.09 cfs

Computed Results:

Depth.....	0.32 ft
Velocity.....	3.98 fps
Flow Area.....	0.52 sf
Flow Top Width...	2.28 ft
Wetted Perimeter.	2.43 ft
Critical Depth...	0.39 ft
Critical Slope...	0.0222 ft/ft
Froude Number....	1.46 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze D-1

Comment: Blue Blaze D-1 - Maximum Velocity Section

Solve For Depth

Given Input Data:

Bottom Width.....	1.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1700 ft/ft
Discharge.....	2.09 cfs

Computed Results:

Depth.....	0.23 ft
Velocity.....	6.18 fps
Flow Area.....	0.34 sf
Flow Top Width...	1.93 ft
Wetted Perimeter.	2.03 ft
Critical Depth...	0.39 ft
Critical Slope...	0.0222 ft/ft
Froude Number....	2.60 (flow is Supercritical)

DETERMINATION OF CULVERT SIZING FOR DISTURBED AREA CULVERTS.

WATERSHED I.D.	CULVERT I.D.	PEAK FLOW	REQUIRED CULVERT SIZE (FT)
D-2	DC-1	1.16 CFS	1.0 *
D-3	DC-2	1.25 CFS	1.0 *

* BASED ON INLET CONTROL FOR PROJECTING INLET CMP CULVERTS. NOMOGRAPH ATTACHED.

DETERMINATION OF SPILLWAY SIZING

BASED ON BROAD CRESTED WEIR FORMULA FOR OPEN CHANNEL SPILLWAY CONSTRUCTED THRU POND EMBANKMENT:

$$Q = B \times C \times H^{1.5}$$

B = BOTTOM WIDTH (FT) = 10 FT

C = 3.087 - WEIR COEFF.

H = DEPTH OF FLOW (FT) WITH WEIR SECTION

Q = DISCHARGE = 5.0 CFS

$$H = \sqrt[1.5]{\frac{Q}{B \times C}} = 0.30 \text{ FT}$$

VELOCITY OF FLOW FROM THE SECTION = 2.43

" " " " OUTSLOPE SECTION = 4.65

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Sed Pond Spillway

Comment: Blue Blaze - Sediment Pond Spillway - Crest

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.0300 ft/ft
Discharge.....	5.00 cfs

Computed Results:

Depth.....	0.20 ft
Velocity.....	2.43 fps
Flow Area.....	2.06 sf
Flow Top Width...	10.79 ft
Wetted Perimeter.	10.89 ft
Critical Depth...	0.20 ft
Critical Slope...	0.0315 ft/ft
Froude Number....	0.98 (flow is Subcritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Sed Pond Spillway

Comment: Blue Blaze - Sediment Pond Spillway - Outlet

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.2500 ft/ft
Discharge.....	5.00 cfs

Computed Results:

Depth.....	0.11 ft
Velocity.....	4.65 fps
Flow Area.....	1.07 sf
Flow Top Width...	10.42 ft
Wetted Perimeter.	10.47 ft
Critical Depth...	0.20 ft
Critical Slope...	0.0315 ft/ft
Froude Number....	2.55 (flow is Supercritical)

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

DETERMINATION OF SEDIMENT VOLUME TO SED. POND.

SEDIMENT PRODUCTION IS ESTIMATED TO BE:

0.05 AC-FT/AC DISTURBED.

BASED ON LAYOUT OF FACILITIES 10.35 AC OF THE BLUE BLAZE MINE WILL BE DISTURBED GROUND.

THEREFORE, SEDIMENT VOLUME IS ANTICIPATED

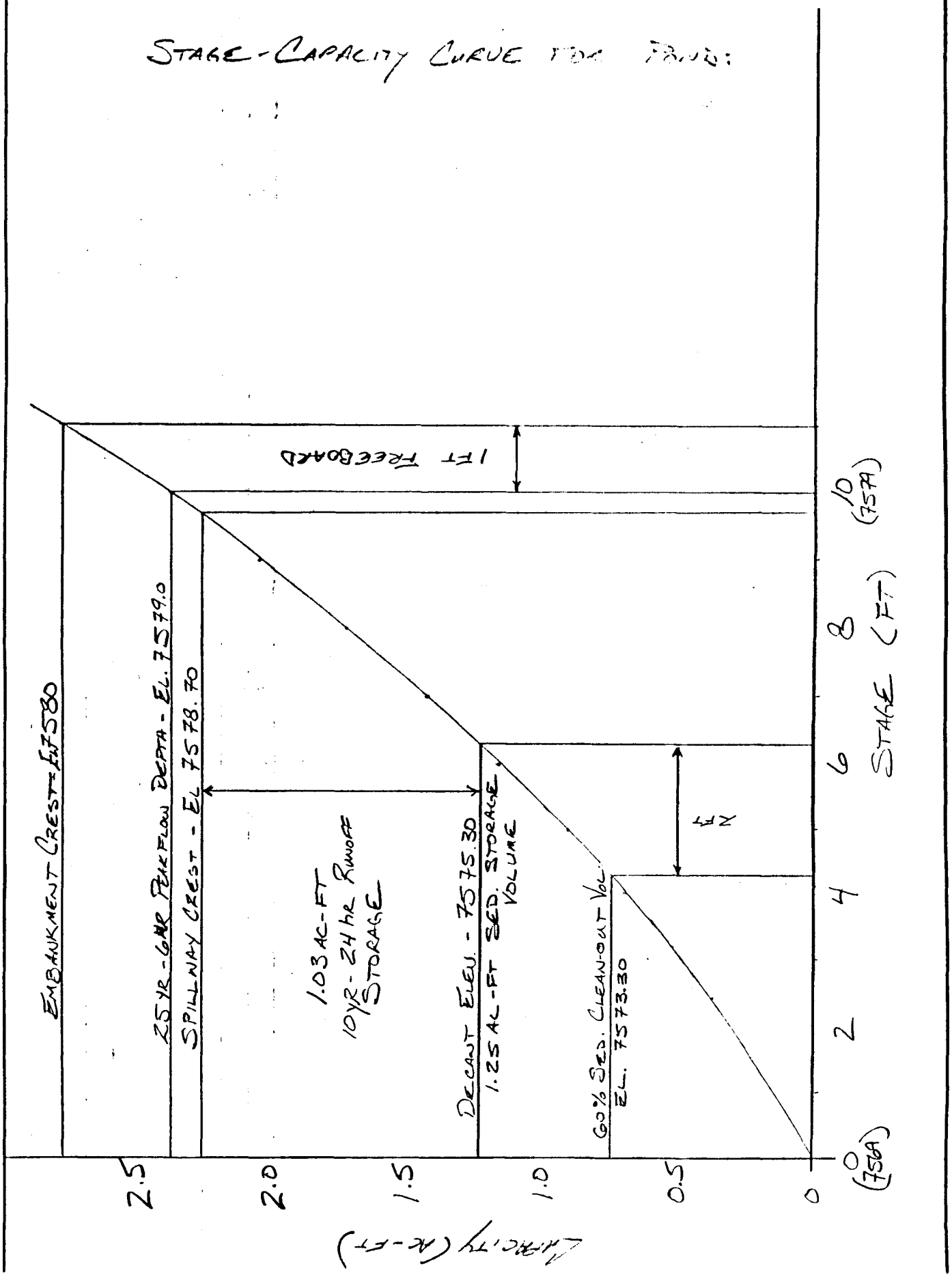
10.35 AC X 0.05 AC-FT/AC = 0.52 AC. FT

SEDIMENTATION POND DEPTH-CAPACITY TABLE

DEPTH (feet)	(cu.ft.)	STORAGE CAPACITY (acre-feet)
0	0	0
2.4	16,628.5	.377
3	21,704	.49
3.2	22,651.2	.52
4	30,680	.70
5	40,550	.92
6	51,406	1.17
6.7	58,806	.83
7	63,250	1.43
8	76,114	1.73
9	90,030	2.04
10	105,030	2.38

Measurements for Rectangular Sedimentation Pond at the bottom of the spillway are 200' x 75'.

STAGE-CAPACITY CURVE FOR POND:



SIZING OF CULVERT UC-6

DISCHARGE FROM:

UC-5	14.91 CFS
SPILLWAY OVER FLOW	5.00 CFS
ADDITIONAL CONTRIB. AREA ~	6.0 CFS
	25.91 CFS

REQUIRED CULVERT SIZE: BASED ON INLET CONTROL FOR PROJECTING INLET CMP CULVERT

FROM ATTACHED NOMOGRAPH:

DIAMETER = 36 in w/ HW/D = 1.0

BLUE BLAZE WILL UTILIZE A 42-INCH CULVERT TO BE CONSISTANT W/ CULVERT UNDER STATE HIGHWAY.

DETERMINATION OF PEAK FLOWS
FOR RECLAIMED DRAINAGES

DETERMINATION OF DRAINAGE AREA FOR RECLAIMED WATERSHEDS.

WATERSHED I.D.	DRAINAGE AREA (IN²)	(AC)
RIGHT FORK OF NORTH FORK GORDON CREEK	29.88	171.5
LEFT FORK OF NORTH FORK GORDON CREEK	60.69	348.3
NORTH FORK GORDON CREEK	94.87	544.5

DETERMINATION OF HYDRAULIC LENGTH FOR RECLAIMED WATERSHEDS

WATERSHED I.D.	HYDRAULIC LENGTH (IN)	(FT)
RIGHT FORK	11.3	5,650
LEFT FORK	12.4	6,200
NORTH FORK	14.7	7,350

DETERMINATION OF CURVE NUMBERS FOR RECLAIMED WATERSHEDS

WATERSHED I.D.	CURVE * NUMBER
RIGHT FORK	70
LEFT FORK	70
NORTH FORK	75

* DETERMINED BASED AREA WEIGHTED AVE. VALUES.

DETERMINATION OF AVERAGE WATERSHED SLOPE.

WATERSHED I.D.	MAX. ELEV.	MIN. ELEV.	CL 25	CL 50	CL 75	AREA (AC)	Y (%)
RIGHT FORK	8905	7610	5050	3375	1450	171.5	42.8
LEFT FORK	8900	7600	7900	8100	5300	348.3	45.6
NORTH FORK	8905	7530	12150	12550	7500	544.5	46.7

DETERMINATION OF TIME OF CONCENTRATION

WATERSHED I.D.	HYDRAULIC LENGTH	CURVE NUMBER	AVE. W.S. SLOPE	TIME OF CONCENTRATION
RIGHT FORK	5650	70	42.8	0.43 hr
LEFT FORK	6200	70	45.6	0.45 hr
NORTH FORK	7350	75	46.7	0.44 hr

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: Right Fork North Fork Gordon Creek - 100 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 171.50 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.430 hrs

OUTPUT SUMMARY

Runoff depth	0.17002	inches	
Initial abstr	0.85714	inches	
Peak flow =	9.43	cfs	(0.05456 iph)
at time	3.612	hrs	

INPUT FOR: Left Fork North Fork Gordon Creek - 100 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 348.30 acres
Depth = 1.80 inches	CN = 70.00
Duration = 6.00 hrs	Time conc.= 0.450 hrs

OUTPUT SUMMARY

Runoff depth	0.17002	inches	
Initial abstr	0.85714	inches	
Peak flow =	19.10	cfs	(0.05438 iph)
at time	3.660	hrs	

EARTHFAX ENGINEERING, INC.
HYDROGRAPH GENERATION PROGRAM OUTPUT
BASED ON SCS CURVE NUMBER METHODOLOGY

INPUT FOR: North Fork Gordon Creek - 100 yr - 6 hr event

STORM :	WATERSHED :
Dist.=SCS Type 'b' - 6 Hr	Area = 544.50 acres
Depth = 1.80 inches	CN = 75.00
Duration = 6.00 hrs	Time conc.= 0.440 hrs

OUTPUT SUMMARY

Runoff depth	0.28756	inches	
Initial abstr	0.66667	inches	
Peak flow =	66.79	cfs	(0.12164 iph)
at time	2.816	hrs	

DETERMINATION OF [illegible]

RIGHT FORK - RD-1

CHANNEL SHAPE: TRAPEZOIDAL

BOTTOM WIDTH = 5.0

SIDESLOPE = 2H:1V

MANNING'S n = 0.035

MIN. CHANNEL SLOPE = 0.06 FT/FT

MAX. CHANNEL SLOPE = 0.12 FT/FT

DISCHARGE = 9.43 CFS

MAX. DEPTH SECTION

FLOW DEPTH = 0.35 FT

FLOW AREA = 2.0 FT^2

VELOCITY = 4.71 FPS < 5.0 FPS

MAX. VELOCITY SECTION

FLOW DEPTH = 0.29 FT

FLOW AREA = 1.60 FT^2

VELOCITY = 5.90 FPS < 6.5 FPS OK

RIPRAPPED SECTION OF CHANNEL W/ D50 = 0.5 FT
BASED ON PLATE 29.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze RD-1

Comment: Blue Blaze RD-1 - Right Fork - Max. Depth

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.0600 ft/ft
Discharge.....	9.43 cfs

Computed Results:

Depth.....	0.35 ft
Velocity.....	4.71 fps
Flow Area.....	2.00 sf
Flow Top Width...	6.40 ft
Wetted Perimeter.	6.57 ft
Critical Depth...	0.45 ft
Critical Slope...	0.0255 ft/ft
Froude Number....	1.48 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze RD-1

Comment: Blue Blaze RD-1 - Right Fork - Max. Velocity

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.1200 ft/ft
Discharge.....	9.43 cfs

Computed Results:

Depth.....	0.29 ft
Velocity.....	5.90 fps
Flow Area.....	1.60 sf
Flow Top Width...	6.15 ft
Wetted Perimeter.	6.28 ft
Critical Depth...	0.45 ft
Critical Slope...	0.0255 ft/ft
Froude Number....	2.04 (flow is Supercritical)

LEFT FORK - RD-2

CHANNEL SHAPE: TRAPEZOIDAL
BOTTOM WIDTH: 5.0 FT
SIDE SLOPES = 2H:1V
MANNING'S n = 0.036
MIN. CHANNEL SLOPE: 0.04 FT/FT
MAX. CHANNEL SLOPE: 0.10 FT/FT
DISCHARGE = 19.10 CFS

MAX. DEPTH SECTION
FLOW DEPTH = 0.60 FT
FLOW AREA = 3.74 FT^2
VELOCITY = 5.10 FPS

MAX. VELOCITY SECTION
FLOW DEPTH = 0.46 FT
FLOW AREA = 2.75 FT^2
VELOCITY = 6.95 FPS < 7.0 FPS

RIPRAPPED CHANNEL w/ D_{50} = 0.6 FT
BASED ON PLATE 29

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze RD-2

Comment: Blue Blaze RD-2 - Left Fork - Max. Depth

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.036
Channel Slope....	0.0400 ft/ft
Discharge.....	19.10 cfs

Computed Results:

Depth.....	0.60 ft
Velocity.....	5.10 fps
Flow Area.....	3.74 sf
Flow Top Width...	7.41 ft
Wetted Perimeter.	7.70 ft
Critical Depth...	0.70 ft
Critical Slope...	0.0241 ft/ft
Froude Number....	1.27 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze RD-2

Comment: Blue Blaze RD-2 - Left Fork - Max. Velocity

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.036
Channel Slope....	0.1000 ft/ft
Discharge.....	19.10 cfs

Computed Results:

Depth.....	0.46 ft
Velocity.....	6.95 fps
Flow Area.....	2.75 sf
Flow Top Width...	6.85 ft
Wetted Perimeter.	7.07 ft
Critical Depth...	0.70 ft
Critical Slope...	0.0241 ft/ft
Froude Number....	1.93 (flow is Supercritical)

NORTH FORK - RD-3

CHANNEL SHAPE: TRAPEZOIDAL

BOTTOM WIDTH =	5.0 FT
SIDE SLOPES =	2H:1V
MANNING'S n =	0.039
MIN. CHANNEL SLOPE =	0.05 FT/FT
MAX. CHANNEL SLOPE =	0.07 FT/FT
DISCHARGE =	66.79 CFS

MAX. DEPTH SECTION

FLOW DEPTH =	1.19 FT
FLOW AREA =	8.75 FT^2
VELOCITY =	7.64 FPS

MAX. VELOCITY SECTION

FLOW DEPTH =	1.08 FT
FLOW AREA =	7.76 FT^2
VELOCITY =	8.60 FPS < 9 FPS OK

RIPRAPPED CHANNEL w/ D_{50} 1.0 FT
BASED ON PLATE 29.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze RD-3

Comment: Blue Blaze RD-3 - North Fork - Max. Depth

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.039
Channel Slope....	0.0500 ft/ft
Discharge.....	66.79 cfs

Computed Results:

Depth.....	1.19 ft
Velocity.....	7.64 fps
Flow Area.....	8.75 sf
Flow Top Width...	9.74 ft
Wetted Perimeter.	10.30 ft
Critical Depth...	1.45 ft
Critical Slope...	0.0236 ft/ft
Froude Number....	1.42 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Blue Blaze RD-3

Comment: Blue Blaze RD-3 - North Fork - Max. Velocity

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.039
Channel Slope....	0.0700 ft/ft
Discharge.....	66.79 cfs

Computed Results:

Depth.....	1.08 ft
Velocity.....	8.60 fps
Flow Area.....	7.76 sf
Flow Top Width...	9.33 ft
Wetted Perimeter.	9.84 ft
Critical Depth...	1.45 ft
Critical Slope...	0.0236 ft/ft
Froude Number....	1.66 (flow is Supercritical)

RIPRAP GRADATIONS

RD-1 - PORTIONS OF CHANNEL ONLY (SEE PLATE 3-7).

D_{100} = 0.75 FT
D_{85} = 0.63 FT
D_{50} = 0.5 FT
D_{15} = 0.05 FT

RD-2

D_{100} = 0.9 FT
D_{85} = 0.75 FT
D_{50} = 0.6 FT
D_{15} = 0.06 FT

RD-3

D_{100} = 1.5 FT
D_{85} = 1.25 FT
D_{50} = 1.0 FT
D_{15} = 0.1 FT

EVALUATION OF SEDIMENT YIELD FROM RECLAIMED SURFACE

COMPARISON OF TREATMENTS

EVALUATION OF SEDIMENT YIELD FROM RECLAIMED SITE.

DETERMINATION BASED ON UNIVERSAL SOIL LOSS EQUATION

- CALCULATE EXPECTED EROSION FROM:
  - DISTURBED SURFACE (BARE GROUND)
  - RIPPED SURFACE
  - MULCHED & RIPPED SURFACE
  - MULCHED & RIPPED SURFACE W/ SILT FENCE
  - RECLAIMED SURFACE W/ SHRUB-GRASS VEG. TYPE FOR COVER & DENSITY REQUIRED FOR BOND RELEASE

EQUATION:

$$A = R\ LS\ K\ C\ P$$

WHERE:

A = COMPUTED SOIL LOSS PER UNIT AREA (TONS/AC/YR)

R = RAIN FALL FACTOR (ANNUAL)

LS = LAND SLOPE FACTOR

K = SOIL ERODIBILITY FACTOR

C = COVER FACTOR

P = PRACTICE FACTOR

RAINFALL FACTOR = 15 (FROM ISRAELSEN, ET.AL., 1934)
(FIG. ATTACHED)

LS FACTOR BASED ON

$$LS = \left(\frac{\lambda}{72.6}\right)^{M}\left(\frac{430X^2 + 30X + 0.43}{6.613}\right)$$

WHERE:

λ = SLOPE LENGTH (FT)

X = SIN θ

θ = SLOPE ANGLE (DEG) = ATAN $\left(\frac{RISE}{RUN}\right)$

M = SLOPE EXPONENT

SLOPE $\leq$ 3% $M = 0.3$

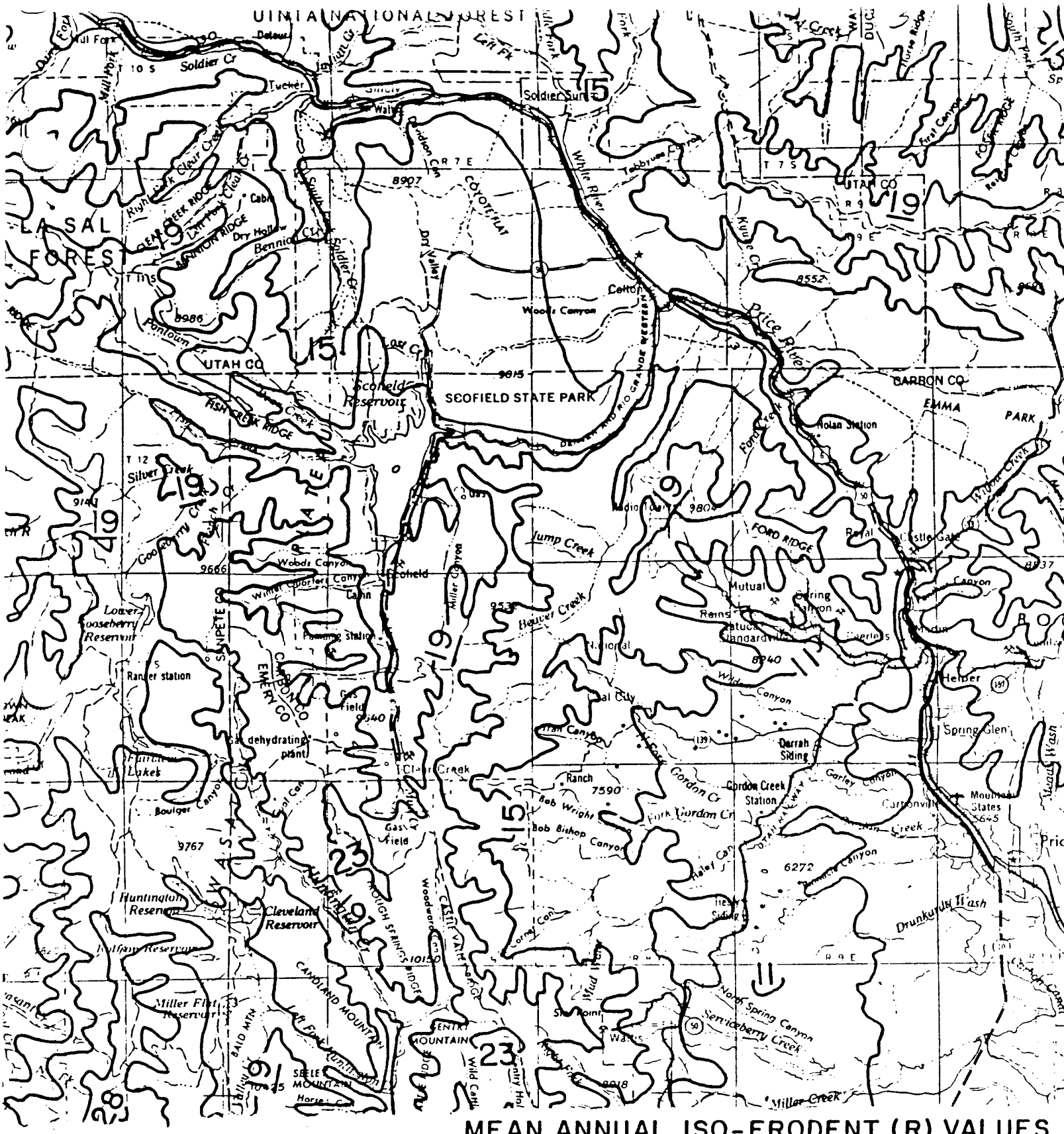
SLOPE $\geq$ 5% $M = 0.5$

SLOPE $>$ 3% & $<$ 5% $M = 0.4$

K FACTOR = 0.31 (FROM ISRAELSEN, ET. AL., 1984)

C FACTOR:	VALUE *
FOR BARE SOIL:	0.94
FOR RIPPED SOIL:	0.8
FOR MULCHED + RIPPED SOIL (2 TONS PER AC):	0.06
FOR EROSION MATTING:	0.10
FOR RECLAIMED WATERSHED W/ 50% COVER NO APPRECIABLE CANOPY	0.11

* VALUES DETERMINED FROM: BARFIELD, ET. AL. (1981)



ote:
values shown are for rain and
nowmelt together. R value for
nowmelt alone = $R_s = 0.23881\,R$
- I. 28.

MEAN ANNUAL ISO-ERODENT (R) VALUES

Units of R
English R = foot tons/acre/hour
Metric Rm = meter tonnes/hectare/hour
$Rm = 1.735 \times R$

UTAH WATER RESEARCH LABORATORY UTAH STATE UNIVERSITY LOGAN, UTAH 1983

EROSION FROM MULCHED + RIPPED SURFACE W/ SILT FENCE:

BASED ON MIRAFI TECHNICAL NOTE, R.G. CARROLL, JR. "SILT FENCES FOR SEDIMENTATION CONTROL IN MINING" PUB NO. 81-17.

&

WYANT, D.C. 1980. EVALUATION OF FILTER FABRIC FOR USE AS SILT FENCES. VHTRC 80-R49. VIRGINIA HIGHWAY AND TRANSPORTATION RESEARCH COUNCIL. CHARLOTTESVILLE, VIRGINIA.

SILT FENCES RETAIN APPROXIMATELY 75% OF SEDIMENT.

THEREFORE:

SED. PRODUCTION = (MULCHED + RIPPED PROD. X 0.25)

ALTERNATIVE SEDIMENT CONTROL SUMMARY – Blue Blaze

WATERSHED I.D.	Area (Ac)	Rainfall Factor	Height of Rise	Field Slope Length (ft)	Slope Angle (%)	Slope Angle (deg)	Slope Factor m	LS FACTOR	K FACTOR	Undisturbed Sed. Prod.	SILT TO STREAM BARE (TONS)	SILT TO STREAM RIPPED (TONS)	SILT TO STREAM MULCHED (TONS)	SILT TO STREAM SILT FENCE (TONS)	SILT TRAPPED BY SILT FENCE (TONS)	SILT TRAPPED BY SILT FENCE (CU FT)
Right Fork North Fork Gordon Creek																
NORTH SIDE																
RECLAIMED AREA	3.0	15.0	40.0	500.0	8.0	4.6	0.5	2.2	0.3	3.4	29.1	24.8	1.9	0.0	1.0	22.2
UNDISTURBED AREA	19.0	15.0	570.0	1642.0	34.7	19.1	0.5	40.6	0.3	394.1	3368.1	2866.5	215.0	54.0	161.0	3577.8
SUBTOTAL:										397.5	3397.2	2891.2	216.8	54.0	162.0	3600.0
SOUTH SIDE																
RECLAIMED AREA	1.3	15.0	15.0	100.0	15.0	8.5	0.5	2.5	0.3	1.7	14.8	12.6	0.9	0.0	1.0	22.2
UNDISTURBED AREA	12.7	15.0	260.0	1060.0	24.5	13.8	0.5	18.5	0.3	119.7	1023.3	870.9	65.3	16.0	49.0	1088.9
SUBTOTAL:										121.5	1038.1	883.5	66.3	16.0	50.0	1111.1
TOTAL SEDMENT TO STREAM										519.0	4435.3	3774.7	283.1	70.0		
North Fork Gordon Creek																
EAST SIDE																
RECLAIMED AREA	1.4	15.0	20.0	150.0	13.3	7.6	0.5	2.6	0.3	1.8	15.5	13.2	1.0	0.0	1.0	22.2
UNDISTURBED AREA	5.0	15.0	255.0	1050.0	24.3	13.7	0.5	18.1	0.3	46.3	395.4	336.5	25.2	6.0	19.0	422.2
SUBTOTAL:										48.1	410.9	349.7	26.2	6.0	20.0	444.4
WEST SIDE																
RECLAIMED AREA	5.5	15.0	35.0	600.0	5.8	3.3	0.5	1.6	0.3	4.4	37.7	32.1	2.4	1.0	2.0	44.4
UNDISTURBED AREA	12.5	15.0	305.0	733.0	41.6	22.6	0.5	36.2	0.3	230.8	1972.0	1678.3	125.9	31.0	94.0	2088.9
SUBTOTAL:										235.2	2009.7	1710.4	128.3	32.0	96.0	2133.3
TOTAL SEDMENT TO STREAM										283.3	2420.6	2060.1	154.5	38.0		

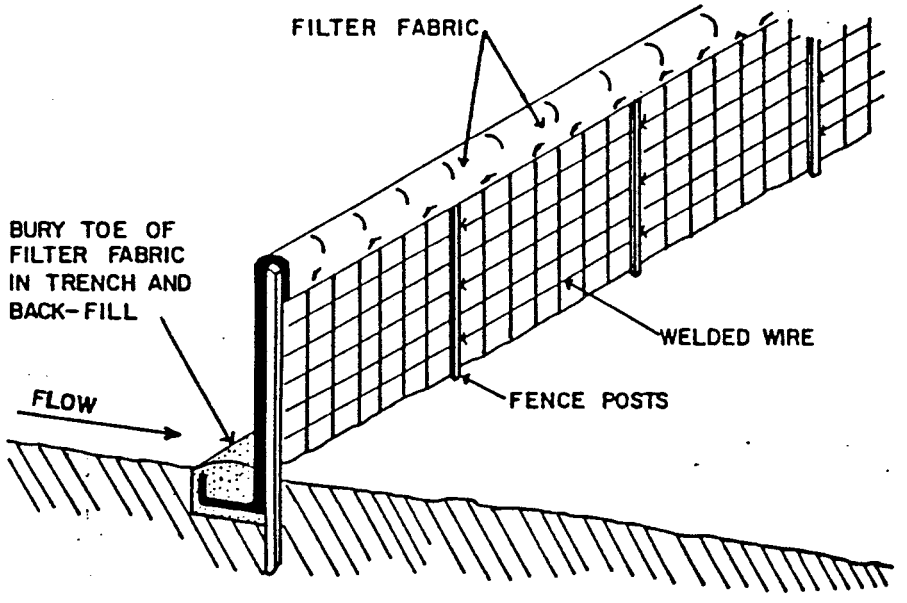
SOIL CONDITION	CP FACTORS
BARE	0.94
RIPPED	0.8
MULCHED	0.06
UNDISTURBED	0.11
ERODIBILITY FACTOR	0.31
ANNUAL R FACTOR	15

REFERENCES:

ISRAELSEN, C.E, J.E. FLETCHER, F.W. HAWS, E.K. ISRAELSEN, 1984. EROSION & SEDIMENTATION IN UTAH: A GUIDE FOR CONTROL. UTAH WATER RESEARCH LABORATORY, USU. UWRL/H-84/03. LOGAN, UTAH.

BARFIELD, B.J., R.C. WARNER, & C.T. HAAN. 1981. APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS. OKLAHOMA TECHNICAL PRESS. STILLWATER, OKLAHOMA.

APPENDIX 6E


FILTER FABRIC
BURY TOE OF FILTER FABRIC IN TRENCH AND BACK-FILL
FLOW
WELDED WIRE
FENCE POSTS

APPENDIX 4

Drainage report

C&W Coal Properties

drainage report

June 1980

prepared by The Land Group

Landscape Architects Engineers Land Surveyors - Suite 304 205 West 700 South Salt Lake City Utah

ABSTRACT

A storm drainage study of the area surrounding the C & W Coal Properties Mine Site in Carbon County, Utah was done, resulting in the design of a drainage and settlement pond system. The results of that study, and the details of the drainage system are presented in this report.

TABLE OF CONTENTS

STORM DRAINAGE REPORT

for

C & W COAL PROPERTIES

June 10, 1980

INTRODUCTION:

This report represents a study of the storm runoff conditic at the C & W Coal Properties mine site in Carbon County, Utah, and describes the proposed methods for controlling the runoff. The design of sedimentation ponds to settle out particulate material fr the site runoff is also discussed. The supporting data and methods of the study are included.

The study was completed for C & W Coal Properties Corp. by The Land Group, Engineering Department, 205 West 700 South, Salt Lak City, Utah 84101.

CURRENT DRAINAGE CONDITIONS:

As can be seen on the "Outside Facilities Plan" and as illustrated in photographs of the area, much of the surface area which is drained by the North Fork of Gordon Creek is covered by coal waste and debris from old, long abandoned mining operations. This makes it impossible under current conditions for surface drair to not come into contact with possible contaminants. It is therefc felt that any proposed burial measures could only be beneficial to

environmental balance of the area, as well as removing possible pollutants which currently flow into Gordon Creek less than a mile away.

The drainage in the side canyon where the proposed mine is to be operated is subject to similar conditions as the North Fork drainage. The entire loading, stockpile, and office area is covered by a layer of coal and other debris from the previously mentioned abandoned operations. There is also a mine dump further up the canyon across from the proposed portals, as is shown on the "Outside Facilities Plan". An existing drill road cuts the hillside on the east side of the canyon and the topography in the center of the canyon has been greatly disrupted. Much of the current surface drainage in the area of the proposed facilities flows across this coal waste and is probably contaminated to some degree. The culvert which at one time carried the canyon drainage through the old haulage road is buried under several feet of material and doesn't allow any flow. This creates a small pond behind the haulage road. The proposed establishment of drainage patterns and the scrapping and burial of surface coal waste are felt to be of benefit to the immediate area and entire downstream Gordon Creek drainage both in the short term and long term time frames.

METHODS AND DISCUSSION:

The drainage study was separated into three parts:

1. The evaluation of storm runoff from the area above the mine site in order to select culvert sizes and route the runoff through the site.

2. The evaluation of runoff from the site itself to facilitate the design of sedimentation ponds.

3. The evaluation of runoff above the haulage road and the placement of culverts along the road to drain the runoff.

The storm runoff for this study was calculated using the "Rational Method", Q = CiA, where "Q" is the peak flow runoff in cubic feet per second (cfs), "C" is an empirical runoff coefficient representing ground slope and imperviousness, "i" is the average rainfall intensity for the storm duration in inches per hour, and "A" is the contributing drainage area in acres. This formula assumes that the runoff coefficient remains constant from storm to storm, and that the maximum rate of runoff for a given intensity occurs when all parts of the drainage area are contributing, a phenomenon which takes place after a critical time, t_c, into the storm.

The values used for the various factors in the Rational Method equation were determined through the use of topography maps, local weather statistics, and prior experience in the area.

The area above the mine site is considered undisturbed, and the runoff therefrom needs to be routed through the site in such a way that it does not become contaminated. To insure that this is the case, drainage ditches will be constructed around the site perimeter to collect storm runoff from the undisturbed areas. The runoff will be routed through the site, bypass the sedimentation ponds, and drain into the natural drainage channel, as shown on the site map. (see Appendix) It is necessary, at the lower end of the site, to place a culvert to carry the runoff flow from the undisturbed area. In order to size this culvert, the runoff was evaluated for the 100-year and 1000-year storm return periods. A critical time of 15-minutes, a "C" value of 0.20, and a contributing drainage area of 160 acres

were used for the evaluation. Based on the estimated runoff, which is shown in Table 1, a 60-inch diameter culvert was selected. Located as shown on the site map, this culvert will safely pass the runoff from storms up to the 1000-year event. In most studies of this type the runoff from snow melt is evaluated and compared with that from rainfall. In this situation, however, the site is located on the dry side of the mountain range where the snowpack is generally light. It is assumed, therefore, that the critical runoff situation is from rainfall rather than snowmelt.

In order to protect the hydrologic balance of natural streams, federal regulation requires that runoff from disturbed areas meet certain water quality standards. Runoff from the mine site will therefore be routed through a sedimentation pond system, allowing for the removal of particulates from the water before it enters the natural stream. Berms will be constructed around the perimeter of the mine site, and the area will be graded so that runoff flows overland to the bottom end of the site and into the sedimentation ponds, as can be seen on the site map. After sedimentation, the water will flow into the natural drainage channel.

Storm runoff from the disturbed area was evaluated for the 10-year precipitation event. The drainage area contains 2.9 acres, and a "C" factor of 0.70 was used. The maximum flow resulting from this drainage area will be from a short duration, 5-minute storm, and is estimated to be 3.9 cfs.

The sedimentation ponds were designed for a minimum detention time of 24-hours. The pond size is dictated by two criteria: The capacity to store runoff from a 10-year, 24-hour precipitation event, and the capacity to accommodate a three-year accumulation of sediment.

The volume of runoff produced by a 24-hour duration storm was determined to be 16,000 cubic feet, and the two ponds were designed to retain this volume. Shorter storms will produce smaller volumes of water and will therefore have adequate detention times. Sufficient sediment storage volume is provided by allocating 0.1 acre-feet of storage for each acre of disturbed area in the drainage basin. With 2.9 acres of disturbed area, 12,600 cubic feet of storage volume is required.

The layout and design of the sedimentation ponds is shown on the detail sheet, and is in accordance with federal regulation. The ponds provide for 13,300 cubic feet of sediment storage and 16,400 cubic feet of storm retention capacity. (See Table 2) In addition, a permanent water level in each pond will provide for more efficient settlement and improve asthetics. The permanent water depth will fluctuate according to the sediment in the pond bottom, being at a maximum when there is no sediment, and at a minimum of one foot when sediment storage is at design capacity. When sediment accumulates beyond design capacity, then it will be necessary to clean the ponds out.

The inlet-outlet structures and transfer structure between the ponds are designed to prevent any floating oil and debris from contaminating the effluent. (See detail sheet) The 24-hour detention time should be adequate to settle out all suspended solids.

A twenty-foot wide emergency spillway on each of the settling pond dams has been designed so as to minimize damage in the event of a large storm. The design was based upon a 1000-year frequency storm. The spillways shall be rocked with 12-inch median size rock to prevent erosion.

Federal regulation requires that culverts be placed along the haulage road for storm runoff drainage. The road, which extends from Gordon Creek Road to the mine site is a class I road, and cross drains must handle a 10-year precipitation event. In addition, the road crosses the drainage channel for an adjacent canyon, and a culvert must be placed to allow for this drainage.

Runoff from the adjacent canyon was evaluated for the 100-year and 1000-year storms. A drainage area of 340 acres, a critical time of 20-minutes, and a "C" value of 0.20 was used to determine the runoff values, which are shown in Table 1. A 60-inch culvert will be more than sufficient to carry the flow from this canyon.

The haulage road below the 60-inch culvert extends 1500 feet to Gordon Creek road. With an average slope of 4-6% a culvert is required every 800 feet, so two cross drains will need to be placed along this road, one at the intersection with Gordon Creek Road, and one about 750 feet above that point. The size of these culverts was determined based on the estimated runoff from a 10-year storm. With a critical storm of 15 minutes, and an area of 12 acres, a 12-inch diameter culvert was selected.

Before any construction in the area is begun, a silt fence should be installed across the stream at a location near Gordon Creek Road as shown on the site map. The fence will retain any material that the stream picks up as it flows through the construction area. The fence should be cleaned periodically to prevent the stream from flowing around it. See the detail map for fence details.

CONCLUSIONS:

Based on the analysis of storm runoff conditions, a storm drainage and sedimentation pond system has been designed for the C & W Coal Properties mine site. The design is according to Federal Surface Mining Regulations. Storm runoff from undisturbed areas above the site will be routed through the site and into the natural drainage channel. Runoff from the site will be routed through a sedimentation pond system designed to settle out the suspended solids. Cross-drains will be placed along the haulage road to allow for drainage from the area above the road. A silt fence will be placed to protect the watershed downstream from the adverse effects of construction. Details of the system and results of calculations are given in the appendices.

As a result of this system, the storm runoff will be adequately controlled with little danger of flooding, and the effects of the mining operation on the natural stream flow and water quality should be minimized.

APPENDIX A

TABLE 1: STORM RUNOFF

	C	i (in/hr)	A (acres)	Q (cfs)	Culvert Diameter (inches)
Undisturbed Drainage Area:					
10-year, 15-minutes	0.2	1.25	160.	40	42
100-year, 15-minutes	0.2	2.4	160	77	48
1000-year, 15-minutes	0.2	3.5	160	112	54
Disturbed Drainage Area:					
10-year, 5-minute	0.7	1.92	2.9	3.9	n/a
10-year, 24-hour storm	0.7	0.09	2.0	0.18	n/a

Total runoff volume from 24-hour storm:

V = Qt = (0.18 cfs) (24 hours) (3600 sec./hour) = 15,785 cubic feet

North Fork Drainage Area:					
(adjacent canyon)					
25-year, 20-minutes	0.2	1.5	337	101	43"
100-year, 20-minutes	0.2	2.1	337	141	54"
1000-year, 20 minutes	0.2	3.0	337	202	60"

TABLE 2: POND CAPACITIES

	Elevations (ft)	Volume (cubic feet)
UPPER POND:		
Bottom	7609	-
Sediment	7609-7614	6400
Permanent Water	7612-7615	7900
Storm Retention	7615-7617	7900
Emergency Spillway	7618	-
Top	7619	-
LOWER POND:		
Bottom	7591	-
Sediment	7591-7595	6900
Permanent Water	7593-7596	7600
Storm Retention	7596-7598	8500
Emergency Spillway	7599	-
Top	7600	
TOTAL:		
Sediment	-	13,300 (need 12,600)
Permanent Water	-	14,300
Storm Retention	-	16,400 (need 16,000)

APPENDIX B

vicinity ma

784.24

Provide the additional information listed above and pertaining to road drainage and cut/fills pursuant to 30 CFR 784.24. Geotechnical and analyses of the stability of any cuts or fills pursuant to 817.152 will be required since the area is considered a "steep slope" area. Provide an analysis of culvert headwalls if pursuant to 30 CFR 784.24(d). Provide complete description of the entire truck haul route to the coal loadout. Provide evidence from the appropriate governmental agencies with authority for road maintenance and safety that the proposed truck haul traffic is acceptable. Provide evidence the the coal loadout is permitted and/or approved under the authority of Public Law 95-87 and complies with 30 CFR Part 827.

784.24

§ 784.24 Transportation facilities.

Each application shall contain a detailed description of each road, conveyor, and rail system to be constructed, used, or maintained within the proposed permit area. The description shall include a map, appropriate cross sections, and the following:

(a) Specifications for each road width, road gradient, road surface, road cut, fill embankment, culvert, bridge, drainage ditch, and drainage structure.

(b) A report of appropriate geotechnical analysis, where approval of the regulatory authority is required for alternative specifications or for steep cut slopes under 30 CFR 817.150(d), 817.152(c), 817.160(d) or 817.162(c).

(c) A description of each measure to be taken to obtain approval of the regulatory authority for alteration or relocation of a natural drainageway under 30 CFR 817.153(d), 817.163(d), or 817.173(c).

(d) A description of measures, other than use of a rock headwall, to be taken to protect the inlet end of a ditch relief culvert, for approval by the regulatory authority under 30 CFR 817.153(cX2Xvi) and 817.163(cX2Xvi).

(e) Each plan shall contain a general description of each road, conveyor, or rail system to be constructed, used, or maintained within the proposed mine plan area.

The coal shall be transported from the mine via a 42 inch covered conveyor a distance of 75 feet and be dumped into a crusher. From the crusher the coal will travel along 630 feet of 42 inch covered conveyor to be dumped into a 2,000 ton open stockpile as shown on Enclosure 13. Trucks will be loaded on the east side of the stockpile by a large front-end loader. Trucks will then proceed to the scale house and down the 26 foot wide compacted gravel roadway as shown on Enclosure 13. Cuts and fills and grades for the proposed access/haul road are illustrated on the "Road Profile", Enclosure 18.

A study of the stability of the road cuts, etc. was done by Sidney W. Smith P.E., and is included following.

The plan is revised to state that there will be no coal loadout at this time at any location other than the mine site. Trucks will either purchase coal at the mine or be contracted by the purchaser to haul coal for their needs.

Included herein is a letter from Carbon County regarding use of U-139 for additional truck traffic.

OPERATION PLAN: MAPS AND PLANS - 784.23

See Access and Haulage Road Design, Enclosure 8. Certified by Sidney W. Smith P.E.

Disturbance areas are shown on all surface area maps, also see reclamation map, 784.13.

The plan is revised to completely remove and reclaim the Class I Access and Haulage Road after cessation of mining operations and return the area occupied by the road to the same standards as for the rest of the proposed disturbed area as was outlined previously.

CARBON COUNTY
PRICE, UTAH 84501

February 6, 1989

William Roger Skaggs
P.O. Box 784
Price, Utah 84501

Dear Mr. Skaggs,

This is in response to your request concerning the impact your company would have in hauling coal down the Gordon Creek Road. It is our opinion that the impact would not be too severe, and your company hauling coal on that road would be permissible.

There is one problem, however, Beaver Creek Coal has been maintaining that road for the last few years and there would have to be an agreement between Beaver Creek Coal and Carbon County as to the upkeep of the road. If you need more information, please call me.

Very truly yours,

BOARD OF CARBON COUNTY
COMMISSIONERS,

Emma R. Kuykendall

Emma R. Kuykendall
County Commissioner

EK/rp

C & W COAL MINE REPORT

SLOPE STABILITY REQUIREMENT:

The surface of the C & W Coal Mine site was examined on February 27. 1980 for the purpose of determining existing site conditions with regard to the stability of natural slopes and the stability of artificial slopes formed as a result of past mining activity.

Natural slopes in the general vicinity of the proposed coal mine are convex upwards with slopes ranging from 20 to 70%. The stream bottoms, both perennial in Gordon Creek and ephemeral in the mine area, are incised as a result of regional uplift in pre-pleistocene time. Artificial slopes consisting of mine spoil and sandstone and shale are stable at slopes up to 70% (35°), the maximum observed. The stability and resistant of these slopes channeling and sliding may be due to partial cementation in a process analogous to caliche formation in sediments in arid or semi-arid climates.

The coal haulage road entering the mine canyon from U-139 in Gordon Creek will be cut in sandstone. This sandstone stands nearly vertical in natural exposures. No stability problems will result from completing the cut in accordance with regulations of IV:25H for cuts in consolidated materials.

The concrete ruins from past mining that lie along or near the haulage roadway could be disposed of by burial. Alternatively they could be used as silt barriers along the course of the present ephemeral stream bed.

The 40 foot radius curve about 1600 feet north of the mine canyon mouth, crosses an ephemeral drainage channel with culvert designed to withstand a 100 year, 24 hour precipitation event. The inlet and discharge ends will need to be rip-rapped to avoid bank erosion during spring runoff or heavy annual thunderstorms. Rock from the cut near the haulage road mouth could be used for this purpose and could be permitted to stand at a slope of IV·1·35H in accordance with regulations.

The uphill sides of cuts for Class I and II roads, mine portals and ancillary structures and buildings in the mine area may be cut at slopes of IV:.25H in the consolidated rock formations in accordance with regulations. The outslopes must meet a regulatory requirement of IV:2H (50%) and should be seeded as soon as completed. even if watering is required, for the purpose of further reducing erosion and fostering slope stability.

The soil structure and the rock formations of the mine and road areas were studied carefully in relation to slope stability. The underlying rock formations do not show any signs of slopes that would slip with pressure changes due to construction of mine facilities and there are no springs or seeps to decrease slope stability. The soils at the site include a fair amount of sands and sandstone gravels and provide stable slopes under standard construction techniques.

In summary, sediment and soils stability should not be problems at the C & W mine site during mining or reclamation operations. This is due to the fact that natural slopes at the site are equal to or greater than slopes mandated by regulatory authorities for the various natural materials existing at the site.

Sidney W. Smith P.E./L.S.#2U

March 4, 1980
Date

REGISTERED PROFESSIONAL ENGINEER
SIDNEY W. SMITH
STATE OF UTAH

ENGINEERING REPORT

by

SIDNEY W. SMITH P.E., L.S.

State of Utah

Department of Natural Resources

Division of Oil, Gas and Mining

1588 West North Temple

Salt Lake City, Utah

RE: Engineering Report - Consolidated Comments of UDOGM and OSM for the C&W No. 1 Mine, Carbon County, Utah

This letter is an answer to specific statements in the comments made for the C&W No. 1 Mine. The specific items are those that apply to the Civil Engineering of the project. Paragraph numbers refer, in order, to paragraphs under specific title and regulation number in the Consolidated Comments of UDOGM and OSM.

SURFACE WATER INFORMATION 783.16.

Paragraph 4.

Engineering experience has shown that a 12 inch culvert is the smallest practical culvert size from a maintenance standpoint. The Nomographs prepared by the National Corrugated Steel Pipe Association, in their technical manual, show that a 12 inch culvert carry 2.6 cfs to 3.0 cfs on a minimum slope of 5% and with end sections, with less than 1.25 head water (less than 3 inchs over crown of pipe). Experience also shows that a storm duration of less than 15 minutes is not necessary in that the storm is dissipated in local depressions and is too

short to do any damage to roadways. Therefore, we found that we do not need to delineate and calculate drainage areas less than 12 acres since a 12 inch culvert will provide ample capacity for drainage areas less than 12 acres.

As requested, we have delineated the drainage areas on Exhibit and the results of the calculations are as follows:

	C	x	I	x	A	=	Q	D
			In/Hr		Acres		cfs	Culvert Si
Area A Upper Culvert 10 year 15 min. storm Triangle Ave Dimensions 600' x 1,000'	.2		1.25		7.0		1.75	12"
Area B Middle Culvert 10 year 15 min. storm Rectangle 600' x 750'	.2		1.25		10.3		2.6	12"
Area C Lower Culvert 10 year 15 min. storm Rectangle 600' x 750"	.2		1.25		10.3		2.6	12"

It is our opinion that the 12 inch culverts are large enough to carry the storm runoff.

Paragraph 5.

The hydrology of the surface runoff, showing total flow rate is shown, with flow rates for the various areas, in Table 1, Appendix A.

The upper 60" culvert south of the proposed bath house will be required to carry 112 cfs for a 1,000 year 15 min. storm. The downstream channel and slope is sufficient to insure no tailwater accumulation. The nomographs prepared by the "National Corrugated Steel Pipe Association" include the entrance

losses for a projecting pipe with no headwall, which is the worst case. The entrance loss coefficient Ke is 0.5. The 60" culvert is capable of carrying 115 cfs. Therefore, the 60" culvert provides for normal entrance and exit losses and a sizeable safety factory particularly in light of the 1,000 year 15 minute storm.

The middle 60" culvert next to the proposed substation has the same circumstances as above.

The lower 60" culvert on the North Fork drainage has a larger drainage area but also a longer critical duration time of 20 minutes. The 25 year 20 minute storm produces 101 cfs. The 60" culvert will carry more than this as shown above. The site grading is such that a headwater depth of two times the culvert diameter is reasonable and probable. The 60" culvert will carry 250 cfs with the double headwater depth. Therefore, the culvert and the projecting entrance will carry the design flows.

The 12" roadway culverts have been disucssed previously and their designs also include standard entrance losses.

The roadway culverts will drain onto riprap pads where the flows will be spread to slow the flows and reduce erosion. Whereve ditches are required the minimum cross section will be a V with side slopes two horizontal to one vertical or flatter. Wherever the channel slope exceeds 10% the channel will be covered with riprap to prevent erosion. A one foot deep ditch will carry over

4 cfs on a minimum slope of 1%. The minimum depth will be 16 inches. The channel realignment for the flows from the undisturbed areas will have a minimum cross section of four foot bottom width and side slopes that are two horizontal to one vertical or flatter. The minimum channel depth will be three feet. The minimum channel bottom slope will be .5% or greater. Whenever the bottom slope is greater than 1% the channel will be covered with riprap for erosion protection. This channel will carry a flow in excess of 100 cfs, which is more than ample with freebroad for the maximum 100 year 24 hour event.

No channel changes are expected for the North Fork drainage. Should changes be necessary the channel cross section used would be a six foot bottom width, side slopes two horizontal to one vertical and a four foot minimum depth. This channel will carry 150 cfs on minimum grade and three foot depth which is sufficient for the maximum 100 year 24 hour event.

All channel sections will be covered with 12" median size riprap except for minimum channel slopes. Channels with slopes over 15% will be covered with 18" median size riprap. Where channel slopes are steep the flow depth will be sufficiently shallow, that the riprap will dissipate the energy and prevent erosion. Riprap will also be provided at all culvert exit locations to provide erosion protection.

These channel capacities are computed using the Manning Equation with an "n" valve of .04.

Paragraph 6.

The oil skimmer and riser specifications were included on Land Group Drawing No. 4, except that the weir plate should be five feet in diameter and three feet high. The fiberglass manhole sections provide an easy economical installation that holds up well to freeze-thaw action and is easily replaceable. The four two inch holes are designed to release the retained water over a long period of time automatically at a maximum rate of .5 cfs total. An orifice "C" factor of .6 is assumed. The slow exit rate coupled with the permanent retention will provide more than the required 24 hour retention.

Should a storm larger than the 10 year 24 hour event occur or should the two inch drain holes become plugged, the water would overflow the riser. The riser will pass up to 10 cfs and still maintain the skimming action. The 12" "Armco Truss Pipe" between ponds has a recommended "n" valve of 0.009 and with the given head conditions will carry up to 10 cfs. Therefore, the riser and skimmer will carry two and one-half times the maximum 10 year flow rate and still remain operational.

OPERATIONAL PLAN: GENERAL REQUIREMENTS - 784.11.

Paragraph 2.

The retention pond cut slopes and embankment have been designed within the standards of the State and Federal Codes. The enclosed Detail Map shows the exterior slopes to be 2÷1 and the interior slopes are 3÷1. These slopes are stable and within

good design practice. The earthwork will be constructed according to the attached specifications.

The ponds are designed to be self operating. The only operation and maintenance required is the occasional removal of silt and debris. See reclamation plan for removal plans.

The roadway has been designed in accordance with the provisions of UMC Paragraphs 817.152 c&d, see the road profiles and the typical cross section shown on Enclosure 18, following this report. The road will also be constructed according to the attached earthwork specification.

Paragraph 5.

The sanitary wastewater disposal system will be designed to serve 30 people. The system will consist of a septic tank and drainfield. Plans will be submitted to the Southeast District Health Department prior to drainfield construction as some of the site excavation will be required to do proper percolation tests at the proposed location. Preliminary soil studies indicate that the expected percolation rate will be within acceptable limits. The drainfield will be relocated, if necessary, to find acceptable soils.

Paragraph 6.

The stream diversion will generally be an excavated channel as described previously and shown on details following this report. Wherever practical the steeper channel sections will be flattened. Riprap has been specified where necessary to

control erosion. Some banks may require fill which will be constructed according to the attached specifications. Very little maintenance is required for the diversion channels. The debris may need to be removed occasionally. Should some erosion occur then riprap would be added to repair the erosion. Restoration is addressed elsewhere. However, since native soils and rock are the construction materials, restoration will be simple. The channels to be relocated are dry intermittent channels without habitat dependent on flowing water. The affected drainage can be classed as ephemeral.

Paragraph 7.

The discharge structures are relatively small in size and discharge flow rates. The discharge point will commence within a riprap channel and sufficient riprap will be used to prevent erosion. Since the discharge is into a dry channel the hydrologic balance will not be upset and no additional mitigation measures should be necessary. Standard engineering practice will be used in ground layout and construction of all structures.

RECLAMATION PLAN: PROTECTION OF HYDROLOGIC BALANCE 784.14.

The Land Group Report details the runoff volumes and peak flows. The C factor used for undisturbed areas of .2 was selected from Table 21-16 of the "Standard Handbook for Civil Engineers" as being conservative since unimproved areas are listed as .10 to .30, lawn and grass areas were listed as .050

to .20. The C factor for the disturbed area was chosen as .70 which is conservative since railyards are listed as .2 to .4 and light industrial areas are listed as .5 to .8.

RECLAMATION PLAN - PONDS, IMPOUNDMENTS, BANKS, DAMS AND EMBANKMENTS 784.16.

The sedimentation ponds and embankments, the diversion facilities, and other drainage facilities and the roadways have been designed by an experienced competent engineer licensed in the State of Utah, see certification at the end of this report.

The ponds will be lined with a one foot thick layer of decomposed Mancos shale or a one foot thick layer of native fine silts with 2% bentonite. These treatments will provide near zero percolation from the ponds.

Cut-off collars have been added to the Land Group Plans which constitute final design of the sedimentation ponds, see new design following this report. Exact horizontal location may be adjusted slightly at the time of construction staking.

DIVERSIONS 784.22.

There are three small diversions to separate the runoff from undisturbed areas and route the undisturbed runoff around the disturbed areas. All three areas are less than 6.0 acres each. All three ditches will be constructed at minimum grades for most of their lengths and will have only short sections of

moderate grades where they enter the main channel. Riprap will be used wherever necessary to prevent erosion and particula at steep sections and entrances to the main channel.

	C	x	I	x	A	=	Q
Area D North of the Bath House 10 year 15 min. storm	.2		1.25		5.5 acres		1.4 cfs
Area E South of Water Storage 10 year 15 min storm	.2		1.25		2.75 acres		.7 cfs
Area D	.2		1.25		3.2 acres		.8 cfs

These flows will be carried 10 year 15 min. storm

The ditch will be a simple V ditch with one vertical and two horizontal side slopes and a minimum of 16" deep. The V ditch will carry four cfs at 1% slope and one foot deep which provides ample capacity and freeboard. Riprap will be used in all areas where the slope exceeds 10%.

All diversions will carry the maximum 10 year 24 hour event and any permanent diversions will carry the maximum 100 year 24 hour event.

The diversion around ponds at the outlet of the lower pond are large enough to accommodate the maximum 100 year event which is far in excess of Section 817.46(4)(i) undisturbed area CZ .7, I=4, A=2.9, Q=8 cfs. The diversions are capable of 10 cf In addition, emergency spillways are provided that will carry even greater flows.

TRANSPORTATION FACILITIES 784.24.

Paragraph 1.

The roads have been designed under the supervision of a competent Registered Professional Engineer. (See State of Certification).

Paragraphs 3 and 4.

The typical cross section shown on Enclosure 18 notes that the cut and fill slopes are within the standards set by Section 817:150 to 817:152. Rock cuts will not exceed IV:0.25 horizontal.

Paragraph 5.

The roadway drainage is in compliance with 817:153 as noted earlier in this report.

ENGINEER'S CERTIFICATE

I hereby certify that I designed or supervised all of the designs and calculations represented in this report and the original application. The designs and calculations are in accordance with UMC regulations and Standard Engineering Practice. I am duly registered to practice engineering in the State of Utah and hold Utah License No. 3420.

Sidney W. Smith Date Aug. 18 1981

Sidney W. Smith

REGISTERED PROFESSIONAL ENGINEER
No. 3420
SIDNEY W. SMITH
STATE OF UTAH

SIDNEY W. SMITH
PROFESSIONAL ENGINEER & LAND SURVEYOR
PHONE 867-5153 1206 NORTH MAIN FARMINGTON, UTAH 84025

Appendix A.

Material for engineered fills above water table should meet the following recommendations. The material should be granular, and free of organic materials and other delterious matter. The fines should have a plastic index less than 10 and meet the following limitations on gradations:

a.	Maximum size of particles	4 inch
b.	Retained on the 3/4" sieve	30% maximum
c.	Passing the No. 100 sieve	45% maximum
d.	Passing the No. 100 sieve	10% minimum
e.	Passing the No. 200 sieve	12% maximum

The grading shall be in accordance with ASTM C117 and C136. The subgrade shall be prepared by stripping topsoil, organic matter, rubbish and debris. The surface to receive fill shall be compacted so that the top six inches meets the specifications for compacted fill. Compacted fill or engineered fill shall be placed in layers not greater than 8 inches uncompacted and at a moisture content slightly drier than optimum moisture. Each layer shall be compacted to not less than 95% of the maximum density determined in accordance with ASTM Standard specifications D1557, for all fill under structures. Paved areas and others should be compacted to 92% of maximum density. Fill should not be placed when wet or frozen nor should it be placed on wet or frozen subgrade. All material sources should be approved by the soils engineer Tests of the compacted soils should be made under the direction of a qua

SIDNEY W. SMITH
PROFESSIONAL ENGINEER & LAND SURVEYOR
PHONE 867-5153 1206 NORTH MAIN FARMINGTON, UTAH 84025

Appendix B.

Materials for engineered fills below the water table should meet the following recommendations: The material should be granular, free draining and should be free of organic matter or other deleterious matter. The fine should have a plastic index less than 10 and meet the following limitations on gradation:

a.	Maximum particle size	12 inch
b.	Passing the 3/4" sieve	75% maximum
c.	Passing the 3/4" sieve	25% minimum
d.	Passing the 100 sieve	45% maximum
e.	Passing the 200 sieve	5% maximum

Some allowance can be made in the above gradation for good quality bank run gravel. What is desired is a coarse rock material with enough finer portions to fill all the big voids but to allow for a free movement of water.

A layer of fill just thick enough to support equipment should be placed and worked until a firm surface is developed or until any soft existing soil is squeezed into the voids in the fill. Material can then be added in 6 to 12 inch layers, each layer being compacted and worked until a firm, unyielding surface is developed. When the level of the water table is reached then engineered fills for above the water table and footings must be placed on firm unyielding surfaces. The water should be removed from the excavation until after the fill is placed and compacted. All material sources should be approved by the soils engineer. Tests of the compacted soils should be made under the direction of a qualifie[illegible] engineer to insure proper compaction.

SIDNEY W. SMIT
PROFESSIONAL ENGINEER & LAND SURVEYO
PHONE 867-5153 1206 NORTH MAIN FARMINGTON, UTAH 8

Appendix C.

Materials and workmanship for engineered fills should be modified as described below when they are placed on ground too soft to support equipment, particularly below the water table.

A compaction base should be established by placing a layer of cobble rock several inches thick over the bottom of the excavation. This layer should be just thick enough to support the equipment without difficulty. The layer should then be worked with compaction equipment until the cobbles are worked into the soft soils in such a manner that the void in the cobbles are filled with soil. The excavations should be free from water during the process, and work should proceed in such a manner that proper drainage is maintained and mud does not develope. The cobbles should be as large as practical (up to 12 inches) and should be free from moisture or fines.

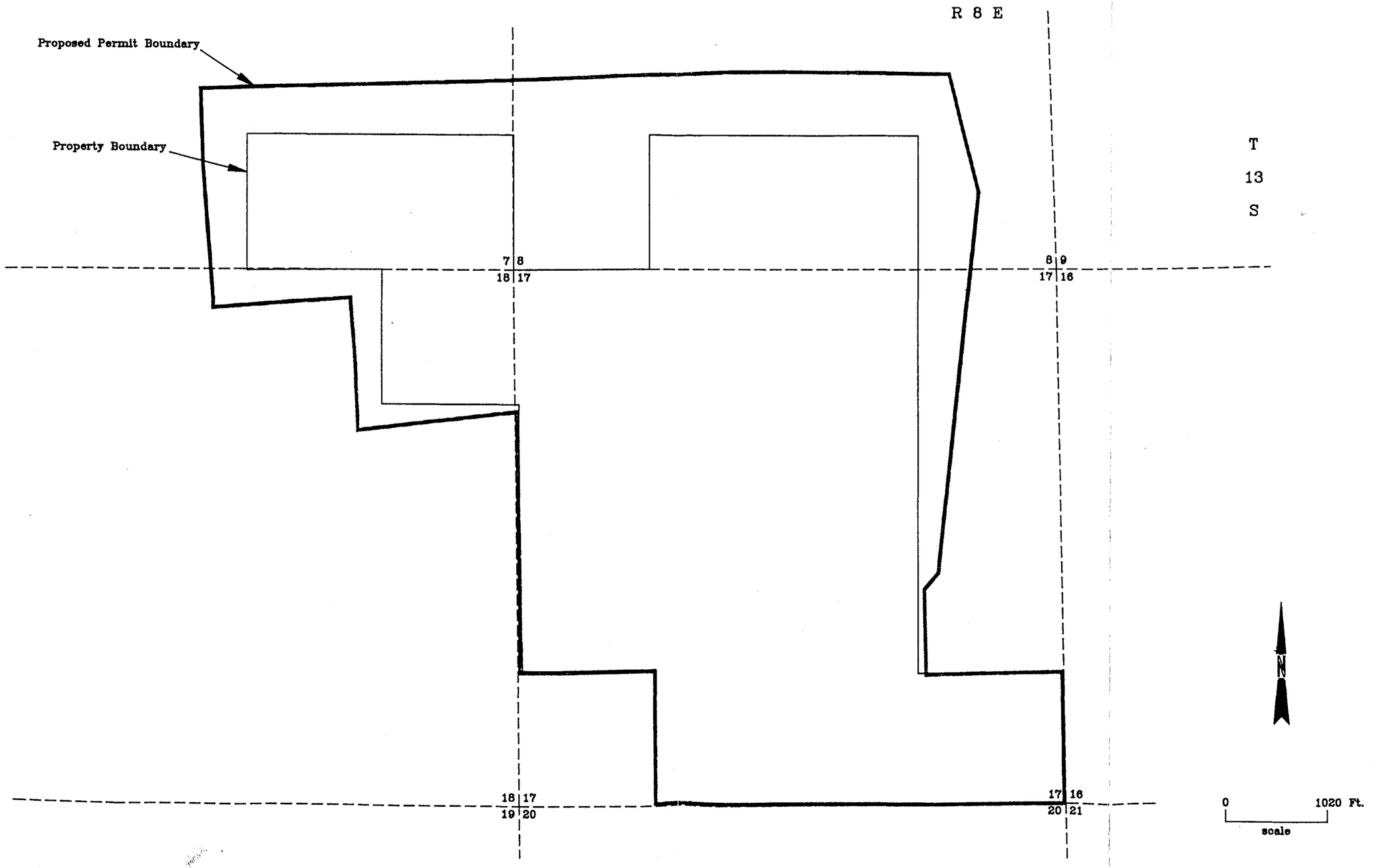
All material sources and workmanship should be approved by the soils engineer.

After a compaction base is established then the placement of engineered fill should proceed according to the recommendations of the applicable appendix A or B.

APPENDIX 7-5

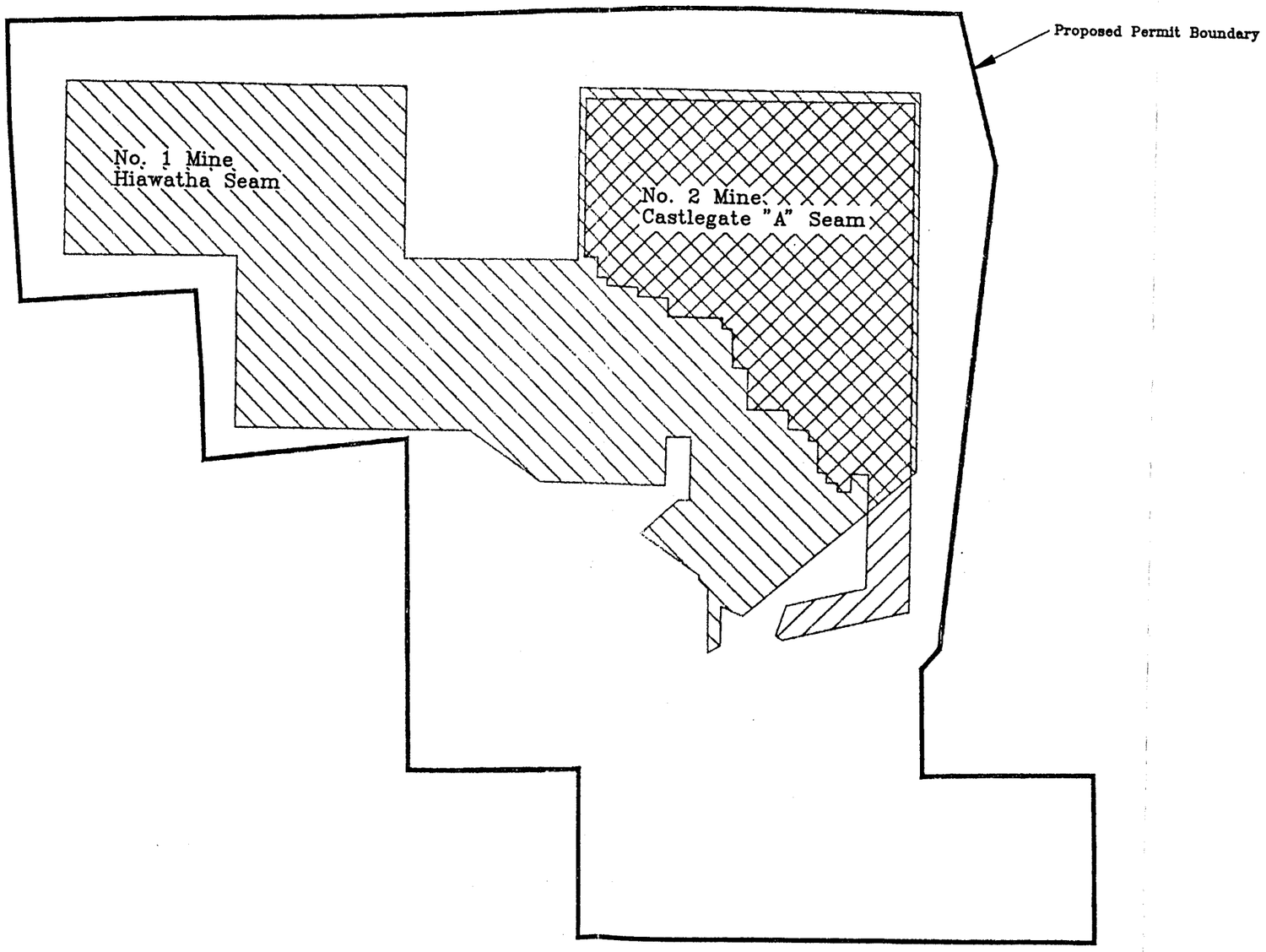
HISTORIC MINE DEVELOPMENT

MAP 1 : PROPOSED PERMIT AREA
BLUE BLAZE COAL



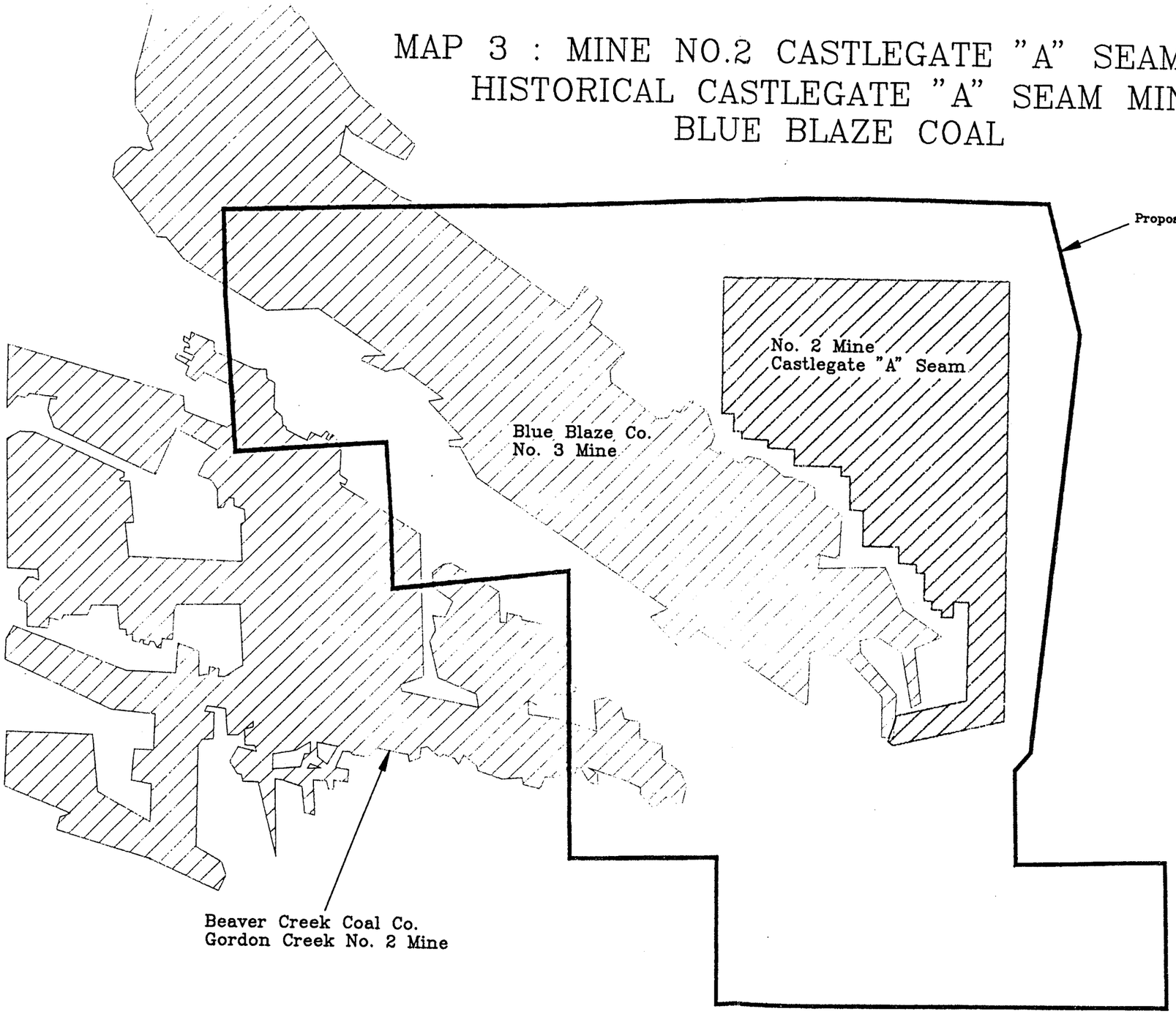
(HP)

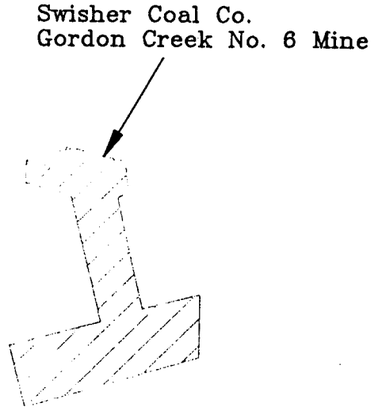
MAP 2 : BLUE BLAZE No. 1 and No. 2 MINE AREAS
BLUE BLAZE COAL



(HQ)

MAP 3 : MINE NO.2 CASTLEGATE "A" SEAM AND HISTORICAL CASTLEGATE "A" SEAM MINES BLUE BLAZE COAL



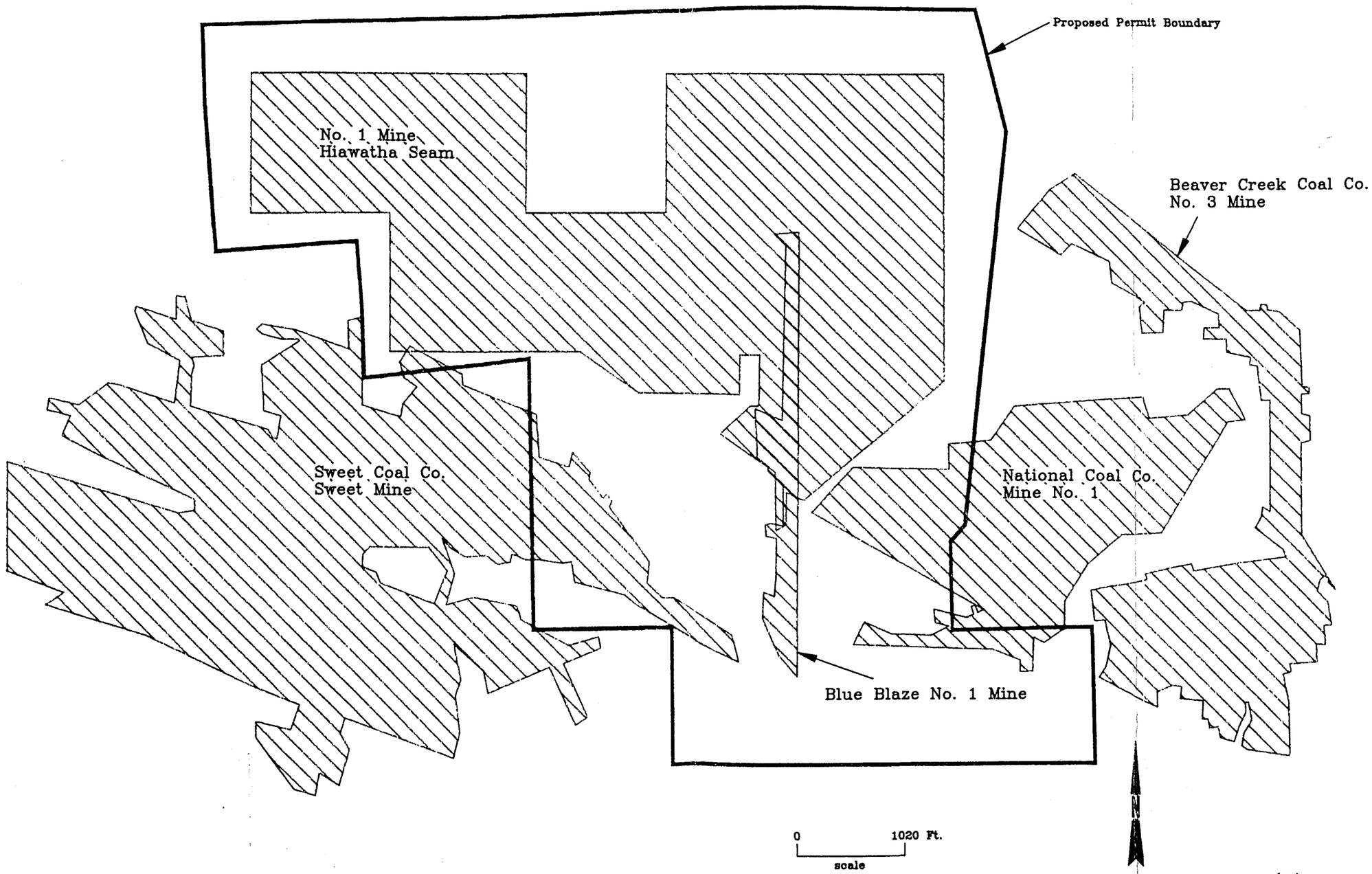


0 1020 Ft.
scale

N

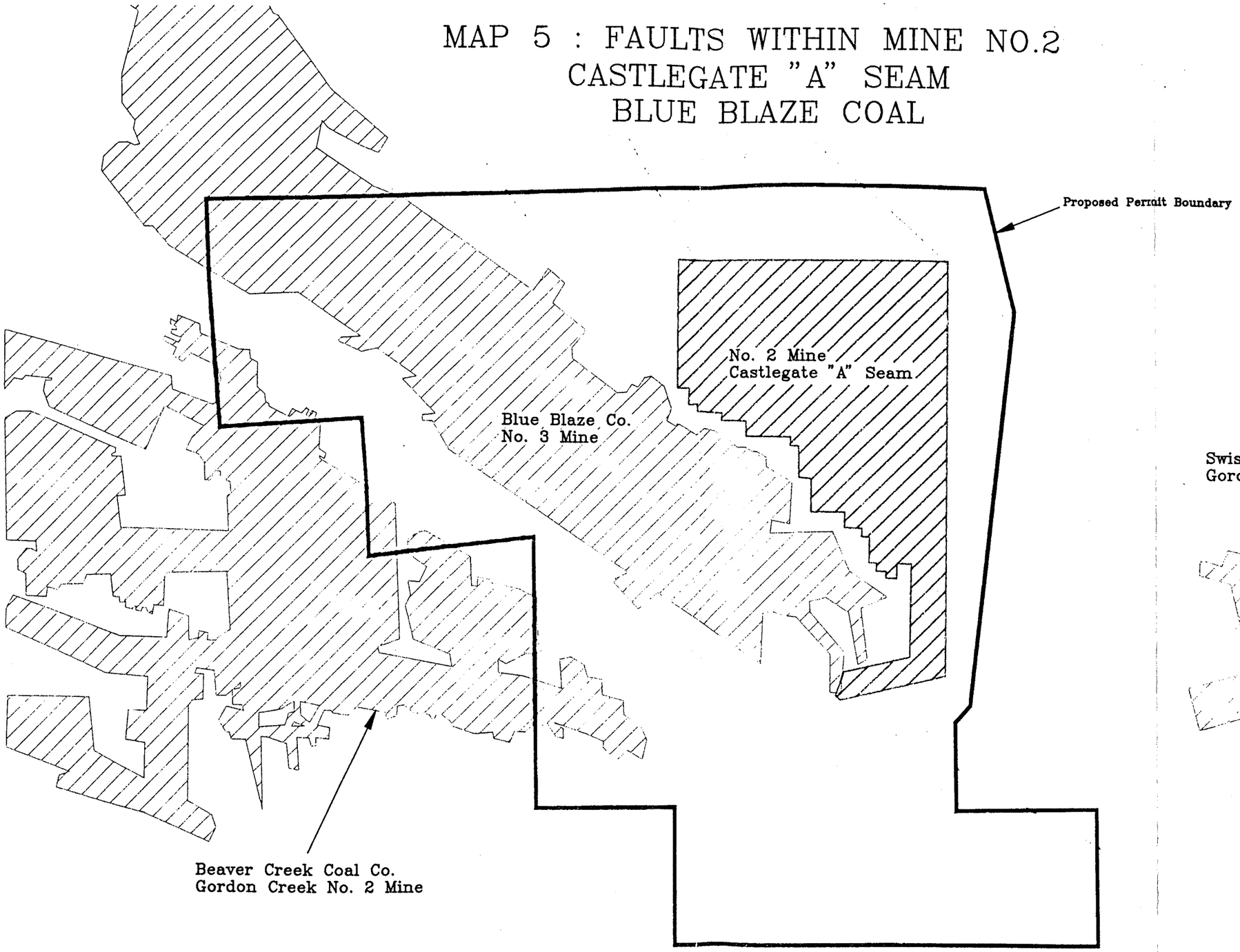
(HR)

MAP 4 : MINE NO. 1 HIAWATHA SEAM AND HISTORICAL HIAWATHA SEAM MINES BLUE BLAZE COAL



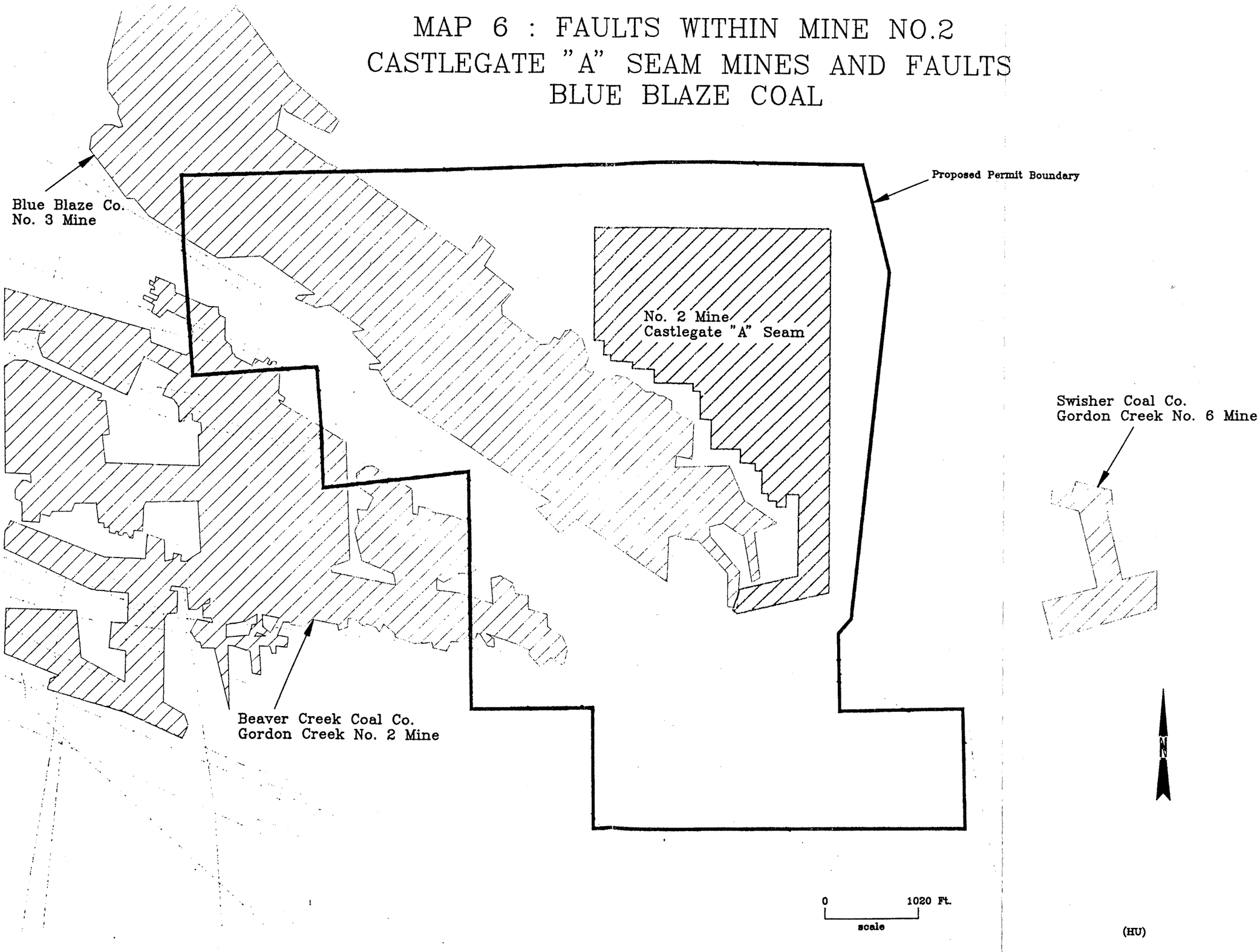
(HS)

MAP 5 : FAULTS WITHIN MINE NO.2
CASTLEGATE "A" SEAM
BLUE BLAZE COAL



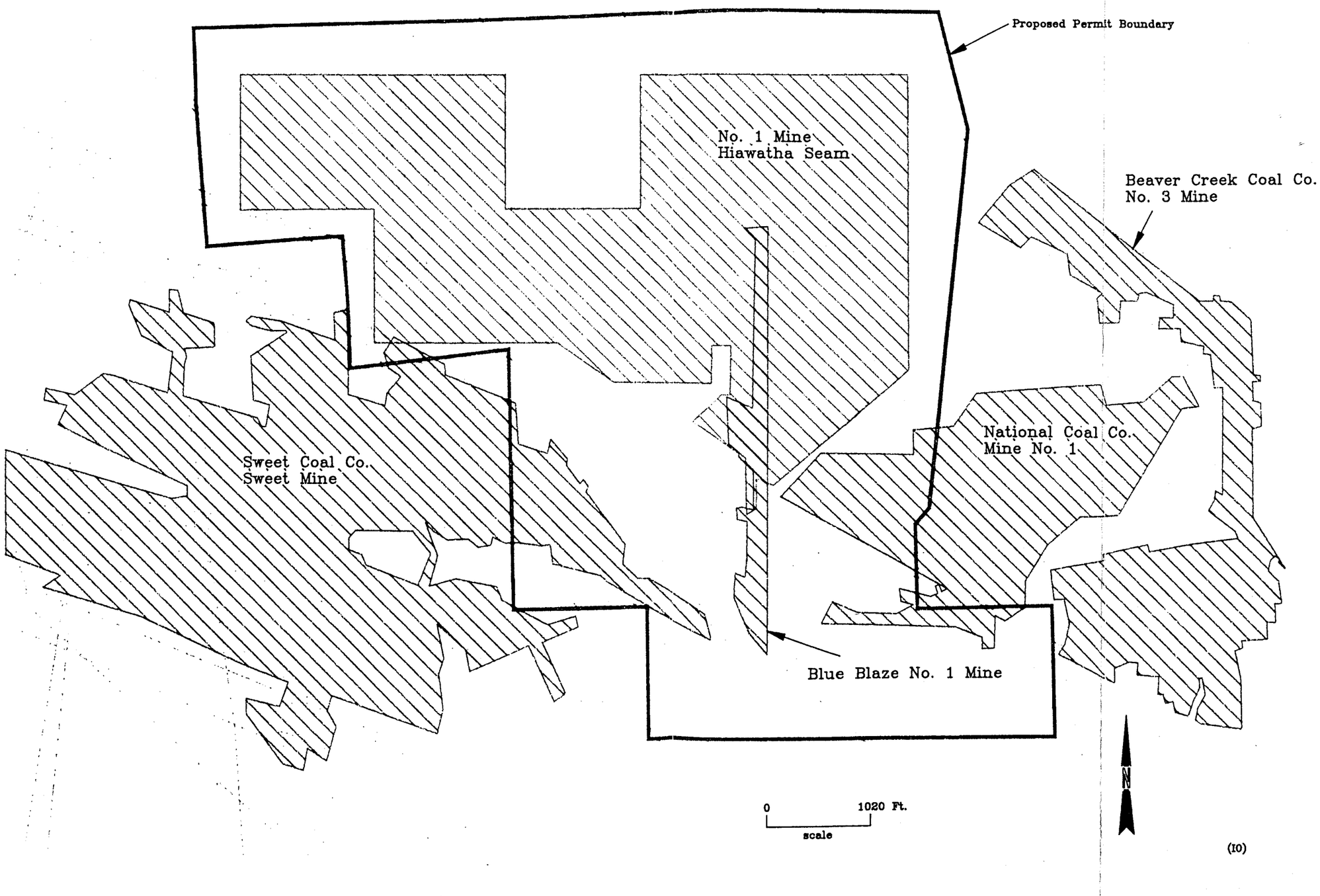
(HT)

MAP 6 : FAULTS WITHIN MINE NO.2
CASTLEGATE "A" SEAM MINES AND FAULTS
BLUE BLAZE COAL

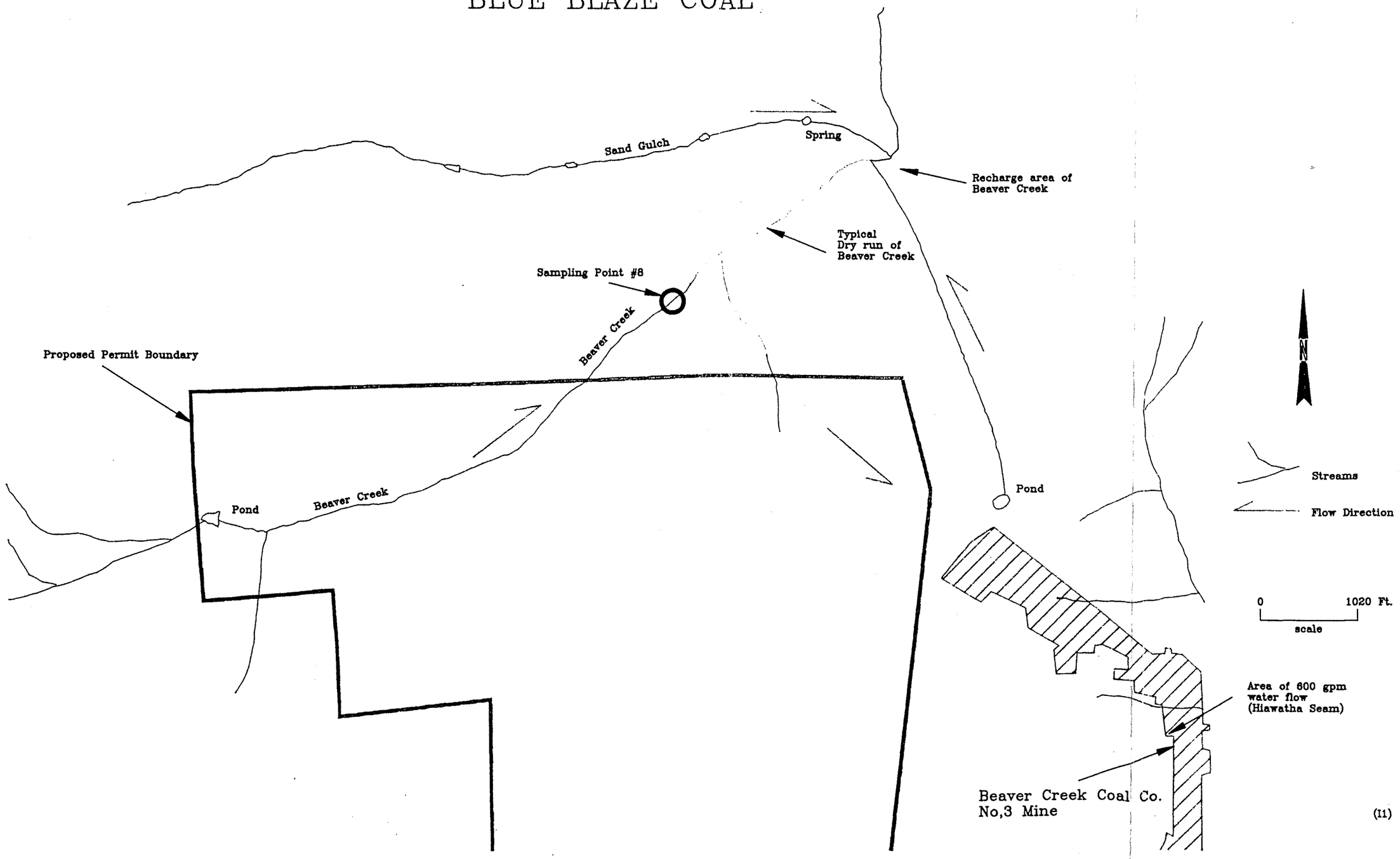


(HU)

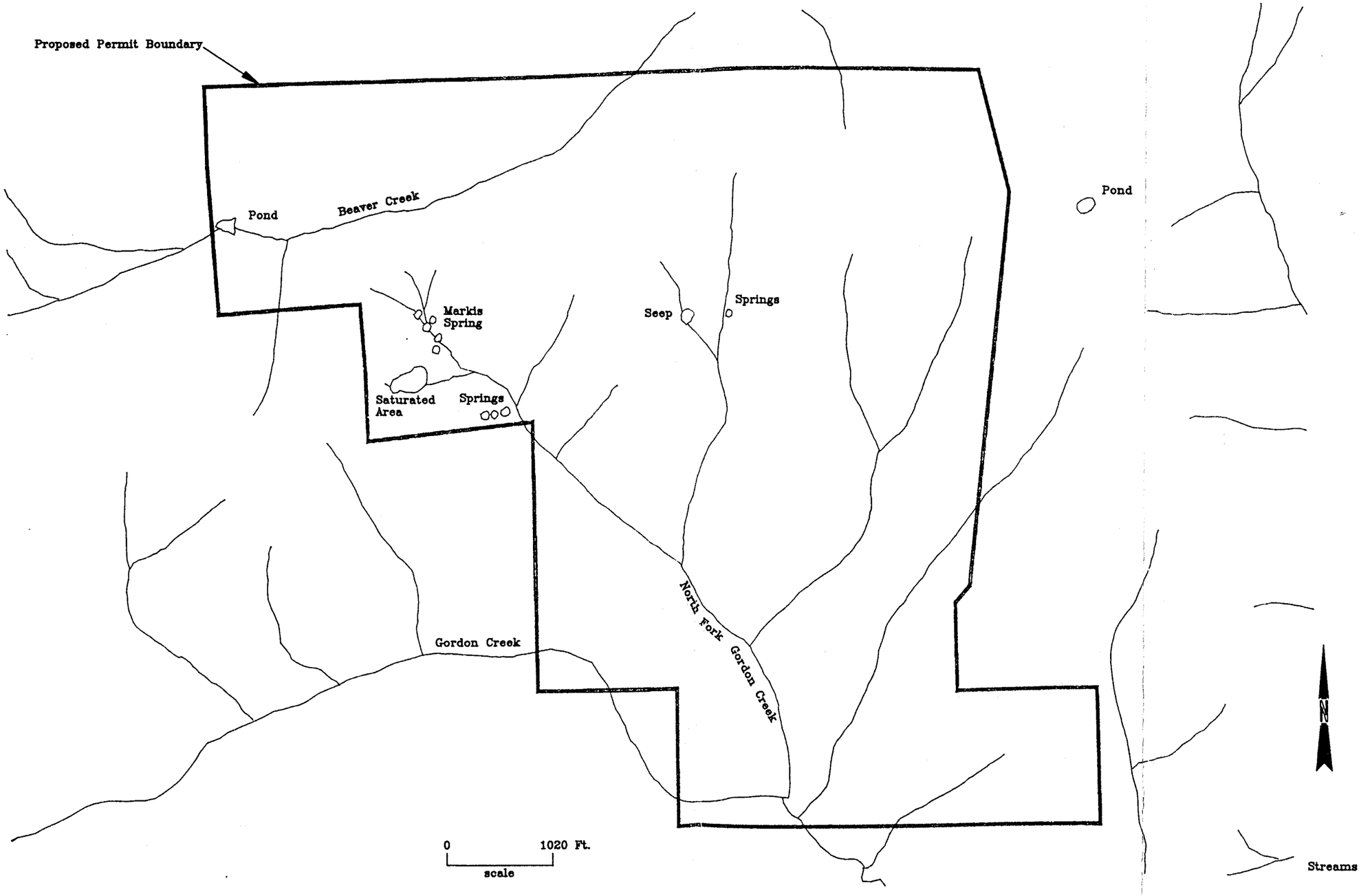
MAP 7 : MINE NO.1 HIAWATHA SEAM, HISTORICAL HIAWATHA SEAM MINES AND FAULTS BLUE BLAZE COAL



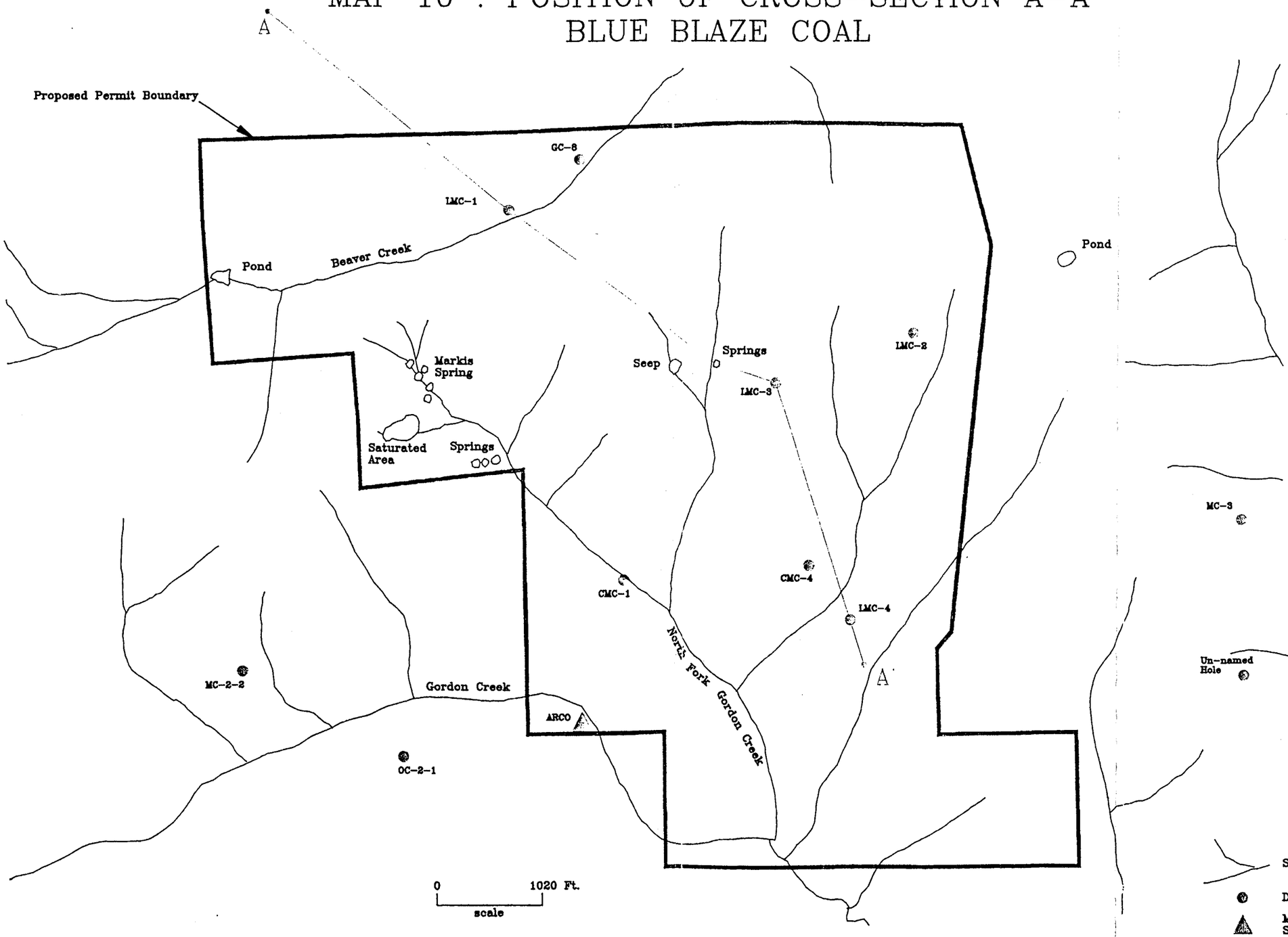
MAP 8 : EFFECT OF FAULT ON BEAVER CREEK AND BEAVER CREEK No.3 MINE
BLUE BLAZE COAL



MAP 9 : SURFACE WATER AND SPRINGS
BLUE BLAZE COAL



MAP 10 : POSITION OF CROSS-SECTION A-A'
BLUE BLAZE COAL



APPENDIX 7-6

EXPLORATION PERMIT APPLICATION

Horizon Coal Corporation
P.O. Box 2560
Wise, VA 24293

April 12, 1995

Department of the Interior
Bureau of Land Management
Utah State Office
P.O. Box 45155
Salt Lake City, Utah 84145-0115
Attention: **Chris Merritt**

Re: Application for Exploration License, "Beaver Creek Tract"

Dear Sir:

Horizon Coal Corporation hereby applies for an exploration license to obtain geological, environmental, and other pertinent data concerning coal deposits pursuant to 43 CFR Sub-part 3410. The lands requested to be explored are located in Carbon County, Utah and are described more fully as follows:

Township 13 South, Range 8 East. Salt Lake Meridian Utah

Section 8; N½ S½

Containing 160 acres, more or less

Attached are five copies of the Exploration Plan for the proposed exploration area, which is referred to as the "Beaver Creek" Tract. The Exploration Plan includes one hole to be drill on Federal Lease SL 063011. Application for on-lease exploration is being made to the Price River Resource Area under separate cover. The required fee of $250.00 is attached.

Also attached is the proposed "Notice of Invitation" for your review and approval. Upon receipt of your approval, Horizon will publish the notice once every week for two consecutive weeks in the Sun Advocate, a newspaper having general circulation in the general area of interest.

Your prompt attention to this matter is greatly appreciated.

Sincerely,

Richard Gilliam

cc. Brad Bourquin

Notice of Invitation to Participate in a Coal Exploration Program
Horizon Coal Corporation
Beaver Creek Track

Horizon Coal Corporation is inviting all qualified parties to participate in proposed exploration of certain Federal coal deposits in the following described lands in Carbon County, Utah:

Township 13 South, Range 8 East. Salt Lake Meridian Utah

Section 8; N½ S½

Containing 160 acres, more or less

Any party electing to participate in this exploration program must send written notice of such election to the Bureau of Land Management, Utah State Office, P.O. Box 45155, Salt Lake City, Utah 84145-0155 and to Brad Bourquin, 1131 S. Dover, Lakewood, Colo. 80232. Such written notice must be received within thirty days after publication of this notice in the Federal Register.

Any party wishing to participate in this exploration program must be qualified to hold a lease under the provisions of 43 CFR 3472.1 and must share all cost of the exploration program. An exploration plan submitted by Horizon Coal Corporation, detailing the scope and timing of this exploration program is available for public review during normal business hours in the Public Room of the BLM State Office, 324 South State Street, Salt Lake City, Utah.

Horizon Coal Corporation
P.O. Box 2560
Wise, VA 24293

April 12, 1995

US Department of Interior
Bureau of Land Management
Price River Resource Area
900 N 700 E
Price, Utah 84501
Attention: Mark Bailey

Re: Application for Approval of "On-Lease" Exploration Plan

Dear Sir:

Horizon Coal Corporation hereby applies for approval of an exploration plan to obtain geological, environmental, and other pertinent data concerning coal deposits pursuant to 43 CFR Sub-part 34 82.1. The lands requested to be explored are located in Carbon County, Utah and are contained within Federal Lease SL 063011 and are described more fully as follows:

Township 13 South, Range 8 East. Salt Lake Meridian Utah

Section 7:	S½/SE¼
Section 8:	SW¼SE¼
Section 17:	N½NW¼, SW¼NE¼
Section 18:	NE¼NE¼

Containing 280 acres, more or less.

Attached are five copies of the Exploration Plan for the proposed exploration area, which is written to include one hole to be drilled on Federal Lease SL 063011 and three holes to be drilled during the same project on adjacent open Federal Lands. Application for an exploration license is being made, under separate cover, to the state office for the open federal lands.

Your prompt attention to this matter is greatly appreciated.

Sincerely,

Richard Gilliam

cc. Brad Bourquin

Horizon Coal Corporation
P.O. Box 2560
Wise, VA 24293

April 12, 1995

Pamela Grubaugh Littig
UDOGM
355 West North Temple
3 Triad Center, Suite 350
S.L.C., Utah 84180-1203

Re: Transmittal of Horizon Coal Exploration Plan for 1995

Pamela;

Enclosed pleased find a complimentary copy of the Horizon Coal Exploration plan which details plans to drill on lands lying within and adjacent to the Horizon Coal Mine Permit Land in Carbon County, Utah (formerly know as Blue Blaze). Per standard procedure, the official copy of this plan will be forward to you by the State BLM Office, we desire that you have a copy ASAP therefor we are sending this via Federal Express.

Please note the State Land "surface" in Section 17 on which we desire to drill one hole is administered by:

SCHOOL AND INSTITUTIONAL TRUST LANDS ADMINISTRATION
355 W. N. Temple
3 Triad Center
Suite 400
Salt Lake City, Utah 84180-1204

Please direct any questions regarding this application to either Greg Hunt @ Geo-Hunt consulting 303-660-9368, or Brad Bourquin 303-989-4242.

We look forward to your review and comments.

Sincerely,

Richard Gilliam

cc: Brad Bourquin

EXPLORATION PLAN

for

PROPOSED "BEAVER CREEK" EXPLORATION TRACT

UNLEASED FEDERAL COAL LAND

CARBON COUNTY, UTAH

PRIVATE Surface

and

FEDERAL COAL LEASE SL 063011

CARBON COUNTY, UTAH

STATE Surface

HORIZON COAL CORPORATION

APRIL 1995

INTRODUCTION

This exploration Plan has been prepared by Horizon Coal Corporation acting as operator and owner for this exploration project. Horizon Coal Corporation has been assigned all leases mineral and surface rights, and the Mine Permit for the property formerly known as Blue Blaze. This property and permit will be referred to as the Horizon Coal Mine and Permit throughout this plan. The focus of the proposed exploration program is to explore the extent and mineability of potential coal resources adjacent to the existing leases controlled by Horizon Coal and to construct ground water monitoring wells. It is our desire to commence drilling activities as soon as possible and complete all activities in one field season, however, drilling activities could spread over two drilling seasons.

The leased and unleased federal land for which this exploration plan has been prepared are not contained within an "approved" permit area and therefore the format utilized follows that of 43 CFR, Subpart 3482 (12/31/92, edition). The appropriate regulation is referenced and underlined and Horizon's response follows. References to *figures, tables* and *maps* are *italicized* for easy recognition.

Five copies of this plan are herewith submitted to the Utah State BLM office. Courtesy copies are also being forwarded to the Price, Utah, BLM office and to the UDOGM office in SLC.

The information contained in this exploration plan demonstrates that environmental protection and reclamation are integral parts of the proposed exploration program and that reclamation will progress as contemporaneously as practical with the exploration program. Sufficient information is provided in the exploration plan to substantiate the effectiveness of the proposed reclamation method.

3482.1(a) (3) Exploration plans shall contain all of the following:

3482.1(a)(3)(I) the name, address, and telephone number of the applicant, and, if applicable the operator/lessee of record.

Applicant and Operator:
Horizon Coal Corporation
P.O. Box 2560
Wise, VA 24293
Telephone (703) 679-0804

3482.1(a)(3)(Ii) The name, address, and telephone number of the applicant who will be representation and be responsible for conducting the exploration.

Responsible Party:
Brad Bourquin
1131 S. Dover
Lakewood, Colo. 80232
Telephone (303) 989-4242

3482.1(a)(3)(iii) A narrative description of the proposed exploration area, cross-referenced to the map required under paragraphs (a)(3)(viii)of this section, including applicable federal lease and license serial numbers; surface topography; geologic, surface water, and other physical features; vegetative cover; endangered or threatened species listed pursuant to the endangered Species Act of 1973 (16 U.S.C. 1531, et a seq.); districts, sites, buildings, structures, or objects listed on, or eligible for listing on, the National Register of Historic Places; and known cultural or archeological resources located within the proposed exploration area.

Narrative description of the proposed exploration area

The proposed exploration plan area includes land on existing Federal Coal Lease SL 063011 controlled by Horizon Coal Company (formerly known as Blue Blaze), and on land immediately north of and contiguous to the existing Horizon Coal leases, referred to herein as the Proposed "Beaver Creek" Exploration License Area. The attached *Proposed Drill Sites & Access* Map shows the area covered by this exploration plan.

Legal Description

Legal descriptions of the two parcels of land which comprise the area of interest for this Exploration Plan are as follows:

Proposed "Beaver Creek" Exploration License Area, Un-Leased Federal Coal Land, Private Surface (controlled by Pete and Steve Stamatakis):

Township 13 South, Range 8 East, SLM
Section 8, N½/ S ½

The small (40 acres) portions of Federal Lease SL 063011 (The full lease encompasses 280 acres), for which the State of Utah controls the surface:

Township 13 South, Range 8 East, SLM
Section 17, SW¼/NE¼

The attached *Surface Ownership* Map shows surface ownership of all lands in the exploration plan area. Note that two surface owner's one; State of Utah, two; Pete & Steve Stamatakis, control the lands upon which exploration activities will be conducted under this exploration plan. The rather unusual circumstance of having federal coal lying beneath surface controlled by the State of Utah is the result of a land swap.

Proposed Site Locations

Site designation nomenclature "PRP" for "Proposed" drill hole site. A permanent designation will be given when the hole is actually drilled. *Table 1* lists the proposed drill sites and their locations.

TABLE 1 PROPOSED DRILL SITE LOCATIONS

Site Designation	State Coordinates		Approx. Legal Description
PRP-1	2,127,300 E	497,200 N	S W ¼ / N E ¼ S 17 T 13 S, R 8 E
PRP-2	2,128,700 E	500,700 N	N E ¼ / S E ¼ S 8 T 13 S, R 8 E
PRP-3	2,124,890 E	501,100 N	N W ¼ / S W ¼ S 8 T 13 S, R 8 E
PRP-4	2,129,100 E	501,000 N	N E ¼ / S E ¼ S 8 T 13 S, R 8 E

Surface Topography Features

The area is characterized as deeply incised "plateau topography," existing as flat-topped ridges elevated above the adjacent desert lands. This topography is the result of advanced erosion carving up a flat top "plateau," forming steep-walled canyons cutting into the exploration plan area. Elevations range from more than 9,000 feet above sea level on the tops of the highest ridges to 7,500 feet above sea level in the bottom of the deepest canyon.

Geologic Features

The lease tract lies at the northern end of the Wasatch Plateau Coal Field which contains minable coal only within the lower, Cretaceous Age, Blackhawk Formation (*Figure 1, Generalized Stratigraphic Column*).

Stratigraphic units present are, in ascending order, Mancos Shale, overlain by the deltaic and coastal plain sediments of the Blackhawk, Price River and North Horn Formations.

The Mancos Shale forms the valley floor and lower slopes of the south facing escarpment and is more than 4,000 feet thick in the area and contains the interfingered, eastward thinning delta sandstones of the Lower Blackhawk Formation. Locally the Blackhawk Formation is comprised of foreshore deltaic cliff forming sandstone members in ascending order, Panther, Storrs, Spring Canyon, and Aberdeen and lower coastal plain coal seams. The landward pinch out of the Aberdeen Sandstone occurs within the boundaries of the exploration plan area.

The aggregate thickness of the Blackhawk formation in this area is approximately 1,200 feet. The Blackhawk Formation is the primary coal-bearing formation within the area where thick and laterally extensive seams are closely associated with the above mentioned shoreline delta sandstone units.

Overlying the Blackhawk Formation is the lower Castlegate Sandstone (lowest member or the Price River Formation, massive cliff-forming sandstones 200-250 feet thick,) overlain by lenticular sandstones and mudstones of the Upper Price River Formation which grade upwards into the North Horn Formation.

The North Horn Formation, composed of lenticular sandstones and clay-rich mudstones, is the uppermost unit present in the exploration plan area, and is present only on the highest ridge tops.

Stratigraphic units in this part of the Wasatch Plateau Coal Field typically dip 8° North-Northeast. This regional dip is modified locally in individual fault blocks. Four faults with throws large enough to be considered "mine bounding" occur within, or in the immediate vicinity of, the exploration license area and form three separate fault blocks. These faults include the N 60° W Fish Creek Graben (Northern Boundary Fault), the N ≈ 45° W "B-C Fault," the arcuate ≈ N-S C-D Fault and the N 20° W "Eastern Boundary Fault " which is likely a northern extension of the Bear Canyon Grabben.

The "Fish Creek Graben" and the "Eastern Boundary Fault" are considered large enough to significantly influence ground water levels, whereas the "B-C" and the "C-D" Faults are considered too small to significantly impact the ground water regime.

Proposed drill holes' PRP-1 and PRP-3 lie within one fault block and PRP-2 and PRP-4 are in a second fault block. A conscious effort has been made to locate the proposed drill holes away from faults wherever possible.

Surface Water

The three principal drainages found within the exploration plan are, Beaver Creek, North Fork of Gordon Creek, and Gordon Creek. Beaver Creek is the only perennial stream in the exploration area. Gordon Creek and the North Fork of Gordon Creek are intermittent streams flowing only in response to snow melt or precipitation.

A number of seeps and springs also occur along rock-soil interfaces, or along fracture/joint zones, and most of these are intermittent.

Vegetative Cover

The surface is predominantly covered with sage brush, grasses and occasional conifers. A more complete description of vegetative cover may be found in section 9 of the Blue Blaze Mine Permit.

The exploration plan area includes lands inside of the Blue Blaze Mine Permit Area and lands which are contiguous with the Blue Blaze Mine Permit Area (the proposed Beaver Creek Exploration License Area). It will be noted that the Proposed Beaver Creek Exploration License Area is small (160 acres), and that the boundary lying the greatest distance from the Blue Blaze Mine Permit Area is less than 1,500 feet from the Blue Blaze Mine Permit Boundary. Vegetation Resources have been evaluated within the Blue Blaze Mine Permit Area as outlined in section 9 of the Mine Permit Document. The Mine Permit Document has been reviewed by DOGM and was found to be satisfactory but has not been approved, pending only posting of the bond (personal communication, Pamela Grubaugh Littig, April 5, 1995)

Because PRP-1 lies within the Permit Boundary and because the other holes are located within 1,200 feet from the Permit Boundary it is believed that studies of vegetative cover detailed

in the Horizon Mine Permit, and extrapolations of the vegetative cover data into the exploration tract area, satisfies the data requirements.

National Register of Historical Places Listings

No listed district, site, building, or structure, is located within the exploration plan area.

Archeological Resource Inventory

A cultural and archaeological resource inventory of the proposed drill sites and access roads (where applicable) will be completed as soon as is practicable, and the results will be forwarded to become an attachment to this plan. The inventory will fulfill the requirements of the National Historic Preservation Act of 1966 (amended), the National Environmental and Historic Preservation Act of 1971, the Archaeological Resources Protection Act of 1979, and the Utah Antiquities Act of 1973 (amended).

Other Physical Features

No significant physical features will be affected by the proposed drilling activities.

Soils

All soils within the exploration plan area have been surveyed by the USDA, Soil Conservation Service. The results of area soil surveys were published as the Soil Survey of Carbon Area, Utah (USDA-SCS, 6/88). Two soils surveys were conducted within the Horizon Coal Mine Plan Area and the results are summarized in the Horizon Coal Mine Plan Permit Document. The close proximity of the exploration license area to the permit area facilitates extrapolation of the soil types into the exploration permit area. Soils described in the area are as follows:

Shupert-Winetti Complex

The Shupert - Winetti complex consists of very deep, well drained, moderately permeable soils on narrow valley and canyon floors. These soils formed in alluvium derived from sandstone and shale. Slopes are 1 to 8 percent. Elevation ranges from 4,600 to 7,200 feet. Average annual precipitation is 12 to 16 inches, and average annual air temperature is 43 to 45 degrees F. These soils are fine-loamy, mixed (calcareous), frigid Typic Ustifluvents.

Brycan

The Brycan Series consists of very deep, well drained, moderately slowly permeable soils on alluvium derived from shale and sandstone. Slope is 3 to 8 percent. Elevation is 7,700 to 8,600 feet. Average annual precipitation is 16 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

Rabbityex

The Rabitex series consists of very deep, well drained, moderately permeable soils on mountain slopes and ridgetops. These soils formed in residuum and colluvium derived dominantly from sandstone, shale, limestone, and siltstone. Slope is 15 to 70 percent. Elevation is 7,000 to 9,200 feet. Average annual precipitation ranges from 16 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

Threatened or Endangered Species

There are no known threatened or endangered species found on or near the permit area, and by extrapolation, within the exploration plan area.

Wildlife and Fish

Some of the predominate mammals which may occur in the general area include elk, deer, black bear, cougar, bobcat, coyote, badger, porcupine, snowshoe hare, golden mantled squirrel, Andy ground squirrel, red fox, gray fox, marmot, flying squirrel, and other species of small rodents.

Data from UDWR Fish and Wildlife information indicate the following birds may be found in the ecological zone:

Golden Eagle (protected, common)
Bald Eagle (endangered, rare)
Prairie Falcon (protected, common)
American Peregrine (endangered, rare)
American Kestrel, (protected, summer resident)
Goshawk (protected, uncommon)
Sharp-shinned Hawk (protected, uncommon)
Cooper's Hawk (protected, transient)
Red-tailed Hawk (protected, common)
Swainsons's Hawk (protected, summer resident)
Marsh Hawk (protected, common)
Various species of owls (essentially all are protected and most show an abundance designation of common, summer resident, or transient)
Blue Grouse (protected as a gamebird, common)
Ruffed Grouse (protected as a gamebird, common)
Sage Grouse (protected as a gamebird, common)
California Quail (protected as a gamebird, common)
Gambel's Quail (protected as a gamebird, common)
Chukar (protected as a gamebird, common)
Great Blue Heron (protected, abundance unknown)
Various species of geese, ducks, teal scaups, mergansers, and widgeons (essentially all are protected as gamebirds and most show an abundance designation of either common, summer resident, or transient)

Wildlife in the exploration plan area has been monitored for more than six years by the UDWR as a result of the proximity to the Gorden Creek Wildlife Management Area which lies less than 3,000 feet east of proposed drill site PRP-1. Personnel communications from Bill Bates and Ben Morris (UDWR) indicate the exploration plan area is used as non-critical deer and elk winter range from December 1 through April 15. They also indicate that two Bald Eagle / Prairie Falcon Nests are located in the N½ of S 17. Proposed drill site PRP-1 lies within a 0.5 mile radius of both nests. Holes PRP-2, 3&4 lie outside of a 0.5 mile radius from the nests. It is not known if these nests are active this year.

A Raptor survey will be conducted by UDWR on approximately May 15 to determine if the Bald Eagle/Prairie Falcon Nests are active, and if there are any Goss Hawk Nests in the area. Results of this survey will be forwarded to become an attachment to this exploration plan.

3482.1(a)(3)(iv) A narrative description of the methods to be used to conduct coal exploration, reclamation, and abandonment of operations including, but not limited to-

The proposed coal exploration program will utilize drilling and coring (conventional truck-or track-mounted), core sampling and testing, and down-hole geophysical logging of the open holes as the main methods of data collection. All three holes will be completed as groundwater monitor wells. The attached *Proposed Drill Sites & Access* Map shows pad site locations and access roads.

Pad & Site Access Detail

PRP-1 is located approximately 1,200 feet up drainage from the old Blue Blaze Mine Portals. Access will be gained along the existing road to the mine portals and via an approximate 500-foot extension up the drainage to the proposed drill site. The pad is planned as a single 75 X 125 foot rectangle, and a minor amount of cut and fill will be required to obtain these dimensions.

PRP-2 is located approximately 100 feet west of the existing road which passes up the drainage tributary to Beaver Creek in the east half of section eight. Access will be gained via the county road which passes through the head of Beaver Creek then via the private road passing down Beaver Creek, then along another private road passing up the drainage to the drill site. Approximately 400 feet of new road will be constructed starting from the existing road, along elevation contour, north-westward to PRP-2. The planned pad dimensions are 75 X 150 feet to accommodate the mud pit and compressors for air-foam drilling.

PRP-3 is located along the access road in Beaver Creek approximately one mile down stream from the large beaver pond. Access will be gained via the county road to the head of Beaver Creek, then down Beaver Creek via the private road as described for PRP-2 access. Construction of a new road will not be required because the site is adjacent to the existing private road. Planned pad dimensions are 75 X 150 to accommodate the mud pit and all equipment on-site.

PRP-4 is located approximately 500 feet east of PRP-2 and approximately 400 feet east of the existing road. Access will be gained via the same route as for PRP-2 except an approximately 600 feet of road will be constructed, along grade, from the existing road to the proposed site. Pad dimensions are planned to be 100 X 100 feet to accommodate the mud pit and all equipment on-site.

PRP-4 is planned as an alternative site to PRP-2 because of the risks presented by not knowing the exact location of the fault which passes up the drainage. Two sites are permitted in this vicinity so if the fault is inadvertently encountered in the first choice site, we will have the option of moving to the alternate site without having to wait for the permitting process. Planned pad dimensions are similar to those for PRP-2.

Three drill holes "only" are planned to be drilled to "total depth" and completed as groundwater monitor wells on this project.

Drill Water

Drill Water for PRP-2,3,&4 and possibly PRP-1, will be procured from the artesian well which flows approximately 15 gmp, located adjacent to the access road in the SE¼ of section 5.

A small (approximately 500 gal.) storage tank will be placed immediately down-hill from the artesian well to act as a reservoir from which to pump.

Permission is being sought to use the large beaver pond which lies along the access road in upper Beaver Creek as an alternate water source.

3482.1(a)(3)(iv)(A) The types, sizes, numbers, capacity and uses of equipment for drilling and blasting, and the road or other access route construction:

Equipment

A variety of equipment is expected to be utilized during this drilling project. At lest one truck mounted drill rig, together with a variety of ancillary or support equipment and a geophysical logging truck and other service trucks may be used at each site.

PLANNED MAJOR EQUIPMENT

One D-4 or D-6 dozer
One rubber tired back-hoe
One truck mounted rotary or continuous core rig
One pipe truck
One casing trailer
One on-site water tank
One equipment/"dog house" trailer
Possibly one or two compressors
One or two flat-bed/rig-up trucks
Two≈ 2,000 gal. water trucks
One ≈ 15 ft core /field office trailer
Three or four 4X4 pickup trucks

Seed Mixtures

The proposed drill sites and access routes are located on private land. The seed mix listed below on *Table 2* was provided by the BLM specifically for sites in this area.

Table 2

Seed Mix

SHRUBS	Pounds per Acre
Symphoricarpus albus	1.0
Artemesia tridentata wyomingensis	0.5
Cercocarpus ledifolius	1.0

Table 2 (cont.)

FORBS	
Achillea millefolium	0.5
Balsamorhiza saggitata	0.5
Penstemon strictus	0.5
GRASSES	
Poa secunda	1.5
Bromus carinatus	1.5
Agropyron spicatum	1.5
A. smithii	1.5
A. trachycaulum	1.5
Total, lbs./acre, Pure Live Seed	**11.5**

3482.1(a)(3)(iv)(B) Excavated earth or debris disposal activities:

All soils excavated in any phase of the proposed exploration activities will be treated the same. Unless otherwise required, the topsoil and native vegetation at the drill sites will be removed, if present, and stockpiled for re-distribution during site reclamation. Topsoil will only be removed where required; generally where soils would be directly impacted at the drill site.

A competent and responsible person, knowledgeable about soils, will be on the site during excavation and reclamation in order to minimize environmental impacts and assure proper soil extraction (depth, etc.) and replacement. This person will be on the drill site during any type of excavation, construction, or reclamation. Methods used to extract topsoil from drill pad locations will be mechanical equipment such as a front-end loader, backhoe, medium to small dozer, or other method.

Stockpiled soil will be protected from erosional loss by containment berms or silt fencing. Wind erosion is not anticipated to be a problem at these locations. If the topsoil pile is dry and deflating, it will be wet down. Weathered rock and/or subsoils excavated from the mud pits will be stockpiled separately from the topsoil and will be used to backfill the mud pits after coring and plugging activities are complete. Drill cuttings will be contained and buried in the mud pit. Mud pits will not be backfilled until drilling fluids are pumped out or evaporated.

Soil loss off the drill site will be controlled by berms, straw bales, or silt fences.

The sites and roads will be graded/reclaimed to approximate original contour and recovered with topsoil in a roughened and scarified state. Reclamation parameters of existing roads will be

determined by BLM personnel. Drainage will be controlled to prevent runoff across exposed soils.

All debris and trash will be disposed of properly and in a timely manner. Location of disposal will be completely off the exploration area. Areas on the drill site which might be contaminated by fuels or toxic substances will be protected by ground tarps or other means. Contaminated soils will be removed from the sites and transported to an approved disposal facility.

3482.1(a)(3)(iv)(C) The proposed method for plugging drill holes:

The three drill holes drilled to TD will be completed as groundwater monitor wells, as described below in the response to 3482.1(a)(3)iv)(E). Completion details will be in compliance with the State of Utah ADMINISTRATIVE RULES FOR WATER WELL DRILLERS, July 15, 1987, Part II, Section 8 for drilled wells. The annular space between the casing and/or drill hole wall and the well casing above the well screen completions will be completely sealed with cement, bentonite or a mixture of cement and bentonite up to within 20 feet of the ground surface. A cement surface seal will be placed from the surface to a depth of 20 feet.

All drill holes not completed as monitor wells will be grouted from bottom to the surface with a slurry of Portland cement and bentonite.

3482.1(a)(3)(iv)(D) Estimated size and depth of drill holes, trenches and test pits:

The size of the core holes will range from ten inches in diameter for surface casing to about five inches for the cored intervals. The deepest hole should not exceed about 1,200 feet in depth.

No trenches or test pits are planned.

3482.1(a)(3)(iv)(E) Plans for transfer and modification of exploration drill holes to be used as surveillance, monitoring, or water wells.

Monitor well installation will be under the direction of a currently licensed Utah Water Well Driller. Completion details will be in compliance with the State of Utah Administrative Rules for Water Well Drillers, July 15, 1987, Part II, Section 8 for drilled wells.

Each monitor well will be completed as shown on *Figures 2 and 3 (Ground Water Monitor Well Detail, & Suggested Locking Cap Detail For Monitor Wells*) with two inch steel , PVC, or fiberglass well pipe and a ten foot section of approved two inch well screen, near but not at the bottom of the hole. It is anticipated that the well screen will be placed approximately 50 feet below the top of the StarPoint Sandstone which immediately underlies the lowest minable coal seam.

The hole will be fitted with a one quarter inch nylon tubing as a permanent water level monitoring device. Sand or gravel will be used as filter pack and emplaced in the annular space between the borehole and well screen, extending at least two feet above the top on the well screen. A fine sand seal, at least five feet thick, will be emplaced on top of the filter pack. The annular space between the well pipe and bore hole and or casing will be grouted with cement.

3482.1(a)(3)(v) An estimated timetable for conducting and completing each phase of the exploration, drilling and reclamation.

TABLE 3 TIMETABLE FOR PROPOSED 1995 EXPLORATION ACTIVITIES

	July	August	Sept	Oct
WEEK ⇒	2 3 4	1 2 3 4	1 2 3 4	1 2 3
PROGRAM PHASE ⇓				
Drilling	**********			
Reclamation		**********		

3482.1(a)(3)(vi) The estimated amounts of coal to be removed during exploration, a description of the method to be used to determine those amounts, and the proposed use of the coal removed.

The proposed exploration plan calls for three drill holes. Three-inch diameter coal core with length equal to the seam thickness will be removed from each of the anticipated seams encountered. Two Coal Seams (Castlegate A, and Hiawatha) will be cored with an estimated 16 feet of coal being removed from each hole. Calculated amount of coal to be removed is approximately 201 lbs.

Calculations for lbs. of coal per hole:

(1.5²in.) X π/144 X 16 ft.= (est. cubic ft. coal/hole)
X 85 lbs./cu. ft. = **67 lbs .coal / hole**

Total for Program = 67 X 3 = **201 lbs. of coal to be removed.**

The core sampled will be used for quality and geo-technical testing. The results of these tests will aid in thickness, seam geometry, coal quality determinations, mine planning and future exploration planning.

3482.1(a)(3)(vii) A description of the measures to be used during exploration for Federal coal to comply with the performance standards for exploration (3481.1(a) and applicable requirements of 30 CFR 815.15 or an approved state program.

3484.1(a)(2) The operator/lessee, if required by the authorized officer, shall set and cement casing in the hole and install suitable blowout prevention equipment when drilling on lands valuable or prospectively valuable for oil, gas, or geothermal resources.

If required by the authorized officer, casing will be set and cemented in the hole and suitable blowout prevention equipment will be installed.

3484.1(a)(3) All exploration drill holes must be capped with at least 5 feet of cement and plugged with a permanent plugging material that is unaffected by water and hydrocarbon gases and will prevent the migration of gases and water in the drill hole under normal hole pressures. For exploration holes drilled deeper than stripping limits the operator/lessee, using cement or other suitable plugging material approved by the authorized officer shall plug the hole through the thickness of the coal bed(s) or mineral deposits(s) and through aquifers for a distance of at least 50 feet above and below the coal bed(s) or mineral deposit(s) and aquifers, or to the bottom of the drill hole. A lesser cap or plug may be approved by the authorized officer. Exploration activities shall be managed to prevent water pollution and mixing of ground and surface waters and ensure the safety of people, livestock, and wildlife.

As noted above in 3482.1(a)(3)(iv)(C), this stipulation will be complied with if, for some reason, the drill hole is not to be completed as a water monitoring well site. The possibility of contamination of surface waters by drilling materials is low because of location. Adequate precautionary measures (such as berms, bales, and/or silt fences) to prevent the escape of drilling materials into stream drainages will be incorporated into individual site designs. The potential for contamination of surface waters will be minimized by constructing waste pits of sufficient size to contain all effluent drilling materials. To prevent overflow, the waste pits will be pumped out and waste fluids will be disposed of properly. Waste pits will be lined if percolation of fluids through the walls into stream drainages appears possible.

In accordance with the revised stipulations of 43 CFR 3482.2(b), all coal exploration drill holes will be: 1.)"cemented from the total depth of the hole to the surface and, 2.) the surface and the intermediate casing(if used) will be fully pressure grouted in the annulus from the bottom of the string to the surface". These measures will be taken to prevent intermixing of ground water. Detail on encountered groundwater flow will be noted on appropriate form for the BLM records. When monitoring wells are no longer needed, they will be plugged with Portland cement and sealed.

3484.1(a)(4) The operator/lessee shall retain for one (1) year, unless a shorter time period is authorized by the authorized officer, all drill and geophysical logs and shall make such logs available for inspection or analysis by the authorized officer, if requested. The authorized officer, at his discretion, may require the operator/lessee to retain representative samples of drill cores for one (1) year. Confidentiality of such information will be accorded pursuant to the provisions of 3481.3 of this title.

Drill and geophysical logs as well as representative core samples obtained from the proposed exploration program will be available for inspection or analysis by the authorized officer for one year. An exception to the above will be those core samples consumed during quality testing. Splits of the samples will be maintained by the testing labs. Typically all collected data including seam depth, thickness, quality, geophysical logs, structure, geo-technical, drilling logs, etc. have been copied and transferred to the appropriate personnel at the B.L.M. offices for review and confidential storage, pursuant to 43 CFR 3485.1.

3484.1(a)(5) The operator/lessee may utilize exploration drill holes as surveillance wells for the purpose of monitoring the effects of subsequent operations on the quantity, quality, or pressure of groundwater or mine gases only with the written approval of the

authorized officer, in consultation with the regulatory authority. The operator/lessee may convert exploration drill holes to water wells only after approval of the operator/lessee's written request by the authorized officer and the surface owner or authorized officer in consultation with the regulatory authority. All such approvals shall be accompanied by a corresponding transfer of responsibility for and liability including eventual plugging, reclamation, and abandonment. Nothing in this paragraph shall supersede or affect the applicability of any state low requirements for such a transfer, conversion, or utilizations a supply for domestic consumption.

Refer to response to 3482.1(a)(3)(iv)(E)

3482.1(a)(3)(viii) A map at a scale of 1:24,000 or larger showing the areas of land to be affected by the proposed exploration and reclamation. The map shall show existing roads, occupied dwellings, and pipelines; proposed location of trenches, roads, and other access routes and structures to be constructed; applicable federal lease and license boundaries; the location of land excavating to be conducted; coal exploratory holes to be drilled or altered; earth or debris-disposal areas; exiting bodies of surface water; and topographic and drainage features.

Proposed Drill Sites & Access Map is attached to this application. The map is at a scale of 1:24,000 and contains the requested information (proposed drill hole locations, access routes, etc.).

3482.1(a)(3)(ix) The name and address of the owner of record of the surface land, if other than the United States, if the surface is owned by a person other than the applicant or if the federal coal is leased to a person other than the applicant, a description of the basis upon which the applicant claims the right to enter that land for the purpose of conducting exploration and reclamation.

Surface ownership for lands covered in this exploration plan is privately held The attached *Surface Ownership* Map depicts ownership within and in vicinity of the Horizon coal Mine. The surface owners of record are:

PETE STAMATAKIS JR.
STEVE N G. STAMATAKIS
1111 S. 450 W
Price, Utah 84501

STATE OF UTAH
SCHOOL AND INSTITUTIONAL TRUST LANDS ADMINISTRATION
355 W. N. Temple
3 Triad Center
Suite 400
Salt Lake City, Utah 84180-1204

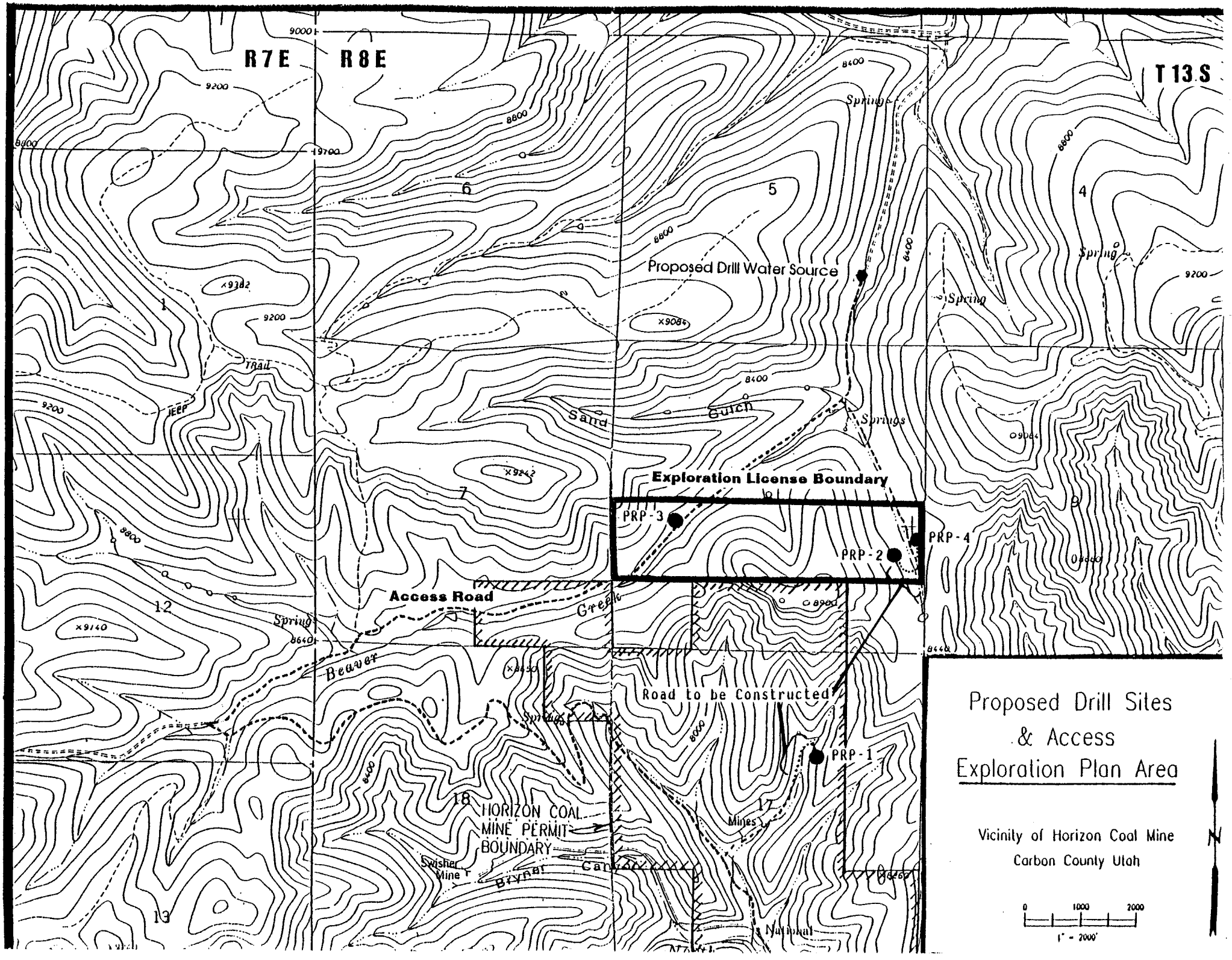
All lands on which drill pads and roads are to be constructed for execution of this exploration plan are owned by the above named surface owners. The access road to PRP-2,3,& 4 passes over two other parcels of private land. Approximately one half mile of the access road passes across land controlled by Medicine Bear Land & Cattle Company, Provo, Utah. Approximately 1,000 feet of the access road crosses over land owned by Robert F. & Linda N. Jewkes, Salt Lake City, Utah.

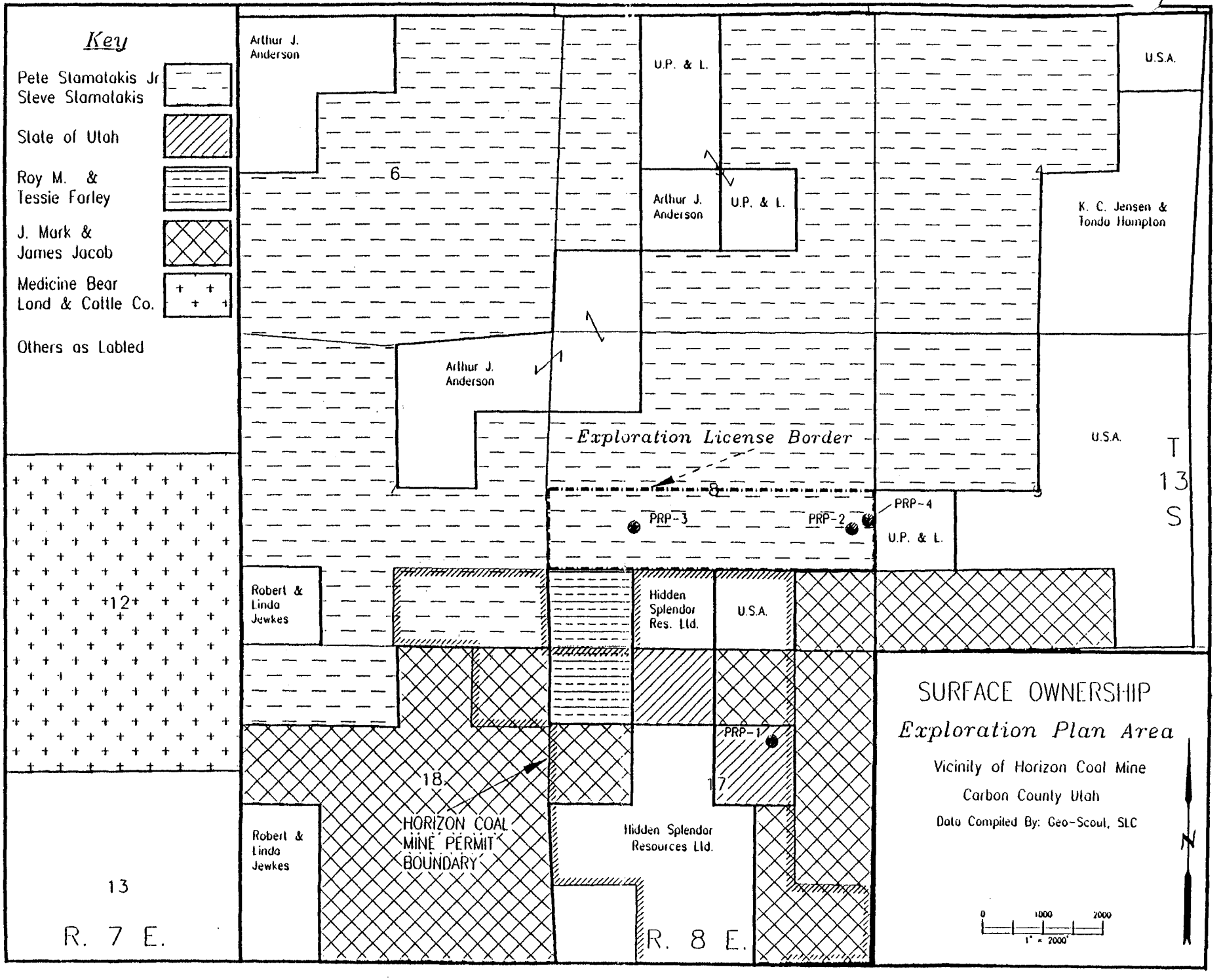
Access to PRP-1 passes over land controlled by Horizon Coal Corporation.

8432.1(a)(3)(x) Such other data as may be required by the authorized officer.

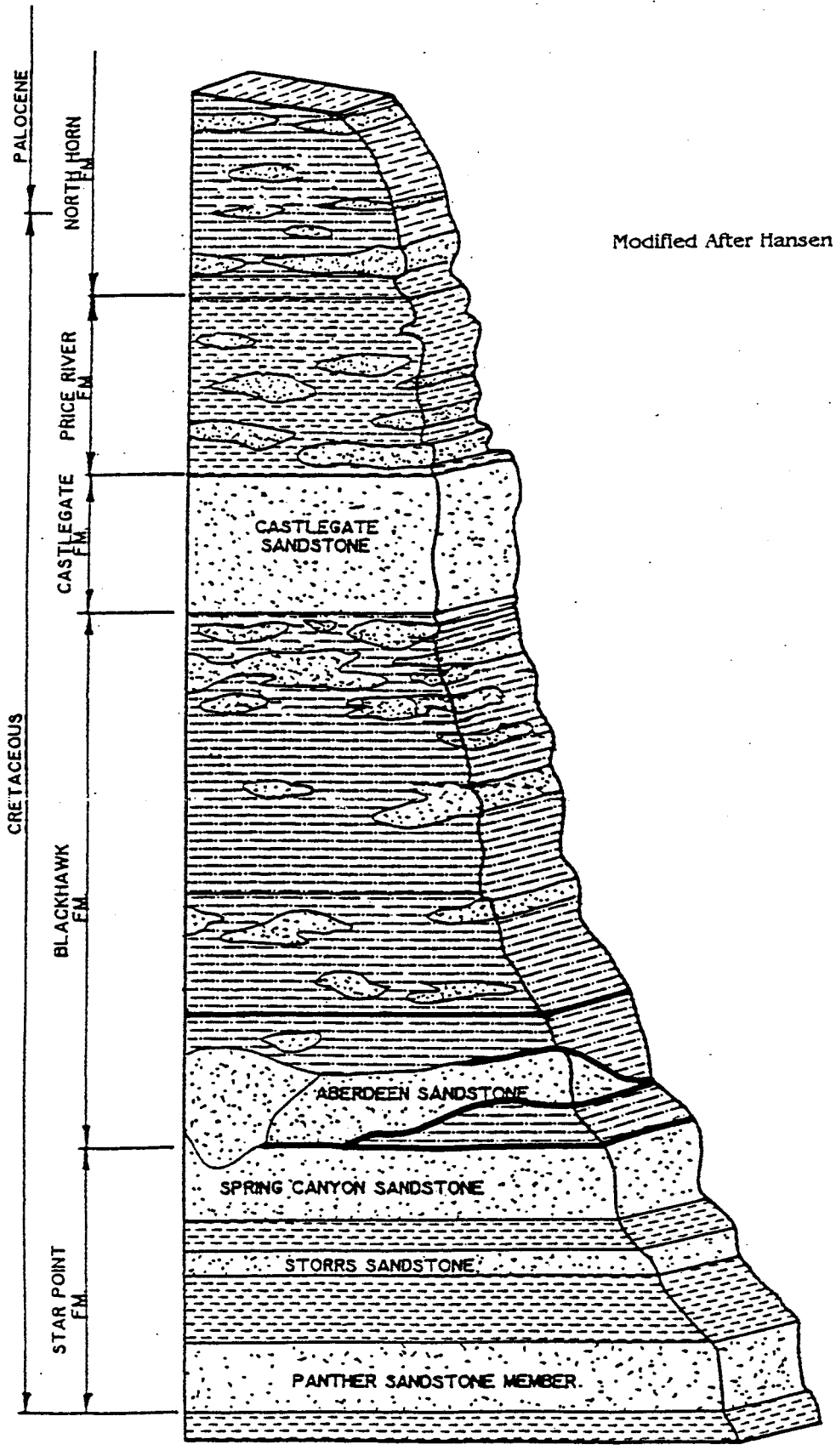
Other data that may be required will be made available as soon as possible upon the request of the BLM.

Maps


R7E
R8E
T13S
Proposed Drill Water Source
Exploration License Boundary
PRP-3
PRP-2
PRP-4
PRP-1
Access Road
Road to be Constructed
HORIZON COAL MINE PERMIT BOUNDARY
Sand Gulch
Beaver Creek
Trail
Jeep
Spring
Springs
Mines
Proposed Drill Sites & Access Exploration Plan Area
Vicinity of Horizon Coal Mine
Carbon County Utah
0 1000 2000
1" = 2000'
N


Key
Pete Stamatakis Jr
Steve Stamatakis
State of Utah
Roy M. &
Tessie Farley
J. Mark &
James Jacob
Medicine Bear
Land & Cattle Co.
Others as Labled
Arthur J.
Anderson
U.P. & L.
U.S.A.
6
Arthur J.
Anderson
U.P. & L.
K. C. Jensen &
Tondo Hampton
Arthur J.
Anderson
Exploration License Border
U.S.A.
T
13
S
8
9
PRP-3
PRP-2
PRP-4
U.P. & L.
Robert &
Linda
Jewkes
Hidden
Splendor
Res. Ltd.
U.S.A.
12
PRP-1
18
17
HORIZON COAL
MINE PERMIT
BOUNDARY
Robert &
Linda
Jewkes
Hidden Splendor
Resources Ltd.
13
R. 7 E.
R. 8 E.
SURFACE OWNERSHIP
Exploration Plan Area
Vicinity of Horizon Coal Mine
Carbon County Utah
Data Compiled By: Geo-Scout, SLC
N
0
1000
2000
1" = 2000'

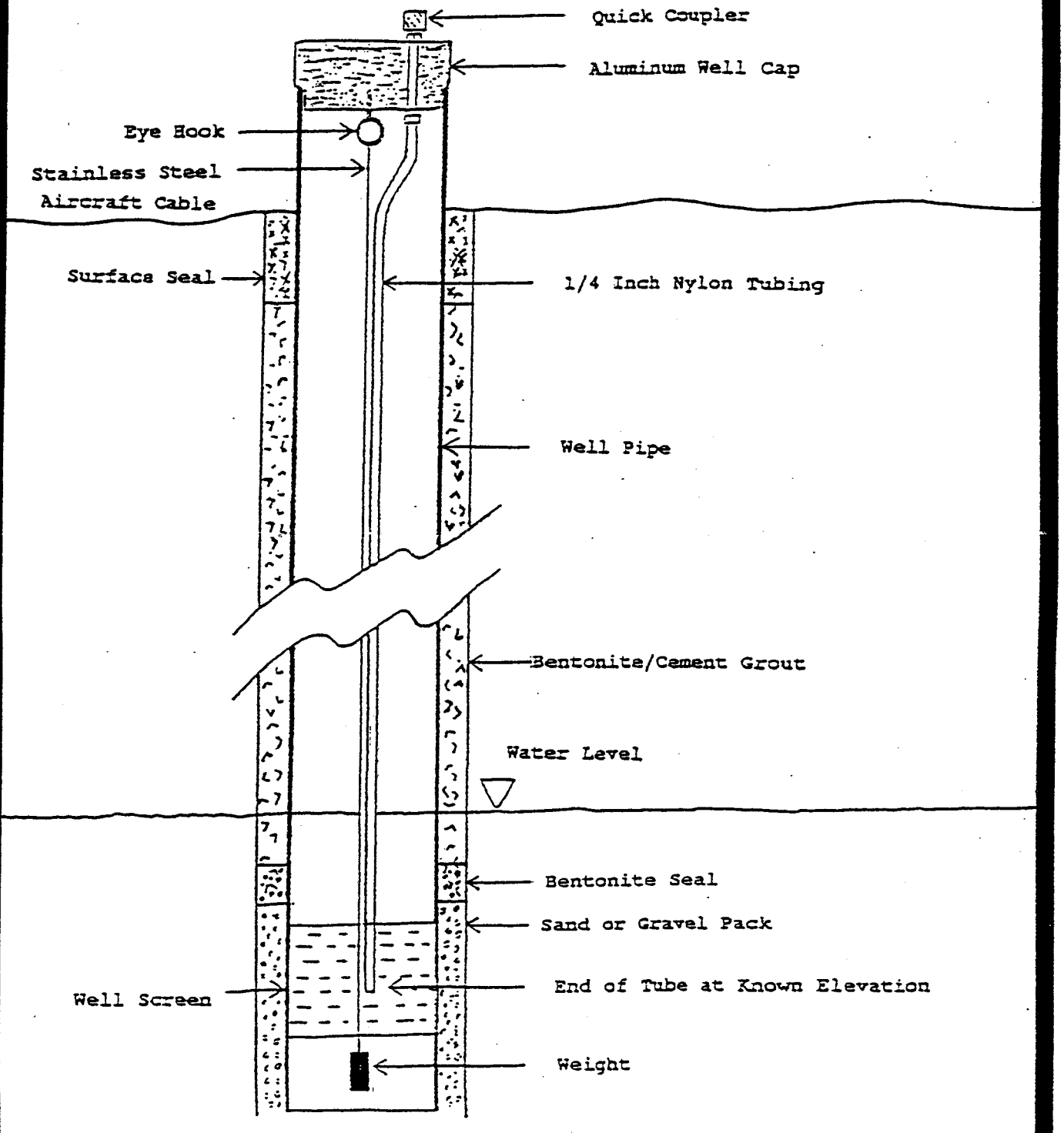
Figures



Generalized Stratigraphic Column
Horizon Coal Mine Area

Figure 1

Ground Water Monitor Well Detail



Not To Scale

FIGURE 2

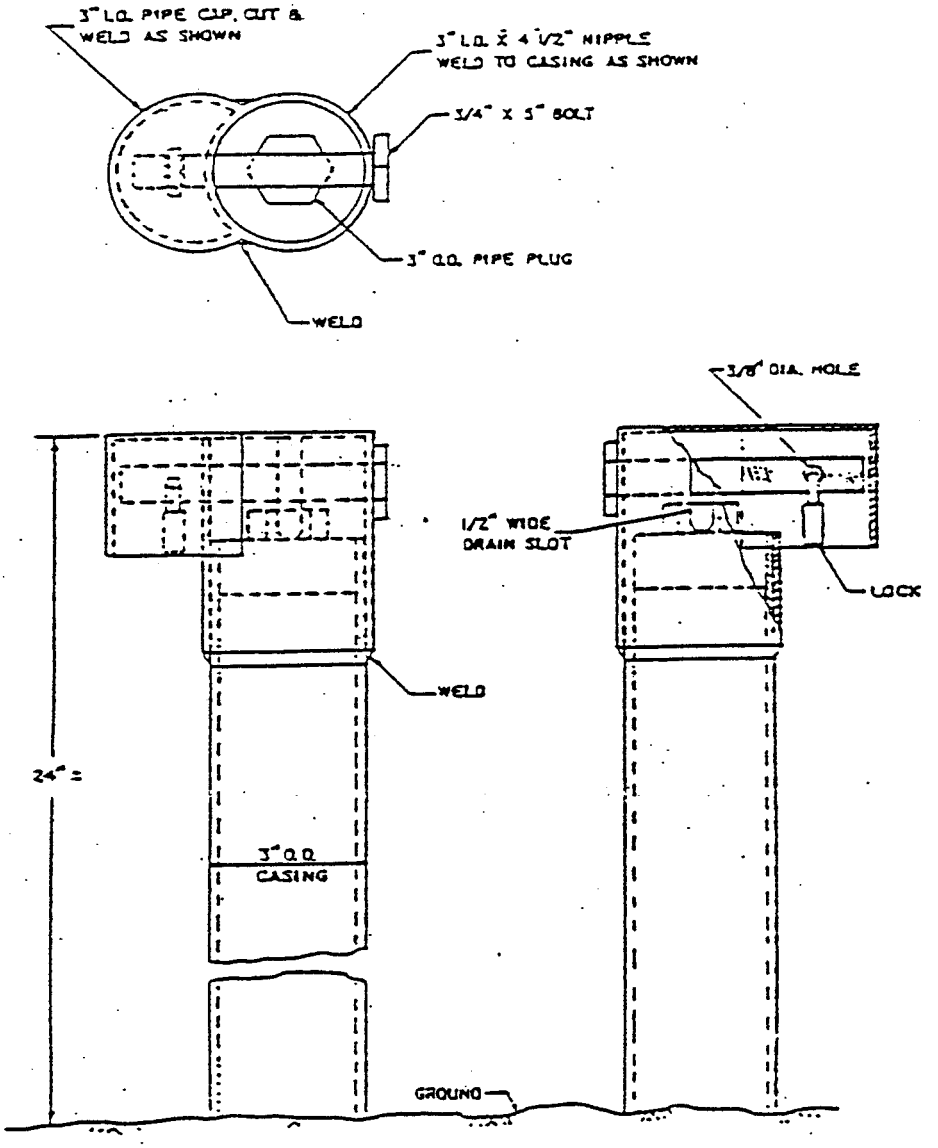


Figure 3
Suggested Locking Cap Detail For Monitoring Wells

CHAPTER 8

SOIL RESOURCES

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SOIL RESOURCES

8.1 Scope

A soil inventory of the Horizon Mines area was conducted to provide soil resource information to meet the requirements of the Utah Division of Oil, Gas and Mining (UDOGM) and the Office of Surface Mining (OSM). The soil survey was performed by Richard A. Foster, Soil Scientist, (USDA Soil Conservation Service) in February 13, 1990 (Section 8.3.1). 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) of the SCS in May 1980 (Appendix 8-1).

8.2 Methodology

Soil mapping of the area (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 George Cook of the SCS as to the locations, types and depths of soils.

George Cook (SCS) and Richard A. Foster used the pit method to estimate depths and quality of the soil. Detailed pedon are described to depths of 60 inches, or until bedrock, whichever was shallowest. These pits were dug below the No. 1 Mine area, up the canyon where new disturbance will occur, and at previously disturbed areas.

The soils to be saved for reclamation were tested at a approved laboratory using the UDOGM 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, tests were preformed for Selenium and Boron.

Present and potential uses of the soils of the site have been evaluated based on Soil Conservation Service 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.

The soils have been correlated by the SCS. Classifications are based on 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 Horizon Mines were initially identified on site. 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 SCS series descriptions. Map units are comprised of soil series and inclusions found within an area to make them site specific. The differences in symbols between the SCS report located in Appendix 8-1 and the new SCS guidelines dated June 1988 used on Plate 8-1, are as follows:

FIA	=	Shupert-Winetti Complex
GIG	=	Curecanti
HIG	=	Senchert
JIB	=	Brycan Loam
DM	=	Mine Dumps (Previous Disturbed Area)
No symbol		Rabbitex

Shupert-Winetti Complex

The Shupert - Winetti complex consists of very deep, well drained, moderately permeable soils on narrow valley and canyon floors. These soils formed in alluvium derived from sandstone and shale. Slope is 1 to 8 percent. Elevation ranges from 4,600 to 7,200 feet but commonly is 5,200 to 6,400 feet. Average annual precipitation is 12 to 16 inches, and average annual air temperature is 43 to 45 degrees F.

These soils are fine-loamy, mixed (calcareous), frigid Typic Ustifluvents.

Brycan

The Brycan Series consists of very deep, well drained, moderately slowly permeable soils on alluvium derived from shale and sandstone. Slope is 3 to 8 percent. Elevation is 7,700 to 8,600 feet. Average annual precipitation is 16 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are fine-loamy, mixed Cumulic Haploborolls.

Rabbitex

The Rabbitex series consists of very deep, well drained, moderately permeable soils on mountain slopes and ridgetops. These soils formed in residuum andl colluvium derived dominantly from sandstone, shale, limestone, and siltstone. Slope is 15 to 70 percent.

Elevation is 7,000 to 9,200 feet. Average annual precipitation range from 16 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are fine-loamy, mixed Typic Calciborolls.

Senchert

The Senchert family consists of moderately deep, well drained, moderately permeable soils on mountain slopes, plateaus, and ridges. These soils formed in residuum and alluvium derived dominantly from sandstone and shale. Slope is 1 to 50 percent. Elevation is 8,000 to 10,100 feet. Average annual precipitation is 20 to 30 inches. An average annual air temperature is 36 to 38 degrees F. These soils are fine loamy, mixed Argic Pachic Cryoborolls.

A description of the soil sampled in Pits 1 through 7 follow.

Pit #1 - Shupert-Winetti Complex

Fine-loamy, mixed (calcareous), frigid Typic Ustifluvents. Colors are for dry soil unless otherwise noted.

A -- 0 to 6 inches (0 to 15.2 cm); light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate thin platey structure paring 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 30.5 cm); 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 dine, common very fine roots; common fine, many very fine random tubular pore; moderately calcareous, lime is disseminate; 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 dine and very fine roots; common fine, many very fine random tubular pore; moderately calcareous, lime is disseminate; 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 disseminate; 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; may 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 non plastic; few very fine random tubular pores; moderately calcareous, lime is disseminate; strongly alkaline (pH 8.5).

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

Pit #2 - Shupert-Winetti Complex

Loamy-skeletal, mixed (calcareous), frigid Typic Ustifluvents. 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 lam, 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 pore; moderately calcareous, lime is disseminate; 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 andy 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 8.3); 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 disseminate; moderately alkaline (pH 8.3); gradual wavy boundary.

C5 -- 47 to 60 inches (119.4 to 152.4 cm); 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 pore; 10 percent stone, 55 percent cobble, 10 percent gravel; moderately calcareous, lime is disseminated; moderately alkaline (pH 8.4).

Pit #3 - Rabbitex

Fine-loamy, mixed Typic Calciboroll. 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); 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 pore; 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 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; moderately 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 pore; 25 percent gravel; moderately calcareous, lime is disseminated and in few fine veins and thin coatings on rock fragments; strongly alkaline (pH 8.5).

This soil is an inclusion in the Rabbitex mapping unit and is found predominantly at the base of steeper slopes.

Pit #4 - Shupert-Winetti Complex

Loamy-skeletal, mixed (calcareous), frigid Typic Ustifluvent. Colors are for dry soil 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 pore; 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 per cent 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)

Pit #5 - Brycan

Fine-loamy, mixed Cumulic 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 lightly 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 lam, 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).

Pit #6 -Shupert-Winetti Complex

Fine-loamy, mixed (calcareous), frigid Typic Ustifluvent. 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 pore; 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).

Pit #7 - Brycan

Fine-loamy, mixed Cumulic 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 sub angular 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).

8.3.2 Soil Series Descriptions

Disturbed Land

The disturbed mine area consists of generally deep, nearly level to nearly vertical, moderately well-drained materials. The fill materials are derived from sandstone, shale, and coal from previous mining operations. The fill material comprise most of the proposed mine area. The native vegetation has been previously disturbed in the mine area.

The annual precipitation is 12 to 20 inches. The available water capacity is moderate to low and permeability is moderate. The mean annual air temperature ranges from 38 degrees to 45 degrees F. and the frost free period is 60 to 120 days.

Soils are identified by four categories (FIA, GIG, HIG, JIB) and are identified on plates and in the text as such. Depths and types of soil were identified by SCS. The topsoil to be saved for reclamation is also identified by category (see Plate 8-2 and Section 8.2).

A complete survey of the soil area was completed on November 3, 1990 and the new results were entered on Plate 8-2.

With the use of a planimeter the following amounts of soil for storage were calculated:

Soil Type	Pit No.	Depth to be Stored	Area Sq. Ft.	Volume Cubic Yard
Shupert-Winetti	2	42"	10,450	1,354.6
Rabbitex	3	78"	16,575	3,990.3
Shupert-Winetti	4	18"	22,375	1,243.1
Brycan	5	60"	27,175	5,032.4
Shupert-Winetti	6	18"	8,925	495.8
Brycan	7	60"	28,050	5,194.4
Senchert	-	6"	13,075	242.1

Total cubic yard recoverable ----------17,552.7

Laboratory tests on Pit #1 (Table 8-1) show the soil to be unsuitable for final reclamation.

Table 8-1

Soil Chemical and Physical Properties - Pit #1

Sample depth (cm)	pH	Ec mmhos/cm	Sat%	Particle Size%	Ca meq/l	Mg meq/l	Na meq/l	SAR	Rock Frag. %	N%	Nitrate mg/kg	Organic carbon	Available Water Capacity
0-15[a]	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%	33.5 @ 1/3 16.0 @ 15
15-30[b]	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%	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 16.2 @ 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

[a] Selenium mg/kg <0.1, Boron mg/kg 1.24
[b] Selenium mg/kg <0.1, Boron mg/kg 0.86

Approximately 16,617.3 cubic yards will be required to reclaim the permit area disturbance of 10.3 acres with soil coverage of 12". The extra 955.4 cubic yards of soils will be used to reclaim additional areas or to increase the depth in the reclaimed areas.

Soil will be put in separate stockpiles so that the soil can be spread over a larger area to allow better control over soil nutrients (Plate 8-2, 8-3 and Table 8-2). These stockpiles will be surveyed to verify if the amounts of soils contained are sufficient for reclamation.

Topsoil located southeast of Pits #4, #5, & #6 and the Fan Portal is located on a steep rocky hillside. The topsoil for this area (less than one acre) will be collected and stockpiled. Any vegetation or trees which will interfere with the removal of topsoil, will be removed prior to excavation.

Topsoil which meets the UDOGM suitability criteria will be salvaged from this and all areas within the permit area. Horizon commits to excavating the A or E horizon for the Curecanti Family and Senchert Series in accordance with the profile descriprtions located in the USDA\SCS Soil Survey for the Carbon County Area, Utah. The applicant will submit as-built surveys of the completed subsoil and topsoil stockpiles. The surveys will include: volume of material, maximum and minimum elevations and slopes, cross sections, and all other pertinent dimensions. Based on the survey information topsoil and subsoil mass balance tables will be amended.

If additional soil is required for final reclamation, the soil will be imported from outside the mines area. All topsoil to be used for reclamation will be tested according to the UDOGM soil guidelines. The requirements of regulation R645-301-233 will be meet in the event the mass balance calculations indicate a topsoil\subsoil deficiency.

Waste coal that exists at the site as a result of past mining activities will be segregated during construction and temporarily stockpiled near the proposed coal stockpile (see Plate 3-1). This material will be blended with coal being shipped from the site as indicted in Section 3.3.2.7.

Mapping Legend

The following is a list of the soil symbols and mapping units which appear in the legend on the soils maps and elsewhere in this permit.

Soil Symbol	Soil Mapping Unit Name
FIA	Shupert-Winetti Complex - 0 to 2% slopes
GIG	Curecanti - Very bouldery loam, 55-65% slopes
HIG	Senchert - Silt loam, 50-70% slopes
JIB	Brycan - 4-6% slopes

Table 8-2

Depth Calculations for Soil Stockpiles (3)

Feet cu.yds.	Area A cu.yds.	Area B cu.yds.	Area C cu.yds.	Total
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
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----------17,552.7

DM	Mine Dumps - Previous Disturbed Areas
No symbol	Rabbitex - Fine loamy, mixed Typic Calciborolls

Also included on Plate 8-2 is an isopach as to the depths of soils which can be saved.

The additional surface soil sampling points on Plate 8-1 are from a survey done by George Cook, Earl Jensen and Gary Moreau for the C & W Coal Producers (Appendix 8-1).

8.3.3 Present and Potential Uses - Crops and Pasture Lands

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 in the permit area (see Figure 8-1). None of the soils mapped at the site have potential for the growth of crops or pasture land.

Rangelands

The soils of the site area have been used as rangeland in the past. Data on predicted forage production for rangeland soils for various sites are available from the SCS (Section 9-9). The principle limitations are erosion and shallowness, according to the SCS the soils cannot support cultivated crops. The soils incapability have very severe limitations thus restricting the use of the land largely to grazing, woodland or wildlife.

8.4 Prime Farmland Investigation and Determination

On August 14, 1990, Blue Blaze Coal Company requested the SCS (Price, Utah office) review the soils within the mine area to determine if any soils qualified as prime farmland. After the SCS's field reconnaissance to confirm soil types, the field information was checked against the State listing on prime farmland soils. The State Soil Scientist determined there are no soils classified as prime farmlands in the permit area (see Figure 8-1).

8.5 Physical and Chemical Properties of Soils and Results of Analysis Method of Evaluation

The criteria for evaluating soil as a plant growth media are given in Table 8-3. 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 8-3). 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

United States Department of Agriculture

Soil Conservation Service

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

FIGURE 8-I

11/25/90

The Soil Conservation Service is an agency of the Department of Agriculture

Table 8-3

Soil Reconstruction Material for Disturbed Areas

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

[a] Layer with high potential acidity should be rated poor.
[b] If in kaolinitic family, rate one class better if experience confirms.

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

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).

Soil Chemistry and Physical Properties

Chemical and physical data for project area soils were collected to evaluate the soils as reconstruction material for disturbed areas. Soil chemical and physical data from analysis by Commercial Testing & Engineering Company are reported in Appendix 8-1. The parameters tested were under the UDOGM 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

Appendix 8-1 contains a chemical evaluation of the soils in the undisturbed area and the area to be redisturbed. The soils are rated as good, fair or poor sources for 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 is 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. Coarse fragments are the limiting factor for most of the project area soils.

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. The coal wastes will be handled as outlined in Section 3.3.2.7.

All disturbance was conducted prior to enactment of regulations requiring salvaging of topsoil. Due to the already disturbed area a limited amount of the original topsoil can be salvages for storage. The only future surface disturbance is noted on 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

It is anticipated that there will be enough topsoil stockpiled to re-distribute over the 10.3 acres of disturbed area (see Section 8.3.2). Coal waste, oil, grease, or contaminated material will be removed from the site and disposed of properly before topsoil is replaced.

The locations outlined for soil removal on Plate 8-2 are the areas within the project area with sufficient useable soil for collection. The additional areas located on the map were previously disturbed by other mining operations.

8.7 Soil Plan for Removal, Storage, and Protection

It is proposed to remove the topsoil using the island method to insure the proper depth of the soil being removed. At the time of soil removal a professional soil scientist (that will be approved by the Division) will be on site to insure proper separation and stockpiling of topsoil (A or E horizons) and subsoil (B and/or C horizons) also to delineate phase and inclusion variation and salvage depths.

The soil will be transported to the top soil storage area shown on Plate 8-1. The soil will then be contoured at a rate of not more than 2:1, then contour furrowed to prevent erosion (see Section 8.8). Mulch will be applied at the rate of 2,000 pounds per acre. The soils will be tested and fertilized with an organic material to insure the interim revegetation will succeed (see Table 8-4 for quality standard). The topsoil stockpiles will be seeded using the seed mix listed in Table 3-2 for temporary reclamation. Signs will be placed in this area indicating "Topsoil Storage". The area will be fenced to prevent livestock from entering the area. A berm will be placed around the stockpiles to prevent soil erosion from entering the water courses in the mine area.

8.8 Plans for Redistribution of Soils

Deep scarification of overburden and compacted areas (of no less than 6" depth), will be accomplished to ensure good overburden and redistributed topsoil contact to prevent slippage. The regraded material will be topographically conformed to the relative environmental conditions, which will be approximate to the premining topography with the highwalls being eliminated.

Soil will be redistributed using the wooden stake method, where a stake is marked to the depth of fill (estimated at 12"), then the soils will be added to accomplish that depth. The soil will then be harrowed to break up the cloddy surface and scarify to a depth of 18 inches (see Section 3.5.5.1). The regraded soils surface roughness will be maximized by pitting and gouging. Contour furrowing will take place on slopes that exceed 6 percent. The contour furrows will be discontinuous, laid out on an noneronsive grade and spaced no more than 10

Table 8-4

Seedbed Material Quality Standards for Reclamation

Property	Limits			Restrictive Feature
	Good	Fair	Poor	
Sodium Adsorption Ratio (SAR)[a]	6	6 - 10	10 - 15	Excess Sodium
Salinity (EC) mmhos/cm[a]	0 - 4	4 - 8	8 - 16	Excess Salt
Saturation Percentage[a]	25	80	80	
Soil Reaction (pH)[a]	6.0 - 8.4	8.4 - 8.8	8.8 - 9.0	Excess Lime
USDA Texture[a]		SL, SIL, VFSL, FSL, LFS	CL, S	Too Clayey
Zinc and Boron[b]				
Coarse Frag. (WTPCT) 3-10 in. (7.6-25.4 cm) 10 in. (25.4 cm)	0 - 15 0 - 3	15 - 25 3 - 7	25 - 35 7 - 10	Large Stones Large Stones

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

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

to 15 feet apart. The soil will then be sampled as stated in Section 8.9 to determine needed fertilization levels. The area will then be fertilized as required and mulched at a rate of 2000 lbs. per acre (straw or hay). Seeding will then commence using the final reclamation seed mix listed in Table 3-3. Erosion control matting will be used where the slope grades are 2 1/2H:1V or steeper.

8.9 Nutrients and Soil Amendments

Tests will be taken of soils 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 (UDOGM soil guidelines). The soils chosen for sampling will be based on previous analysis, affected soil series type, postmining land use, and the postmining vegetation ecosystem. Twenty sub-samples per acre will be taken at 12 inch depths then combined, 5 samples will be taken from the combined sub-samples and send to a qualified laboratory for testing. The tests to be performed will be pH, electrical conductivity, sodium absorption ratio, texture, nitrogen, organic content, phosphorus, potassium, available water capacity, and percent rock fragments, in order to determine needed fertilization levels. Commercial organic fertilizers will be added to replenish soil nutrients and to enhance successful revegetation. The soil nutrient and amendments plan will also follow the Divisions Guidelines for management of topsoil and overburden for underground and surface coal mines.

8.10 Effects of Mining Operations on Soils, Nutrients and Amendments

The disturbed land fill which has been impacted by mining operations has some inherit problems. 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. See Section 8.9 for nutrients and soil amendments.

8.11 Mitigation and Control Plans

No additional surface disturbance involving soils will be required for the surface facilities. Therefore, the stripping and stockpiling of soils will be the soils saved from the previously disturbed areas.

8.12 References

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.

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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.

APPENDIX 8-1

SOILS DATA

SOIL SURVEY AND INTERPRETATIONS
VEGETATION SURVEY
for
C & W Coal Producers
May 19, 1980

George Cook, Range Conservationist
Earl Jensen, Soil Scientist
Gary Moreau, District Conservationist

The proposed C & W Coal Producers Mine area is located at Consumers, Utah in Western Carbon County. At the request of Joe Harvey representing C & W Coal Producers and the Price River Watershed Soil Conservation District, the Soil Conservation Service performed a detailed soil survey and vegetation inventory on the proposed mining site. The survey was designed to comply with the Permanent Regulatory Program, Office of Surface Mining Reclamation and Enforcement, Department of Interior.

The survey covers approximately six acres near Consumers, Utah in Section 17, T.13S.,R.8E.,SLBM. The soils are shown on the attached map. Each soil is identified with a three letter symbol, and the pattern and extent denoted by the soil boundary lines on the map. All areas having the same symbol are essentially the same kinds of soils. There may be small areas of included soils that are slightly different. When the overall county survey is completed, small areas may become inclusions in other map units. None of the soils have been correlated and some of them have not been named. The soils that have not been named are outside the range in characteristics for existing series and thus investigation does not supply adequate information for new series. Following the soil descriptions is a table pointing out limitations of the soils for a variety of uses.

The vegetation was analyzed using the range site methods of the Soil Conservation Service. Range sites are shown on the attached map. Present vegetation was inventoried in the fall of 1979 and spring of 1980 and recorded by percentage air dry weight. Where available potential vegetation was presented for range site description with potential productivity according to favorable and unfavorable precipitation years.

More detailed information is on file in the Price Field Office of the Soil Conservation Service.

SOIL LEGEND

Soil Symbol	Soil Mapping Unit Name
FIA	FIA loam, 0 to 1 percent slopes
GIG	Macar Variant, very bouldery loam, 55 to 65 percent slopes
HIG	HI silt loam, 50 to 70 percent slopes
JIB	Brycan loam, 4 to 6 percent slopes
DM	Mine Dumps

DESCRIPTIONS OF THE SOILS

FIA FI loam, 0 to 1 percent slopes

This FI soil is very deep and somewhat poorly drained. It occurs in the pond areas at elevations of about 2,342 meters (7,680 feet). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 16 to 20 inches. Mean annual air temperature is 5 to 6 degrees C. (41 to 43 degrees F.), mean annual soil temperature is 6 to 7 degrees C. (43 to 45 degrees F.), and the average freeze-free season is 60 to 70 days. This soil occurs in the pond area back of the coal dike. Slopes are 0 to 1 percent.

Vegetation is dominantly salina wildrye, muttongrass, and western wheatgrass.

Included in mapping are small areas of a soil with 61 to 97 centimeters (24 to 38 inches) of dark brown loam underlain by very gravelly loamy sand. This soil is on side fans and flood plains of 1 to 4 percent slopes. Also, the FI soil, back of the old rock dam, has about 10 to 15 percent coal and rock fragments that are about .1 to 15 centimeters (¼ to 6 inches) in size.

In a typical profile the surface layer is pale brown loam about 38 centimeters (15 inches) thick. The underlying material is pale brown loam about 64 centimeters (25 inches) thick. The next layer is brown loam

about 51 centimeters (20 inches) thick. The 0 to 102 centimeters (0 to 40 inch) layers have 5 to 8 centimeters (2 to 3 inch) layers of silty clay loam; and the 51 to 152 centimeters (20 to 60 inch) layer has common distinct mottles. This area is flooded frequently and the water table is at about .6 meters (2 feet) at times.

Permeability is slow. Available water capacity is high, (25 centimeters (10 inches)/profile). Organic matter content in the surface layer is low (1 to 3 percent). Effective rooting depth is about 152 centimeters (60 inches). Surface runoff is very slow and erosion hazard is slight as long as the coal dike is holding.

Erodibility is moderate. This soil is used for wildlife habitat.

Taxonomic classification is fine-loamy mixed (calcareous) Aquic Ustifluvents.

A typical pedon of FI loam, 0 to 1 percent slopes was described in the pond area in the drainage at a point about 653 meters (2,140 feet) north 30 meters (100 feet) east of the south ¼ corner of Section 17, T.13S.,R.8E.

C_1 — 0 to 38 centimeters (0 to 15 inches); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) when moist; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; 5 to 8 centimeters (2 to 3 inch) layers of silty clay loam; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0).

C_2 — 38 to 102 centimeters (15 to 40 inches); pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) when moist; few distinct strong brown (7.5YR 5/6) mottles; soft, friable, slightly sticky and slightly plastic; 5 to 8 centimeter (2 to 3 inch) layer of silty clay loam; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0).

A_{1b} — 102 to 152 centimeters (40 to 60 inches); brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) when moist; common distinct strong brown (7.5YR 5/6) mottles; soft, friable, slightly sticky and slightly plastic; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.0).

GIG Macar Variant very bouldery loam, 55 to 65 percent slopes.

This Macar Variant soil is very deep and well drained. It occurs on mountain sideslopes at elevations of 2,333 to 2,379 meters (7,650 to 7,800 feet). This soil formed in local alluvium and residuum derived mainly from sandstone over shale.

The average annual precipitation is 41 to 51 centimeters (16 to 20 inches). Mean annual air temperature is 5 to 6 degrees C. (41 to 43 degrees F.), mean annual soil temperature is 6 to 7 degrees C. (43 to 45 degrees F.), and the average freeze-free season is 60 to 70 days. This soil occurs in the area of the abandoned mines on the north exposure south of the drainage.

Slopes are 55 to 65 percent and north facing. They are medium in length and even in shape.

Vegetation is dominantly salina wildrye and snowberry.

Included in mapping are small areas of rock outcrop (2 percent).

In a typical profile the surface layer is brown, very bouldery loam about 18 centimeters (7 inches) thick. The subsoil is brown, cobbly fine sandy loam about 36 centimeters (14 inches) thick. The upper substratum is pale brown, stony fine sandy loam about 23 centimeters (9 inches) thick. The lower substratum is gray and pale yellow, clay loam and silty clay loam about 89 centimeters (35 inches) thick. The 76 to 152 centimeter (30 to 60 inch) layer has shale fragments that slake in water.

Permeability is moderately rapid to a depth of 76 centimeters (30 inches) and moderately slow below. Available water capacity is moderate (14 centimeters (5.5 inches)/profile). Organic matter content in the surface layer is low (1 to 3 percent). Effective rooting depth is about 165 centimeters (65 inches). Surface runoff is rapid and erosion hazard is moderate under potential native vegetation and high if vegetation is removed and the soil is left bare. Erodibility is moderate. This soil is used for wildlife habitat and range.

Taxonomic classification is fine-loamy, mixed, frigid, Typic Ustochrepts. This unnamed soil is similar to the Macar series except it has 15 to 20 percent rock fragments in the 25 to 102 centimeter (10 to 40 inch) layer and lacks the horizons of carbonate accumulation and segregation.

A typical pedon of Macar Variant very bouldery, fine sandy loam, 55 to 65 percent slopes was described about 455 meters (1,500 feet) N.E. of the North Fork of Gordon Creek, on the south side of an unnamed drainage, by an abandoned mine, 670 meters (2,200 feet) north and 670 meters (2,200 feet) west of the S.E. corner Section 17, T.13S.,R.8E.

A_1 — 0 to 18 centimeters (0 to 7 inches); brown (7.5YR 5/4) very bouldery fine sandy loam, brown (7.5YR 4/2) when moist; moderate medium granular structure; loose, nonsticky and nonplastic; many very fine and fine roots; 10 percent gravel, 10 percent cobble and 1 percent boulder; mildly alkaline (pH 7.8); clear, wavy boundary.

B_2 — 18 to 53 centimeters (7 to 21 inches); brown (7.5YR 5/4) cobbly fine sandy loam, brown (7.5YR 4/4) when moist; weak medium subangular blocky structure that parts to moderate medium granular; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots; 10 percent gravel, 10 percent cobble and 1 percent boulder; moderately alkaline (pH 8.2): clear, wavy boundary.

C_1 — 53 to 76 centimeters (21 to 30 inches);pale brown (10YR 6/3) stony fine sandy loam, grayish brown (10YR 5/2) when moist; weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots; 15 percent gravel, 5 percent cobble and 10 percent stone; slightly calcareous, carbonates are disseminated; moderately alkaline (pH 8.4); abrupt, wavy boundary.

II C_2 — 76 to 102 centimeters (30 to 40 inches); gray (10YR 6/1) clay loam, gray (10YR 5/1) when moist; shale structure; slightly hard, friable, sticky and plastic; few very fine and fine roots; shale fragments slake in water; strongly alkaline (pH 8.6); abrupt, wavy boundary.

III C_3 — 102 to 165 centimeters (40 to 50 inches); pale yellow (2.5Y 7/4) silty clay loam, light yellowish brown (2.5Y 6/4) when moist; massive; slightly hard, friable, sticky and plastic; few very fine and fine roots; moderately calcareous, carbonates are disseminated; strongly alkaline (pH 8.8).

The Macar Variant soils differ from the Macar series because it lacks a horizon of carbonate accumulation.

HIG HI silt loam, 60 to 70 percent slopes.

This HI soil is very deep and well drained. It occurs on very steep mountain slopes at elevations of 2,300 to 2,438 meters (7,600 to 8,000 feet). This soil formed in colluvium derived mainly from sandstone and shale.

The average annual precipitation is 41 to 51 centimeters (16 to 20 inches). Mean annual air temperature is 5 to 6 degrees C. (41 to 43 degrees F.), mean annual soil temperature is 6 to 7 degrees C. (43 to 45 degrees F.), and the average freeze-free season is 60 to 70 days. This soil occurs in the area of the drill test site.

Slopes are 50 to 70 percent and north facing. They are medium in length and concave-convex in shape.

Vegetation is dominantly oak, salina wildrye, and white fir.

Included in mapping are small areas of rock outcrop on 70 to 80 percent slopes.

In a typical profile the surface layer is grayish brown silt loam and dark grayish brown loam about 48 centimeters (19 inches) thick. The subsurface is very pale brown clay loam, about 28 centimeters (11 inches) thick. The subsoil is pale brown gravelly silty clay loam and light yellowish brown. Cobbly silty clay loam to a depth of more than 152 centimeters (60 inches).

Permeability is moderately slow. Available water capacity is 23 to 25 centimeters (9 to 10 inches). Organic matter content in the surface layer is 3 to 5 percent. Effective rooting depth is more than 152 centimeters (60 inches). Surface runoff is rapid and erosion hazard is moderate under potential native vegetation and very high if vegetation is removed and the soil is left bare. Erodibility is moderate. This soil is used for range and wildlife habitat.

Taxonomic classification is fine-loamy, mixed, Pachic Argiborolls. This unnamed soil is similar to the Detra Series except for hue of 10YR in the B_2t horizon.

A typical pedon of HI silt loam, 60 to 70 percent slopes was described near the drill hole on the east part of the survey at a point about 707 meters (2,320 feet) south and 213 meters (700 feet) east of the north ¼ corner of Section 17, T.13S.,R.8E.

O_2 — 3 to 0 centimeters (1 to 0 inches);duff (decomposed leaves and twigs).

A_{11} — 0 to 23 centimeters (0 to 9 inches), grayish brown (10YR 5/2) silt loam; very dark grayish brown (10YR 3/2) when moist; moderate medium granular structure; soft, friable, sticky and slightly plastic; many fine to coarse roots; 5 percent gravel; slightly calcareous; mildly alkaline (pH 7.4); clear, smooth boundary.

A_{12} — 23 to 48 centimeters (9 to 19 inches); dark grayish brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) when moist; weak medium subangular blocky structure that parts to moderate medium granular; very hard, very firm, sticky and plastic; many fine to coarse roots; common fine pores; 5 percent gravel; neutral reaction (pH 6.8); clear smooth boundary.

$B_{21}t$ — 48 to 76 centimeters (19 to 30 inches); pale brown (10YR 6/3) clay loam; brown (10YR 4/3) when moist; moderate medium subangular blocky structure; very hard, very firm sticky and plastic; common fine to coarse roots; common fine pores; few thin clay films in pores; 10 percent gravel; neutral reaction (pH 6.8); clear, smooth boundary.

$B_{22}t$ — 76 to 127 centimeters (30 to 50 inches); pale brown (10YR 6/3) gravelly silty clay loam; dark grayish brown (10YR 4/2) when moist; strong medium and coarse subangular blocky structure; extremely hard, extremely firm, sticky and plastic; few fine and medium roots; few fine pores; many moderately thick clay films on faces of peds; 15 percent gravel and 5 percent cobblestone; neutral reaction (pH 6.8); abrupt, wavy boundary.

$B_{23}t$ — 127 to 160 centimeters (50 to 63 inches); light yellowish brown (10YR 6/4) cobbly silty clay loam; brown (10YR 5/3) when moist; strong medium and coarse subangular blocky structure; extremely hard, extremely firm, sticky and plastic; few fine roots; few fine pores; many moderately thick clay films on faces of peds; 15 percent gravel, 15 percent cobblestone; mildly alkaline (pH 7.4).

JIB Brycan loam, 4 to 6 percent slopes.

This Brycan soil is very deep and well drained. It occurs on alluvial fans in valley bottoms at elevations of 2,329 meters (7,640 feet). This soil formed in alluvium derived mainly from sandstone and shale.

The average annual precipitation is 41 to 51 centimeters (16 to 20 inches). Mean annual air temperature is 5 to 6 degrees C. (41 to 43 degrees F.), mean annual soil temperature is 6 to 7 degrees C. (43 to 45 F.), and the average freeze-free season is 60 to 70 days. This soil occurs below the coal dike.

Slopes are 4 to 6 percent and on all aspects. They are short in length and concave-convex in shape.

Vegetation is dominantly big sagebrush and rabbitbrush.

In a typical profile the surface layer is brown loam about 71 centimeters (28 inches) thick. The underlying layer is pale brown silty clay loam and loam about 41 centimeters (16 inches) thick. The next layer is pale brown sandy clay loam and silty clay loam to a depth of more than 145 centimeters (57 inches).

Permeability is slow. Available water capacity is 27 centimeters (10.5 inches). Organic matter content in the surface layer is 3 to 5 percent. Effective rooting depth is about 152 centimeters (60 inches). Surface runoff is medium and erosion hazard is moderate under potential native vegetation and high if vegetation is removed and the soil is left bare. Erodibility is moderate.

A typical pedon of Brycan loam, 4 to 6 percent slopes was described on the fan below the coal dike, 625 meters (2,050 feet) north and 45 meters (150 feet) west of the south ¼ corner of Section 17, T.13S.,R.8E.

A_{11} — 0 to 15 centimeters (0 to 6 inches); brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) when moist; hard, firm, slightly sticky, plastic, mildly alkaline (pH 7.8).

A_{12} — 15 to 71 centimeters (6 to 28 inches); brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) when moist; mildly alkaline (pH 7.8).

C_1 — 71 to 91 centimeters (28 to 36 inches); pale brown (10YR 6/3) silty clay loam, dark brown (10YR 3/3) when moist; mildly alkaline (pH 7.8).

C_2 — 91 to 112 centimeters (36 to 44 inches); light yellowish brown (10YR 6/4) loam, dark brown (10YR 3/3) when moist; mildly alkaline (pH 8.0).

A_{1b} — 112 to 119 centimeters (44 to 47 inches); yellowish brown (10YR 5/4) loam, very dark grayish brown (10YR 3/2) when moist; mildly alkaline (pH 7.8).

C_3 — 119 to 145 centimeters (47 to 57 inches); pale brown (10YR 6/3) sandy clay loam and silty clay loam, stratified, brown (10YR 5/3) when moist; mildly alkaline (pH 7.8).

DM Mine Dumps

These are piles of waste rock and coal from abandoned coal mines. This material consists mostly of coal, hard shale and sandstone fragments. The fragments are about 1 to 18 centimeters (½ to 7 inches) in size and angular in shape.

Most of this material is not vegetated at the present time. Some areas have a 15 to 20 centimeter (6 to 8 inch) surface layer of mixed soil and fragments. These areas have sparse vegetation of snowberry, salina wildrye, rabbitbrush and some annuals.

Glossary

Alluvium--Soil materials, such as sand, silt, or clay and rock fragments that have been deposited on land by streams or moved and redeposited due to the surface movement of water.

Boulders--Rock fragments greater than 3 feet in diameter.

Colluvium--Soil materials and rock fragments moved and redeposited primarily under the influence of gravity.

Depth, soil--In this report the following terms and their meanings are used to describe the depth of the soil over bedrock:

very deep	More than 60"
deep	40-60"
moderately deep	20-40"
shallow	10-20"

Gravel--Rock fragments from 2 millimeters to 3 inches in diameter.

Leaching--The removal of soluble material from soils or other material by percolating water.

Pedon--A three dimensional unit with its lateral dimension being the smallest size necessary to represent the variability in soil properties of the soil being described.

pH value--a numerical means of designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value--alkalinity; and lower value--acidity.

Residuum--Soil materials weathered from the parent material in place.

Stones--Rock fragments between 10 inches and 3 feet in diameter.

Soil Analysis

Two collecting trips were made to take soil samples. The first trip was in April 1981, the second in August 1981. The first group of soils (numbers 1-10) the following physical and chemical tests and their respective symbols are as follows: (1) Calcium (CaSol. %), (2) conductivity (umhos/cm), (3) magnesium (Mg %), (4) nitrogen (N %), (5) phosphorus (P %), (5) potassium (K %), (6) sodium absorption ratio (SAR), (7) sodium (Na %) and pH units. See Table 1 for the results of these analyses.

A few more tests and different units were used for the analyses of the second group of soils (numbers 11-24). The tests taken and their respective units and symbols are as follows: (1) phosphorus (ppm P), (2) potassium (ppm K), (3) nitrogen (% N), (4) lime (% lime), (5) pH units (pH), (6) conductivity (Ec x 10^3), (7) sodium absorption ratio (SAR), (8) sand (% sand), (9) silt (% silt), (10) clay (% clay), (11) texture class (texture) and (12) total acidity (meq/100g H+). The results for these soils are listed.

Table 3

SOIL LABORATORY REPORT FOR THE C & W NO. 1 MINE.*

Sample	Ca Sol.%	umhos/ cm	Mg%	N%	P%	K%	SAR	Na%	pH
1	.025	190	.014	.250	.032	.051	24.496	.195	8.10
2	.035	158	.018	.188	.025	.055	17.546	.162	9.10
3	.022	144	.020	.086	.015	.066	13.511	.115	9.20
4	.029	180	.025	.211	.023	.049	9.876	.095	9.20
5	.024	164	.022	.178	.030	.037	15.709	.140	9.10
6	.025	174	.010	.125	.022	.037	5.139	.038	9.10
7	.040	28	.012	.095	.014	.050	4.506	.040	9.10
8	.032	150	.020	.150	.010	.044	3.782	.035	9.10
9	.030	140	.024	.124	.016	.050	11.488	.110	8.60
10	.033	155	.023	.285	.022	.039	15.515	.150	8.30

* Soil analyses at FORD CHEMICAL LABORATORY, INC., Salt Lake City, Utah.

Table 4

SOIL LABORATORY REPORT FOR C & W NO. 1 MINE.*

Sample	ppm P	ppm K	% N	% Lime	pH	Ec$\times 10^3$	SAR	% Sand	% Silt	% Clay	meq/100g H+	Texture
11S**	4.3	83.2	.087	25.0	8.5	.63	.55	28.5	50.7	20.8	.75	Silt Loam
12T***	8.4	320	.142	14.4	7.8	.65	.10	36.2	34.7	29.1	1.75	Clay loam
14T	8.4	376	.155	9.8	7.5	.94	.11	35.4	33.5	31.1	23.80	Clay Loam
15T	6.7	328	.196	5.5	7.4	1.26	.10	30.7	37.8	31.5	1.25	Clay Loam
16T	11.2	310	.143	2.8	6.7	1.18	.11	66.0	20.2	13.8	16.60	Sandy Loam
17T	7.2	334	.153	7.5	7.6	.69	.13	31.0	28.5	41.5	3.00	Clay
18T	12.8	290	.170	4.2	7.3	1.24	.17	37.4	37.5	25.1	14.50	Loam
19S	5.4	110	.039	14.4	7.9	.49	.19	17.4	55.5	27.1	2.25	Silt Loam
20T	25.7	318	.212	6.5	7.6	1.04	.09	36.7	40.2	23.1	12.80	Loam
21T	21.1	416	.129	3.5	7.3	1.29	.10	45.4	35.5	19.1	.50	Loam
22T	15.2	99.2	.312	5.1	7.6	.76	.12	73.4	17.5	9.1	4.50	Sandy Loam
23T	27.0	523	.212	6.3	7.6	1.46	.11	43.4	35.5	21.1	45.0	Loam
24T	17.9	101	.128	6.0	7.9	.69	.13	73.4	17.5	9.1	38.3	Sandy Loam

* Soil analyses done at BRIGHAM YOUNG UNIVERSITY SOIL LABORATORY, Provo, Utah.

** S = Subsoil

*** T = Topsoil

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PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us	Soil	
		#1
Sample taken at	Blue Blaze	0-15 Cm.
Sample taken by	Blue Blaze	
Date sampled	------	
Date received	September 11, 1990	

Analysis report no. 59-121750

SOIL ANALYSIS

pH	7.9 units	Rock Fragments	34.0 %
Conductivity	0.6 mmhos/cm	Total Nitrogen	0.35 %
Saturation %	82.4	Nitrate-nitrogen	13.2 mg/kg
		Organic Carbon	3.58 %

PARTICLE SIZE ANALYSIS

% Sand	0
% Silt	56
% Clay	44

Total Available Selenium
<0.1 mg/kg
Total Available Boron
1.24mg/kg

SOLUBLE CATIONS

Calcium	3.42 meq/l
Magnesium	2.45 meq/l
Sodium	0.89 meq/l

Available Water Capacity
33.5 (1/3)
16.0 (15)

Sodium Adsorption Ratio 0.52

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #1

Sample taken by: Blue Blaze — 15-30 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121751

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.5 mmhos/cm
Saturation %	79.6

PARTICLE SIZE ANALYSIS

% Sand	2
% Silt	56
% Clay	42

SOLUBLE CATIONS

Calcium	2.94 meq/l
Magnesium	2.56 meq/l
Sodium	0.81 meq/l

Sodium Adsorption Ratio 0.48

Rock Fragments	46.1 %
Total Nitrogen	0.31 %
Nitrate-nitrogen	15.2 mg/kg
Organic Carbon	3.23 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
0.86mg/kg

Available Water Capacity
32.0 (1/3)
15.9 (15)

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

#1

Sample taken at: Blue Blaze — 30-45 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121752

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.7 mmhos/cm
Saturation %	29.6

PARTICLE SIZE ANALYSIS

% Sand	27
% Silt	40
% Clay	33

SOLUBLE CATIONS

Calcium	3.60 meq/l
Magnesium	2.50 meq/l
Sodium	1.54 meq/l

Sodium Adsorption Ratio 0.88

Rock Fragments	40.0 %
Total Nitrogen	0.27 %
Nitrate-nitrogen	0.4 mg/kg
Organic Carbon	1.44 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
32.3 (1/3)
16.2 (15)

Respectfully submitted,
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Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us	Soil	
		#1
Sample taken at	Blue Blaze	45-75 Cm.
Sample taken by	Blue Blaze	
Date sampled	------	
Date received	September 11, 1990	

Analysis report no. 59-121753

SOIL ANALYSIS

pH	7.8 units	Rock Fragments	70.5 %
Conductivity	1.2 mmhos/cm	Total Nitrogen	0.25 %
Saturation %	26.2	Nitrate-nitrogen	0.3 mg/kg
		Organic Carbon	2.65 %

PARTICLE SIZE ANALYSIS

% Sand	51
% Silt	33
% Clay	16

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

SOLUBLE CATIONS

Calcium	4.93 meq/l
Magnesium	3.33 meq/l
Sodium	0.46 meq/l

Available Water Capacity
29.2 (1/3)
14.5 (15)

Sodium Adsorption Ratio 0.23

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

#1

Sample taken at: Blue Blaze — 76-106 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121754

SOIL ANALYSIS

pH	7.8 units
Conductivity	1.1 mmhos/cm
Saturation %	28.8

PARTICLE SIZE ANALYSIS

% Sand	54
% Silt	33
% Clay	13

SOLUBLE CATIONS

Calcium	5.99 meq/l
Magnesium	3.90 meq/l
Sodium	2.72 meq/l

Sodium Adsorption Ratio 1.22

Rock Fragments	61.3 %
Total Nitrogen	0.19 %
Nitrate-nitrogen	0.36 mg/kg
Organic Carbon	2.80 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
27.5 (1/3)
12.7 (15)

Respectfully submitted,
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Manager, Huntington Laboratory

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TELEPHONE: (801) 653-23

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #2 0-15 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121755

SOIL ANALYSIS

pH	7.8 units
Conductivity	0.7 mmhos/cm
Saturation %	54.9

PARTICLE SIZE ANALYSIS

% Sand	27
% Silt	55
% Clay	18

SOLUBLE CATIONS

Calcium	2.74 meq/l
Magnesium	2.47 meq/l
Sodium	0.59 meq/l

Sodium Adsorption Ratio 0.37

Rock Fragments	20.0 %
Total Nitrogen	0.50 %
Nitrate-nitrogen	11.6 mg/kg
Organic Carbon	8.90 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
0.63mg/kg

Available Water Capacity
26.9 (1/3)
11.6 (15)

Respectfully submitted,
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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #2

Sample taken by: Blue Blaze — 15-30 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121756

SOIL ANALYSIS

pH	7.8 units	Rock Fragments	20.1 %
Conductivity	0.4 mmhos/cm	Total Nitrogen	0.22 %
Saturation %	50.2	Nitrate-nitrogen	2.40 mg/kg
		Organic Carbon	5.66 %

PARTICLE SIZE ANALYSIS

% Sand	33
% Silt	50
% Clay	17

Total Available Selenium
<0.1 mg/kg

Total Available Boron
0.55mg/kg

SOLUBLE CATIONS

Calcium	2.68 meq/l
Magnesium	2.02 meq/l
Sodium	0.73 meq/l

Available Water Capacity
22.3 (1/3)
9.7 (15)

Sodium Adsorption Ratio 0.48

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze #2 30-45 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121757

SOIL ANALYSIS

pH	7.7 units
Conductivity	1.0 mmhos/cm
Saturation %	24.5

PARTICLE SIZE ANALYSIS

% Sand	81
% Silt	6
% Clay	13

SOLUBLE CATIONS

Calcium	3.05 meq/l
Magnesium	1.94 meq/l
Sodium	0.75 meq/l

Sodium Adsorption Ratio 0.47

Rock Fragments	6.2 %
Total Nitrogen	0.06 %
Nitrate-nitrogen	0.07 mg/kg
Organic Carbon	9.83 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
17.2 (1/3)
9.8 (15)

Respectfully submitted,
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Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #2 45-75 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121758

SOIL ANALYSIS

pH	7.7 units
Conductivity	0.7 mmhos/cm
Saturation %	25.0

PARTICLE SIZE ANALYSIS

% Sand	61
% Silt	31
% Clay	8

SOLUBLE CATIONS

Calcium	4.05 meq/l
Magnesium	1.50 meq/l
Sodium	2.93 meq/l

Sodium Adsorption Ratio 1.76

Rock Fragments	12.4 %
Total Nitrogen	0.23 %
Nitrate-nitrogen	0.05 mg/kg
Organic Carbon	6.95 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
17.9 (1/3)
9.4 (15)

Respectfully submitted,
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Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #2

Sample taken by: Blue Blaze — 76-106 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121759

SOIL ANALYSIS

pH	7.8 units
Conductivity	0.7 mmhos/cm
Saturation %	26.2

PARTICLE SIZE ANALYSIS

% Sand	68
% Silt	27
% Clay	5

SOLUBLE CATIONS

Calcium	4.32 meq/l
Magnesium	1.49 meq/l
Sodium	0.90 meq/l

Sodium Adsorption Ratio 0.53

Rock Fragments	12.1 %
Total Nitrogen	0.15 %
Nitrate-nitrogen	0.05 mg/kg
Organic Carbon	17.91%

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
11.2 (1/3)
6.7 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3, 0-15 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121760

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.6 mmhos/cm
Saturation %	36.7

PARTICLE SIZE ANALYSIS

% Sand	46
% Silt	37
% Clay	17

SOLUBLE CATIONS

Calcium	3.90 meq/l
Magnesium	0.73 meq/l
Sodium	0.91 meq/l

Sodium Adsorption Ratio 0.60

Rock Fragments	30.2 %
Total Nitrogen	0.18 %
Nitrate-nitrogen	2.4 mg/kg
Organic Carbon	3.42 %

Total Available Selenium
<0.1 mg/kg
Total Available Boron
3.04mg/kg

Available Water Capacity
17.0 (1/3)
7.4 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3 15-30 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121761

SOIL ANALYSIS

pH	8.0 units	Rock Fragments	14.5 %
Conductivity	0.9 mmhos/cm	Total Nitrogen	0.19 %
Saturation %	41.7	Nitrate-nitrogen	2.0 mg/kg
		Organic Carbon	2.04 %

PARTICLE SIZE ANALYSIS

% Sand	43
% Silt	39
% Clay	18

Total Available Selenium
<0.1 mg/kg

Total Available Boron
3.16mg/kg

SOLUBLE CATIONS

Calcium	6.72 meq/l
Magnesium	1.33 meq/l
Sodium	0.62 meq/l

Available Water Capacity
19.9 (1/3)
7.7 (15)

Sodium Adsorption Ratio 0.31

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3

Sample taken by: Blue Blaze — 30-45 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121762

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.8 mmhos/cm
Saturation %	38.9

PARTICLE SIZE ANALYSIS

% Sand	51
% Silt	34
% Clay	15

SOLUBLE CATIONS

Calcium	6.10 meq/l
Magnesium	1.31 meq/l
Sodium	0.96 meq/l

Sodium Adsorption Ratio 0.50

Rock Fragments	26.7 %
Total Nitrogen	0.14 %
Nitrate-nitrogen	0.0 mg/kg
Organic Carbon	1.60 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
14.4 (1/3)
6.3 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3, 45-75 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121763

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.6 mmhos/cm
Saturation %	36.1

PARTICLE SIZE ANALYSIS

% Sand	52
% Silt	34
% Clay	14

SOLUBLE CATIONS

Calcium	4.74 meq/l
Magnesium	1.25 meq/l
Sodium	0.92 meq/l

Sodium Adsorption Ratio 0.53

Rock Fragments	28.5 %
Total Nitrogen	0.18 %
Nitrate-nitrogen	0.0 mg/kg
Organic Carbon	1.25 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
14.6 (1/3)
5.8 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3, 76-106 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121764

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.7 mmhos/cm
Saturation %	40.8

PARTICLE SIZE ANALYSIS

% Sand	43
% Silt	39
% Clay	18

SOLUBLE CATIONS

Calcium	5.09 meq/l
Magnesium	1.59 meq/l
Sodium	1.03 meq/l

Sodium Adsorption Ratio 0.56

Rock Fragments	18.0 %
Total Nitrogen	0.10 %
Nitrate-nitrogen	0.0 mg/kg
Organic Carbon	1.68 %

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

Available Water Capacity
16.5 (1/3)
7.4 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3

Sample taken by: Blue Blaze — 106-137 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121765

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.6 mmhos/cm
Saturation %	35.1

PARTICLE SIZE ANALYSIS

% Sand	52
% Silt	33
% Clay	15

SOLUBLE CATIONS

Calcium	4.17 meq/l
Magnesium	1.07 meq/l
Sodium	1.07 meq/l

Sodium Adsorption Ratio 0.66

Rock Fragments	32.2 %
Total Nitrogen	0.12 %
Nitrate-nitrogen	10.0 mg/kg
Organic Carbon	1.59 %

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

Available Water Capacity
15.2 (1/3)
6.2 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

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BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3, 137-167 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121766

SOIL ANALYSIS

pH	8.0 units	Rock Fragments	21.6 %
Conductivity	0.4 mmhos/cm	Total Nitrogen	0.09 %
Saturation %	32.4	Nitrate-nitrogen	7.8 mg/kg
		Organic Carbon	1.26 %

PARTICLE SIZE ANALYSIS

% Sand	50
% Silt	34
% Clay	16

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

SOLUBLE CATIONS

Calcium	2.70 meq/l
Magnesium	1.03 meq/l
Sodium	0.78 meq/l

Available Water Capacity
15.3 (1/3)
6.1 (15)

Sodium Adsorption Ratio 0.57

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-9300
Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #3, 167-198 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121767

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.4 mmhos/cm
Saturation %	33.9

PARTICLE SIZE ANALYSIS

% Sand	50
% Silt	33
% Clay	17

SOLUBLE CATIONS

Calcium	2.47 meq/l
Magnesium	1.42 meq/l
Sodium	0.80 meq/l

Sodium Adsorption Ratio 0.57

Rock Fragments	26.7 %
Total Nitrogen	0.11 %
Nitrate-nitrogen	8.8 mg/kg
Organic Carbon	1.91 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
15.4 (1/3)
6.0 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

#4

Sample taken at: Blue Blaze — 0-15 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121768

SOIL ANALYSIS

pH	7.9 units
Conductivity	0.5 mmhos/cm
Saturation %	53.2

PARTICLE SIZE ANALYSIS

% Sand	32
% Silt	51
% Clay	17

SOLUBLE CATIONS

Calcium	2.94 meq/l
Magnesium	1.96 meq/l
Sodium	0.95 meq/l

Sodium Adsorption Ratio 0.60

Rock Fragments	21.3 %
Total Nitrogen	0.24 %
Nitrate-nitrogen	<0.1 mg/kg
Organic Carbon	4.47 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
1.48mg/kg

Available Water Capacity
22.2 (1/3)
9.3 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #1 15-30 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121769

SOIL ANALYSIS

pH	7.7 units
Conductivity	1.0 mmhos/cm
Saturation %	33.2

PARTICLE SIZE ANALYSIS

% Sand	53
% Silt	33
% Clay	14

SOLUBLE CATIONS

Calcium	4.80 meq/l
Magnesium	4.65 meq/l
Sodium	1.40 meq/l

Sodium Adsorption Ratio 0.64

Rock Fragments	22.5 %
Total Nitrogen	0.11 %
Nitrate-nitrogen	2.0 mg/kg
Organic Carbon	2.77 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
1.48mg/kg

Available Water Capacity
13.7 (1/3)
5.6 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #1

Sample taken by: Blue Blaze — 30-45 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121770

SOIL ANALYSIS

pH	8.1 units
Conductivity	0.7 mmhos/cm
Saturation %	36.4

PARTICLE SIZE ANALYSIS

% Sand	48
% Silt	39
% Clay	13

SOLUBLE CATIONS

Calcium	5.18 meq/l
Magnesium	2.74 meq/l
Sodium	1.00 meq/l

Sodium Adsorption Ratio 0.50

Rock Fragments	23.7 %
Total Nitrogen	0.17 %
Nitrate-nitrogen	0.7 mg/kg
Organic Carbon	3.14 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
17.0 (1/3)
7.2 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us	Soil	
Sample taken at	Blue Blaze	#5 0-15 Cm.
Sample taken by	Blue Blaze	
Date sampled	------	
Date received	September 11, 1990	

Analysis report no. 59-121771

SOIL ANALYSIS

pH	7.2 units
Conductivity	0.4 mmhos/cm
Saturation %	36.7

PARTICLE SIZE ANALYSIS

% Sand	47
% Silt	38
% Clay	15

SOLUBLE CATIONS

Calcium	2.04 meq/l
Magnesium	0.53 meq/l
Sodium	0.73 meq/l

Sodium Adsorption Ratio 0.65

Rock Fragments	14.7 %
Total Nitrogen	0.17 %
Nitrate-nitrogen	<0.01mg/kg
Organic Carbon	1.95 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
1.20mg/kg

Available Water Capacity
16.6 (1/3)
6.7 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #5, 15-30 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121772

SOIL ANALYSIS

pH	7.2 units
Conductivity	0.4 mmhos/cm
Saturation %	35.1

PARTICLE SIZE ANALYSIS

% Sand	41
% Silt	41
% Clay	18

SOLUBLE CATIONS

Calcium	2.46 meq/l
Magnesium	0.51 meq/l
Sodium	0.74 meq/l

Sodium Adsorption Ratio 0.60

Rock Fragments	11.9 %
Total Nitrogen	0.15 %
Nitrate-nitrogen	<0.01mg/kg
Organic Carbon	1.84 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
1.36mg/kg

Available Water Capacity
15.2 (1/3)
8.1 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #5

Sample taken by: Blue Blaze — 30-45 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121773

SOIL ANALYSIS

pH	7.2 units
Conductivity	0.5 mmhos/cm
Saturation %	32.1

PARTICLE SIZE ANALYSIS

% Sand	49
% Silt	38
% Clay	13

SOLUBLE CATIONS

Calcium	4.07 meq/l
Magnesium	1.62 meq/l
Sodium	0.60 meq/l

Sodium Adsorption Ratio 0.36

Rock Fragments	17.9 %
Total Nitrogen	0.16 %
Nitrate-nitrogen	0.06 mg/kg
Organic Carbon	1.99 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
16.5 (1/3)
7.9 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #5

Sample taken by: Blue Blaze — 45-75 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121774

SOIL ANALYSIS

pH	8.1 units
Conductivity	0.6 mmhos/cm
Saturation %	23.8

PARTICLE SIZE ANALYSIS

% Sand	57
% Silt	36
% Clay	7

SOLUBLE CATIONS

Calcium	3.17 meq/l
Magnesium	0.86 meq/l
Sodium	0.57 meq/l

Sodium Adsorption Ratio . 0.40

Rock Fragments	24.1 %
Total Nitrogen	0.16 %
Nitrate-nitrogen	0.05 mg/kg
Organic Carbon	1.99 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
16.7 (1/3)
7.3 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #5 75-106 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121775

SOIL ANALYSIS

pH	7.8 units
Conductivity	0.6 mmhos/cm
Saturation %	34.7

PARTICLE SIZE ANALYSIS

% Sand	52
% Silt	33
% Clay	15

SOLUBLE CATIONS

Calcium	2.70 meq/l
Magnesium	1.00 meq/l
Sodium	0.76 meq/l

Sodium Adsorption Ratio 0.56

Rock Fragments	21.0 %
Total Nitrogen	0.09 %
Nitrate-nitrogen	7.8 mg/kg
Organic Carbon	1.26 %

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

Available Water Capacity
15.3 (1/3)
7.3 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312)953-9300

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PLEASE ADDRESS ALL CORRESPONDENCE
P.O. BOX 1020, HUNTINGTON, UT 84
TELEPHONE: (801) 653-2

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — E5

Sample taken by: Blue Blaze — 108-137 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121776

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.6 mmhos/cm
Saturation %	31.5

PARTICLE SIZE ANALYSIS

% Sand	54
% Silt	33
% Clay	13

SOLUBLE CATIONS

Calcium	2.90 meq/l
Magnesium	1.49 meq/l
Sodium	0.78 meq/l

Sodium Adsorption Ratio 0.53

Rock Fragments	20.3 %
Total Nitrogen	0.11 %
Nitrate-nitrogen	7.6 mg/kg
Organic Carbon	2.2 %

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

Available Water Capacity
15.2 (1/3)
6.2 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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PLEASE ADDRESS ALL CORRESPONDENCE TO
P.O. BOX 1020, HUNTINGTON, UT 845[illegible]
TELEPHONE: (801) 653-231[illegible]

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #5 137-152 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121777

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.6 mmhos/cm
Saturation %	30.2

PARTICLE SIZE ANALYSIS

% Sand	32
% Silt	51
% Clay	17

SOLUBLE CATIONS

Calcium	2.90 meq/l
Magnesium	1.95 meq/l
Sodium	0.93 meq/l

Sodium Adsorption Ratio 0.52

Rock Fragments	20.2 %
Total Nitrogen	0.10 %
Nitrate-nitrogen	7.2 mg/kg
Organic Carbon	2.0 %

Total Available Selenium
xx.x mg/kg
Total Available Boron
x.x mg/kg

Available Water Capacity
15.2 (1/3)
8.1 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (801) 653-2

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #6

Sample taken by: Blue Blaze — 0-15 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121778

SOIL ANALYSIS

pH	7.9 units
Conductivity	0.6 mmhos/cm
Saturation %	33.5

PARTICLE SIZE ANALYSIS

% Sand	49
% Silt	34
% Clay	17

SOLUBLE CATIONS

Calcium	4.79 meq/l
Magnesium	0.75 meq/l
Sodium	0.77 meq/l

Sodium Adsorption Ratio 0.46

Rock Fragments	2.3 %
Total Nitrogen	0.13 %
Nitrate-nitrogen	0.40 mg/kg
Organic Carbon	2.16 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
0.67mg/kg

Available Water Capacity
12.3 (1/3)
6.6 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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PLEASE ADDRESS ALL CORRESPONDENCE T
P.O. BOX 1020, HUNTINGTON, UT 845
TELEPHONE: (801) 653-23

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #6

Sample taken by: Blue Blaze — 15-30 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121779

SOIL ANALYSIS

pH	8.0 units
Conductivity	0.5 mmhos/cm
Saturation %	30.2

PARTICLE SIZE ANALYSIS

% Sand	58
% Silt	28
% Clay	14

SOLUBLE CATIONS

Calcium	3.72 meq/l
Magnesium	0.75 meq/l
Sodium	0.70 meq/l

Sodium Adsorption Ratio 0.47

Rock Fragments	1.0 %
Total Nitrogen	0.08 %
Nitrate-nitrogen	0.96 mg/kg
Organic Carbon	1.44 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
0.87mg/kg

Available Water Capacity
10.5 (1/3)
5.6 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-23

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #6, 30-45 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121780

SOIL ANALYSIS

pH	7.8 units
Conductivity	0.6 mmhos/cm
Saturation %	29.4

PARTICLE SIZE ANALYSIS

% Sand	56
% Silt	31
% Clay	13

SOLUBLE CATIONS

Calcium	4.88 meq/l
Magnesium	0.92 meq/l
Sodium	0.58 meq/l

Sodium Adsorption Ratio 0.34

Rock Fragments	26.9 %
Total Nitrogen	0.11 %
Nitrate-nitrogen	0.47 mg/kg
Organic Carbon	2.03 %

Total Available Selenium
XX.X mg/kg
Total Available Boron
X.X mg/kg

Available Water Capacity
12.2 (1/3)
6.3 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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PLEASE ADDRESS ALL CORRESPONDENCE TO
P.O. BOX 1020, HUNTINGTON, UT 8452
TELEPHONE: (801) 653-231

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #7, 0-15 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121781

SOIL ANALYSIS

pH	7.8 units
Conductivity	0.7 mmhos/cm
Saturation %	37.2

PARTICLE SIZE ANALYSIS

% Sand	50
% Silt	34
% Clay	16

SOLUBLE CATIONS

Calcium	4.24 meq/l
Magnesium	0.93 meq/l
Sodium	0.72 meq/l

Sodium Adsorption Ratio 0.45

Rock Fragments	14.9 %
Total Nitrogen	0.29 %
Nitrate-nitrogen	1.68 mg/kg
Organic Carbon	8.34 %

Total Available Selenium
<0.1 mg/kg
Total Available Boron
1.92mg/kg

Available Water Capacity
16.7 (1/3)
7.7 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

#7

Sample taken at: Blue Blaze — 15-30 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121782

SOIL ANALYSIS

pH	7.7 units
Conductivity	0.5 mmhos/cm
Saturation %	35.6

PARTICLE SIZE ANALYSIS

% Sand	49
% Silt	34
% Clay	17

SOLUBLE CATIONS

Calcium	3.82 meq/l
Magnesium	0.64 meq/l
Sodium	0.68 meq/l

Sodium Adsorption Ratio 0.46

Rock Fragments	33.2 %
Total Nitrogen	0.24 %
Nitrate-nitrogen	0.84 mg/kg
Organic Carbon	6.97 %

Total Available Selenium
<0.1 mg/kg

Total Available Boron
2.24mg/kg

Available Water Capacity
17.6 (1/3)
7.9 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #7

Sample taken by: Blue Blaze — 30-45 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121783

SOIL ANALYSIS

pH	7.6 units	Rock Fragments	36.4 %
Conductivity	0.6 mmhos/cm	Total Nitrogen	0.14 %
Saturation %	32.4	Nitrate-nitrogen	1.68 mg/kg
		Organic Carbon	2.38 %

PARTICLE SIZE ANALYSIS

% Sand	43
% Silt	38
% Clay	19

SOLUBLE CATIONS

Calcium	3.75 meq/l
Magnesium	0.78 meq/l
Sodium	0.74 meq/l

Sodium Adsorption Ratio 0.49

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
18.1 (1/3)
7.7 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #7 45-75 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121784

SOIL ANALYSIS

pH	7.5 units
Conductivity	0.4 mmhos/cm
Saturation %	34.7

PARTICLE SIZE ANALYSIS

% Sand	43
% Silt	39
% Clay	18

SOLUBLE CATIONS

Calcium	2.53 meq/l
Magnesium	0.67 meq/l
Sodium	0.63 meq/l

Sodium Adsorption Ratio 0.49

Rock Fragments	21.6 %
Total Nitrogen	0.14 %
Nitrate-nitrogen	2.68 mg/kg
Organic Carbon	1.47 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
17.8 (1/3)
7.2 (15)

Respectfully submitted,
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Manager, Huntington Laboratory

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October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #7, 75-106 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121785

SOIL ANALYSIS

pH	7.6 units
Conductivity	0.4mmhos/cm
Saturation %	37.5

PARTICLE SIZE ANALYSIS

% Sand	36
% Silt	43
% Clay	21

SOLUBLE CATIONS

Calcium	2.61 meq/l
Magnesium	0.74 meq/l
Sodium	0.61 meq/l

Sodium Adsorption Ratio 0.47

Rock Fragments	17.5 %
Total Nitrogen	0.12 %
Nitrate-nitrogen	2.20 mg/kg
Organic Carbon	1.63 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
20.1 (1/3)
8.6 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-231

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #7

Sample taken by: Blue Blaze — 106-137 Cm.

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121786

SOIL ANALYSIS

pH	7.6 units
Conductivity	0.5 mmhos/cm
Saturation %	39.8

PARTICLE SIZE ANALYSIS

% Sand	33
% Silt	43
% Clay	24

SOLUBLE CATIONS

Calcium	3.32 meq/l
Magnesium	1.04 meq/l
Sodium	0.66 meq/l

Sodium Adsorption Ratio 0.45

Rock Fragments	24.3 %
Total Nitrogen	0.04 %
Nitrate-nitrogen	5.60 mg/kg
Organic Carbon	0.09 %

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
21.0 (1/3)
9.0 (15)

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Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2

October 19, 1990

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Soil

Sample taken at: Blue Blaze — #7, 137-152 Cm.

Sample taken by: Blue Blaze

Date sampled: ------

Date received: September 11, 1990

Analysis report no. 59-121787

SOIL ANALYSIS

pH	7.8 units	Rock Fragments	16.0 %
Conductivity	0.5 mmhos/cm	Total Nitrogen	0.02 %
Saturation %	42.1	Nitrate-nitrogen	7.20 mg/kg
		Organic Carbon	0.00 %

PARTICLE SIZE ANALYSIS

% Sand	43
% Silt	36
% Clay	21

SOLUBLE CATIONS

Calcium	2.66 meq/l
Magnesium	1.03 meq/l
Sodium	0.93 meq/l

Sodium Adsorption Ratio 0.68

Total Available Selenium
xx.x mg/kg

Total Available Boron
x.x mg/kg

Available Water Capacity
17.2 (1/3)
7.2 (15)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

COMMERCIAL TESTING & ENGINEERING CO.

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TELEPHONE: (801) 653-231
FAX: (801) 653-247

Blue Blaze Coal Co.
P.O. Box 784
Price, UT 84501

Oct. 5, 1990

Sample identification by

Kind of sample reported to us	Soil
Sample taken at	----------
Sample taken by	----------
Date sampled	----------
Date received	----------

8A
0"-12"

Analysis report no. 59-119541

pH	7.9	units
Electrical conductivity	1.8	mmhos/cm
Saturation %	32.4	
PARTICLE SIZE:		
% Sand	67	
% Silt	21	
% Clay	12	
SOLUBLE CATIONS:		
Calcium	11.78	meq/l
Magnesium	7.04	meq/l
Sodium	1.71	meq/l
Sodium Adsorption Ratio	0.55	
Selenium, total available	<0.1	mg/kg
Boron, total available	4.80	mg/kg
Total Nitrogen	0.59	%
Nitrate-nitrogen	7.2	mg/kg
Organic carbon	28.41	%
Rock fragments	3	%
Available water capacity*	15.6	(1/3)
(%ATM)	7.7	(15)

(*analysis by Utah State Univ.)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311
FAX: (801) 653-2479

Blue Blaze Coal Co.
P.O. Box 784
Price, UT 84501

Oct. 5, 1990

		Sample identification by
Kind of sample reported to us	Soil	
Sample taken at	----------	BB 10'-11'
Sample taken by	----------	
Date sampled	----------	
Date received	----------	

Analysis report no. 59-119542

pH	8.0	units
Electrical conductivity	0.4	mmhos/cm
Saturation %	38.5	
PARTICLE SIZE:		
% Sand	67	
% Silt	21	
% Clay	12	
SOLUBLE CATIONS:		
Calcium	2.86	meq/l
Magnesium	0.78	meq/l
Sodium	0.93	meq/l
Sodium Adsorption Ratio	0.69	
Selenium, total available	<0.1	mg/kg
Boron, total available	5.19	mg/kg
Total Nitrogen	0.64	%
Nitrate-nitrogen	0.16	mg/kg
Organic carbon	32.25	%
Rock fragments	5.4	%
Available water capacity*	15.6	(1/3)
(%ATM)	6.9	(15)

(*analysis by Utah State Univ.)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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FAX: (801) 653-2479

Blue Blaze Coal Co.
P.O. Box 784
Price, UT 84501

Oct. 5, 1990

Sample identification by

Kind of sample reported to us	Soil
Sample taken at	---------- 9A 3' above seam
Sample taken by	----------
Date sampled	----------
Date received	----------

Analysis report no. 59-119543

pH	7.3 units
Electrical conductivity	1.9 mmhos/cm
Saturation %	57.4
PARTICLE SIZE:	
% Sand	30
% Silt	51
% Clay	19
SOLUBLE CATIONS:	
Calcium	4.72 meq/l
Magnesium	10.18 meq/l
Sodium	5.43 meq/l
Sodium Adsorption Ratio	1.98
Selenium, total available	<0.1 mg/kg
Boron, total available	1.61 mg/kg
Total Nitrogen	0.09 %
Nitrate-nitrogen	2.32 mg/kg
Organic carbon	3.5 %
Rock fragments	9.7 %
Available water capacity*	14.7 (1/3)
(%ATM)	6.7 (15)

(*analysis by Utah State Univ.)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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FAX: (801) 653-2476

Blue Blaze Coal Co.
P.O. Box 784
Price, UT 84501

Oct. 5, 1990

Sample identification by

Kind of sample reported to us	Soil
Sample taken at	----------
Sample taken by	----------
Date sampled	----------
Date received	----------

9B
3' below seam

Analysis report no. 59-119544

pH	7.9	units
Electrical conductivity	7.6	mmhos/cm
Saturation %	31.5	
PARTICLE SIZE:		
% Sand	53	
% Silt	36	
% Clay	11	
SOLUBLE CATIONS:		
Calcium	22.05	meq/l
Magnesium	89.88	meq/l
Sodium	7.79	meq/l
Sodium Adsorption Ratio	1.04	
Selenium, total available	<0.1	mg/kg
Boron, total available	<0.1	mg/kg
Total Nitrogen	0.05	%
Nitrate-nitrogen	0.8	mg/kg
Organic carbon	3.95	%
Rock fragments	9.7	%
Available water capacity*	11.1	(1/3)
(%ATM)	3.8	(15)

(*analysis by Utah State Univ.)

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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Blue Blaze Coal Co.
P.O. Box 784
Price, UT 84501

Oct. 5, 1990

Sample identification by

Kind of sample reported to us	Soil
Sample taken at	104
Sample taken by	3 above seam
Date sampled	----------
Date received	----------

Analysis report no. 59-119545

pH	8.2 units
Electrical conductivity	0.4 mmhos/cm
Saturation %	57.6
PARTICLE SIZE:	
% Sand	0
% Silt	63
% Clay	37
SOLUBLE CATIONS:	
Calcium	1.63 meq/l
Magnesium	2.32 meq/l
Sodium	1.29 meq/l
Sodium Adsorption Ratio	0.91
Selenium, total available	<0.1 mg/kg
Boron, total available	<0.1 mg/kg
Total Nitrogen	0.09 %
Nitrate-nitrogen	0.64 mg/kg
Organic carbon	3.72 %
Rock fragments	8 %
Available water capacity*	23.7 (1/3)
(%ATM)	12.4 (15)

(*analysis by Utah State Univ.)

Respectfully submitted,
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Manager, Huntington Laboratory

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TELEPHONE: (801) 653-231
FAX: (801) 653-247

Blue Blaze Coal Co.
P.O. Box 784
Price, UT 84501

Oct. 5. 1990

Sample identification by

Kind of sample reported to us	Soil
Sample taken at	---------- 108
Sample taken by	---------- 3' below seam
Date sampled	----------
Date received	----------

Analysis report no. 59-119546

pH	8.2	units
Electrical conductivity	0.3	mmhos/cm
Saturation %	30.3	
PARTICLE SIZE:		
% Sand	57	
% Silt	30	
% Clay	13	
SOLUBLE CATIONS:		
Calcium	1.31	meq/l
Magnesium	0.74	meq/l
Sodium	1.33	meq/l
Sodium Adsorption Ratio	0.52	
Selenium, total available	<0.1	mg/kg
Boron, total available	<0.1	mg/kg
Total Nitrogen	0.04	%
Nitrate-nitrogen	1.2	mg/kg
Organic carbon	0.71	%
Rock fragments	8.8	%
Available water capacity*	11.8	(1/3)
(%ATM)	4.8	(15)

(*analysis by Utah State Univ.)

Respectfully submitted,
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P.O. BOX 1020, HUNTINGTON, UT 845
TELEPHONE: (801) 653-23
FAX: (801) 653-24

February 22, 1991

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Dirt

No. 8
0-12 inches

Sample taken at: Blue Blaze

Sample taken by: Blue Blaze

Date sampled: ------

Date received: February 11, 1991

Analysis report no. 59-126546

ACID BASE POTENTIAL

Neutralization Potential	129.8	tons $CaCO_3$ equivalent/1000 tons
Maximum Acid Potential	3.1	tons $CaCO_3$ equivalent/1000 tons
Net Acid Base Potential	126.7	tons $CaCO_3$ equivalent/1000 tons

Respectfully submitted,
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FAX: (801) 653-247

February 22, 1991

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Dirt

Sample taken at: Blue Blaze — No. 8

Sample taken by: Blue Blaze — 10-11 Feet

Date sampled: ------

Date received: February 11, 1991

Analysis report no. 59-126547

ACID BASE POTENTIAL

Neutralization Potential	70.4	tons $CaCO_3$ equivalent/1000 tons
Maximum Acid Potential	7.9	tons $CaCO_3$ equivalent/1000 tons
Net Acid Base Potential	62.5	tons $CaCO_3$ equivalent/1000 tons

Respectfully submitted,
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FAX: (801) 653-2479

February 22, 1991

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Dirt

Sample taken at: Blue Blaze — No. 9A, 0-3 Feet Above

Sample taken by: Blue Blaze

Date sampled: ------

Date received: February 11, 1991

Analysis report no. 59-126548

ACID BASE POTENTIAL

Neutralization Potential	134.40 tons $CaCO_3$ equivalent/1000 tons
Maximum Acid Potential	.01 tons $CaCO_3$ equivalent/1000 tons
Net Acid Base Potential	134.39 tons $CaCO_3$ equivalent/1000 tons

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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FAX: (801) 653-2479

February 22, 1991

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Dirt

Sample taken at: Blue Blaze — No. 9B

Sample taken by: Blue Blaze — 0-3 Feet Below

Date sampled: ------

Date received: February 11, 1991

Analysis report no. 59-126549

ACID BASE POTENTIAL

Neutralization Potential	76.4	tons $CaCO_3$ equivalent/1000 tons
Maximum Acid Potential	3.3	tons $CaCO_3$ equivalent/1000 tons
Net Acid Base Potential	73.1	tons $CaCO_3$ equivalent/1000 tons

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Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311
FAX: (801) 653-2479

February 22, 1991

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Dirt

No. 10A
0-3 Feet Above

Sample taken at: Blue Blaze

Sample taken by: Blue Blaze

Date sampled: ------

Date received: February 11, 1991

Analysis report no. 59-126550

ACID BASE POTENTIAL

Neutralization Potential	59.46 tons $CaCO_3$ equivalent/1000 tons
Maximum Acid Potential	.03 tons $CaCO_3$ equivalent/1000 tons
Net Acid Base Potential	59.43 tons $CaCO_3$ equivalent/1000 tons

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311
FAX: (801) 653-2479

February 22, 1991

BLUE BLAZE COAL COMPANY
BOX 784
PRICE UT 84501

Sample identification by
BLUE BLAZE COAL COMPANY

Kind of sample reported to us: Dirt

Sample taken at: Blue Blaze

Sample taken by: Blue Blaze

Date sampled: ------

Date received: February 11, 1991

No. 10B
0-3 Feet Below

Analysis report no. 59-126551

ACID BASE POTENTIAL

Neutralization Potential	6.00 tons $CaCO_3$ equivalent/1000 tons
Maximum Acid Potential	.03 tons $CaCO_3$ equivalent/1000 tons
Net Acid Base Potential	5.97 tons $CaCO_3$ equivalent/1000 tons

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

CHAPTER 9

VEGETATION RESOURCES

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CHAPTER 9

VEGETATION RESOURCES

9.1 Scope

The purpose of this chapter is to describe the vegetation of the mine site. Description of the permit area disturbance as well as some of the surrounding areas are included.

A methodology section is provided for the study. General site descriptions are provided on areas where quantitative data are to be supplied as well as areas where only qualitative data were obtained.

See Section 9.6 for reference area details.

9.2 History

The proposed permit area is the site of previous mining activity, the final mining operations closed in 1953. Consequently, much of the surface area has been previously disturbed. Since 1953 there has been considerable interest in reactivating the area to mining.

In 1981, Mt. Nebo Scientific completed a preliminary vegetation study of the area for Sanders Exploration, Ltd. (C & W No. 1 Mine). In 1990, Mt. Nebo Scientific performed a vegetative study for Blue Blaze Coal Company, which was submitted to UDOGM in a permit application.

9.3 Methodology

Information for this chapter was obtained by utilizing previous vegetation studies by Mt. Nebo Scientific (1981) and field work in November 1990. In November 1990 qualitative analyses, vegetation mapping, and selection of transect areas to be sampled were accomplished. Additionally, on-site sampling areas were approved and 1991 sampling plans were submitted to the UDOGM.

Vegetation mapping was accomplished by using aerial photographs and on-site field mapping on contour maps.

9.4 General Site Description

The permit area is dotted with old mine structures, building ruins, and debris. Previous mining operations left varied degrees of disturbance to the vegetation.

The mine site lies between 7,500 ft and 7,700 ft above sea level. The climate is characterized by cold winters and warm, dry summers. Average annual precipitation ranges from 12 to 20 inches.

9.4.1 Vegetation Patterns

Since revegeation was never performed on the mine site, a host of exotic plant species have been introduced into the disturbed area. For the Mt. Nebo study plant communities were designated as slightly disturbed, moderately disturbed, and severely disturbed.

The mine permit area has been mapped with several vegetation types including: 1) Oak Brush, 2) Salina Wildrye, 3) Maple/Oak Brush/Aspen, 4) Fir/Aspen, 5) Manzanita, 6) Alpine Herb/Grassland, 7) Sagebrush/Grass/Rabbit Brush, and 8) Disturbed/Altered communities. The map provided delineates these vegetation types within and adjacent to the mine permit boundaries (see Plate 9-1).

Except for a relatively small community of Salina wildrye, most of the proposed disturbance will be on areas that have been previously disturbed by mining activity. A description of the existing vegetation types follow.

9.4.1.1 Salina Wildrye Community

This is a relatively small area (approximately 2.5 acres) and is the only undisturbed area that proposed mining activity could affect. This community lies primarily on a dry, west-facing slope, with a 60% incline. Previous sampling indicated a mean total living cover of 43.12%. Ninety-two percent of the living cover were grass species. For a species list, refer to Table 9-1.

9.4.1.2 Disturbed, (Altered) Drainage Bottoms

Another area proposed for disturbance is a site previously disturbed or "altered" by mining activity. Because the area is near the bottom of a drainage, the vegetation community patterns are somewhat dissimilar to adjacent slopes. The bottoms probably have somewhat deeper soils, while some of the species are more mesic. The steep side slopes of oak brush and Salina wildrye often protect the bottoms from exposure to the sun. Consequently, small stands of aspen (Populus tremuloides), white fir (Abies concolor) and oak brush (Quercus gambelii) can be found in and around the drainage. Muttongrass (Poa fenderiana) is one of the dominate grass species of the bottom lands. For a general species list, refer to Table 9-2.

Rick Smith of Engineering Planning Group, was recommended by the Army Corp of Engineers as an approved wetlands specialist. During a site visit on August 16, 1995, he determined that a wetlands existed within the Horizon permit boundary. A threatened and endangered vegetation study of the permit area was done the week of August 21, 1995 by Patrick Collins of Mt. Nebo Scientific. The wetlands area was included in that study.

The wetlands area will be surveyed during September of 1995 to enable Rick Smith to properly delineate the extent of the wetlands. When all the necessary data is available, a permit application will be submitted to the Corp of Engineers. The applicant will not disturb the wetlands area until proper approval has been given.

Table 9-1

Species List for Undisturbed Salina Wildrye Community

Trees and Shrubs	
Bigelov's Sagebrush	Artemisia bigelovii
Big Sagebrush	Artemisia tridentata
Mountain Mahogany	Cercocarpos montanus
Rubber Rabbitbrush	Chrysothamnus nauseosus
Corymb Buckwheat	Eriogonum corybosum
Broom Snakeweed	Gutierrezia sarothrae
Rocky Mountain Juniper	Juniperus scopulorum
Oregon Grape	Mahonia repens
Prickly Pear Cactus	Opuntia polyacantha
Scrub Oak	Quercus gambelii
Elderberry	Sambucus caerulea
Snowberry	Symphoricarpos oreophilus
Gray Horsebush	Tetradymia canescens
Forbs	
Yarrow	Achillea millefolium
Androsace	Androsace septentrionalis
Rosy Pussytoes	Antennaria microphylla
Louisiana Sagewort	Artemisia ludoviciana
Milkvetch	Astragalus spp.
Thistle	Circium sp.
Rock Goldenrod	Petradoria pumila
Globemallow	Sphaeralcea coccinea

Table 9-1 (Continued)

Species List for Undisturbed Salina Wildrye Community

Grasses	
Tall Oatgrass	Arrhenatherum elatius
Salina Wildrye	Elymus salinus
Western Wheatgrass	Elymus smithii
Junegrass	Koeleria macrantha

Table 9-2

Species List for Previously Altered Drainage

Trees and Shrubs	
White Fir	Abies concolor
Big-toothed Maple	Acer grandidentatum
Box Elder	Acer negundo
Serviceberry	Amelanchier utahensis
Big Sagebrush	Artemisia tridentata
Rubber Rabbitbrush	Chyrysothamnus nauseosus
Low Rabbitbrush	Chrysothamnus vicidiflorus
Oregon Grape	Mahonia repens
Aspen	Populus tremuloides
Chokecherry	Prunus viginiana
Douglas Fir	Pseudotsuga menziesii
Scrub oak	Quercus gambelii
Wood's Rose	Rosa woodsii
Willow	Salix caudata
Snowberry	Symphoricarpos oreophilus
Forbs	
Yarrow	Achillea millefolium
Louisiana Sagewort	Artemisia ludoviciana
Aster	Aster spp.
Milkvetch	Astragalus spp.
Thistle	Circium pulchellum

Table 9-2 (Continued)

Species List for the Previously Altered Drainage

Forbs	
Thistle	Circium vulgare
Wild Geranium	Geranium carolinianum
Stickweed	Hackelia micrantha
Hoary Aster	Machaeranthera canescens
Penstemon	Penstemon sp.
Watson's Penstemon	Penstemon watsonii
Curly Dock	Rumex crispus
Dock	Rumex pauciflorus
Russian Thistle	Salsola iberica
Globemallow	Sphaeralcea coccinea
Stinging Nettle	Urtica dioica
Showy Goldeneye	Viguiera multiflora
Mules Ear	Wyethia amplexicaulis
Grasses	
Tall Oatgrass	Arrhenatherum elatius
Orchardgrass	Dactylis glomerata
Salina Wildrye	Elymus salinus
Western Wheatgrass	Elymus smithii
Junegrass	Koeleria macrantha
Indian Ricegrass	Stipa hymenoides
Timothy	Phleum alpina
Muttongrass	Poa fendleriana
Squirreltail	Sitanion hystrix

9.4.1.3 Moderately Disturbed Areas

Some of the areas have had considerable disturbance to the vegetation and the top few inches of soil, but have had relatively little deep, subsurface disturbance. These areas are presently dominated by rabbit brush (Chrysothamnus nauseosus), Wood's rose (Rosa woodsii), stinging nettle (Urtica dioica) and other species that can exist on disturbed areas. For a species list of these areas, refer to Table 9-3.

9.4.1.4 Severely Disturbed Areas

Other areas seemed to be severely disturbed to deeper levels in the soil horizons. These soils/spoils are often compacted and intermixed with coal waste. Much of this area is dominated by weedy species i.e. summer cypress (Kochia scoparia) and ragweed (Ambrosia psilostachya). For a list of existing plant species, refer to Table 9-4.

9.4.1.5 Results From Disturbed Areas

When the three disturbance types (altered drainage bottoms, moderately disturbed, severely disturbed) were combined, the total living cover was estimated at 55%. The cover consisted of 52.43% shrubs, 21.53% forbs and 26.04% grasses (Mt. Nebo Scientific, 1991, Appendix 9-1).

9.5 Vegetation Patterns Prior to Existing Disturbance

The areas previous disturbed by mining activities and which are proposed for new disturbances, are on valley bottoms and adjacent side slopes. Prior to disturbance, the drainages were probably dominated by a big sagebrush/grass/rabbit brush communities. The sagebrush/grass/rabbit brush communities likely had small, isolated patches of aspen, oak brush, fir and/or maple. Although water fed by springs and run off sometimes dissects the bottom lands, no developed riparian community has been established.

The slopes that surround the valley bottoms are dominated by two major community types in its present natural condition: 1) big sagebrush/grass/rabbit brush (valley bottoms) and 2) oak brush/salina wildrye (side slopes).

9.6 Reference Areas

In areas where previous disturbance has not occurred reference area(s) will be established as designated by the UDOGM.

Table 9-3

Species List for Moderately Disturbed Area

Trees and Shrubs	
Rubber Rabbitbrush	Chrysothamnus nauseosus
Wood's Rose	Rosa woodsii
Elderberry	Sambucus caerulea
Snowberry	Symphoricarpos oreophilus
Forbs	
Burdock	Arctium minus
Aster	Aster spp.
Hound's Tongue	Cynoglossum officinale
Stinging Nettle	Urticka dioica
Grasses	
Salina Wildrye	Elymus salinus
Wheatgrass	Elymus spp.
Letterman nettlegrass	Stipa lettermanii

Table 9-4

Species List for Severely Disturbed Area

Trees and Shrubs	
Big Sagebrush	Artemisia tridentata
Rubber Rabbitbrush	Chrysothamnus nauseosus
Scrub Oak	Quercus gambelii
Forbs	
Western Ragweed	Ambrosia psilostachya
Burdock	Arctium minus
Thistle	Circium pulchellum
Bindweed	Convolvulus arvensis
Tansy Mustard	Descurainia pinnata
Stickseed	Hackelia micrantha
Kochia	Kochia scoparia
Stickweed	Lappula redowski
Hoary Aster	Machaeranthera canescens
Bluebells	Mertensia ciliata
Curly Dock	Rumex crispus
Russian Thistle	Salsola iberica
Stinging Nettle	Urtica dioica
Mules Ear	Wyethia amplexicaulis
Grasses	
Cheatgrass	Bromus tectorum
Foxtail Barley	Hordeum jubatum
Rabbitfoot Grass	Polypogon monspeliensis

9.7 Vegetation Map

Plates 9-1 and 9-2 are vegetation maps of the permit area.

9.8 Success Monitoring and Bond Release

Transect areas were chosen and approved by the UDOGM to simulated the previously disturbed areas in their natural, undisturbed condition. The transects were sampled during the 1991 growing season by Mt. Nebo Scientific. Sampling methods followed UDOGM sampling guidelines (see Appendix 9-1).

The reclamation ground cover success will be monitored qualitatively every year of the 10 full years required. The ground cover will be monitored quantitatively in year 2, 3, 5, 9, and 10 during the 10 years of extended responsibility (see Table 9-5). The data collected will be submitted to UDOGM in an annual report.

At a minimum the reclamation vegetative ground cover will equal the present ground cover, and will be adequate to control erosion. Revegetative success standard will comply with UDOGM regulation R645-301-356.

At the time of bond release, shrubs and trees will be healthy, and at a minimum 80 percent will have been in place for at least six growing seasons during the 10 year period of responsibility. Vegetative ground cover will be sufficient to achieve postmining land use and comply with reference area standards of vegetative cover success. For further discussion see Section 3.5.6.

9.9 Threatened and Endangered Species

Table 9-6 contains Federally listed and proposed endangered species in Utah. No threatened or endangered species were found on or near the permit area.

Table 9-5

Reclamation Monitoring Schedule

	YEAR									
	1	2	3	4	5	6	7	8	9	10
QUALITATIVE SAMPLING	X	X	X	X	X	X	X	X	X	X
QUANTITATIVE SAMPLING										
Cover		X	X		X				X	X
Frequency		X	X		X				X	X
Woody Plant Density		X	X		X				X	X
Transplant Survival	X	X	X		X					
Productivity									X	X

Table 9-6

Federally Listed and Proposed Endangered Species in Utah
January 1995

Species		Status
Plants		
Arizona willow	Salix arizonica	PE
Autumn buttercup	Ranunculus aestivalis	E
Barneby reed-mustard	Schoenocrambe barnebyi	E
Barneby ridge-cress	Lepidium barnebyanum	E
Clay reed-mustard	Schoenocrambe argillacea	T
Clay phacelia	Phacelia argillacea	E
Dwarf bear poppy	Arctomecon humilis	E
Heliotrope milk-vetch1[1]	Astragalus montii	T
Jones cycladenia	Cycladenia humilis var. jonesii	T
Kodachrome bladderpod	Lesquerella tumulosa	E
Kodachrome pepper-grass	Lepidium montanum var. stellae	PE
Last chance townsedia	Townsendia aprica	T
Maguire daisy	Erigeron maguirei var maguirei	E
Maguire daisy	Erigeron maguirei	PT
Maguire primrose	Primula maguirei	T
Navajo sedge[1]	Carex specuicola	T
San Rafael cactus	Pediocactus despainii	E

Table 9-6 (Continued)

Federally Listed and Proposed Endangered Species in Utah

Plants (Continued)		Status
Shrubby reed-mustard	Schoencrambe suffrutescens	E
Siler cactus	Pediocactus sileri	T
Uinta Basin hookless cactus	Sclerocactus glaucus	T
Ute Ladies'-tresses	Spiranthes diluvialis	T
Welsh's milkweed1[1]	Asclepias welshii	T
Winkler cactus	Pediocactus winkleri	PE
Wright fishhook cactus	Sclerocactus wrightiae	E

[1]Critical habitat designated.

E - Endangered PE - Proposed Endangered T - Threatened PT - Proposed Threatened

For additional information contact: U.S. Fish and Wildlife Service, 145 East 1300 South, Salt Lake City, Utah 84115, Telephone: (801)524-5001

APPENDIX 9-1

VEGETATION DATA

SOIL SURVEY AND INTERPRETATIONS
VEGETATION SURVEY
for
C & W Coal Producers
May 19, 1980
George Cook, Range Conservationist
Earl Jensen, Soil Scientist
Gary Moreau, District Conservationist

	VRA I vs	Survey Area	VRA II(a) vs	Survey Area	VRA II(b) vs	Survey Area
VEGETATION	Mtn. Loam (Salina Wildrye) Range	Mtn. Loam (Salina Wildrye) Range	Semi-wet Meadow Range	Semi-wet Meadow Range	Mt. Loam (oak)	Mt. Loam (oak)
SOIL	GIC, Macar Variant	GIC, Macar Viraint	FIA loam	FIA loam	JIB, Brycan loam	JIB, Brycan loam
SLOPE	55 - 65%	55 - 65%	0 - 1%	0 - 1%	4 - 6%	4 - 6%
ASPECT	South	South	Southeast	South	Southeast	South
GEOLOGY	Shale and Siltstone	Shale and Siltstone	Shale and Siltstone	Shale and Siltstone	Shale and Siltstone	Shale and Siltstone

Note: VRA - Vegetation Reference Area

TABLE 1

Reference Area Comparison

DESCRIPTION OF VEGETATION

The C & W mine site was visited late in the fall of 1979 and early spring of 1980. Present vegetation and productivity were estimated according to range site analysis methods of the Soil Conservation Service. Potential ecological productivity and composition are available for two of the four sites. The other two sites are being developed by the Bureau of Land Management and should be available in the near future. The sites are keyed with the soils on the map.

Semi-wet Meadow Range Site

This site occurs on valley bottoms, and alluvial fans near water courses. Slopes are nearly level 0 to 1 percent. Elevation is about 2,342 meters (7,680 feet).

The climate is characterized by cold winters and warm dry summers. Average annual precipitation is 41 to 51 centimeters (16 to 20 inches). The important moisture supply for plant growth is from sub-irrigation or a moderately deep but fluctuating water table. The drop in water table during the latter part of the plant growth period affects the amount of herbage production and thus differs from the wet meadow site.

Plant growth begins between March 15 and April 15 depending primarily on soil temperatures. Plant growth usually slows down during late July and early August due to warm temperatures and lowering of the water table. During dry years, plant growth stops at this time as soil moisture becomes depleted. Frost-free period varies from 60 to 70 days. In years of adequate moisture plant growth stops about October 1 to 10 due to killing frosts.

This range site relates to the FIA soil.

Present Vegetation. An inventory of the semi-wet meadow range site recorded the following plant species and percentage estimates by air dry weight.

Grasses and Grass-Like Plants	Percent
Salina wildrye	15
Muttongrass	60
Squirreltail	2
Orchardgrass	1
Alpine Timothy	1
Western wheatgrass	6
Forbs	
Houndstongue	3
Bull thistle	2
Louisiana sagewort	2
Stinging nettle	1
Sour dock	1
Aster	1
Trees and Shrubs	
Snowberry	1
Big rabbitbrush	1
Wild rose	1
White fir	1
Aspen	1

Total annual production is estimated to be 1,500 pounds per acre air dry.

Potential Vegetation. The vegetation of this site is primarily influenced by a water table deeper than 51 centimeters (20 inches), but within the root zone. It is primarily a grass site with approximately 80 percent grass and grass-like plants, 15 percent forbs and 5 percent shrubs.

The following table lists the potential plant community for the semi-wet meadow range site. These species have been identified on similar sites. They will not necessarily occur on every semi-wet meadow site. Those species occurring at higher percentages of air dry weight constitute more important species at the site.

Potential Plant Community -- Semi-wet Meadows

Grasses and Grass-Like Plants	Percent
Alkali bluegrass	5
Alkali sacaton	1
Alpine timothy	1
Basin wildrye	10
Bearded wheatgrass	1
Blue wildrye	1
Bottlebrush squirreltail	1
Columbia needlegrass	1
Field horsetail	5
Idaho fescue	5
Kentucky bluegrass	1
Letterman needlegrass	1
Meadow barley	1
Mountain brome	20
Muttongrass	5
Nodding brome	10
Prairie junegrass	1
Redtop	5
Rushes	5
Sedges	35
Slender wheatgrass	25
Spikerush	5
Timothy	5
Trisetum	1
Tufted hairgrass	10
Western wheatgrass	5
Wiregrass	5
Forbs	
Aspen peavine	10
Aster	1
Buckhorn plantain	2
Cinquefoil	4
Clover	10
Common cowparsnip	1
Edible valerian	5
Elk thistle	1
Geranium	4
Groundsel	1
Lemon scurfpea	1
Lupine	2

Forbs (Cont.)	Percent
Rockymountain iris	5
Starwort	2
Tarweed	2
Violet	3
Yarrow	5
Shrubs and Trees	
Shrubby cinquefoil	1
Silver sagebrush	1
Willow	1
Wood's rose	1
Yellowbrush	1

No tree species occur on this site.

Vegetative cover varies from 70 to 80 percent by ocular estimate.

Plant species not a part of the climax plant community that are most likely to invade the site if plant cover deteriorates are wheatgrass, foxtail barley, annual forbs, curlycup gumweed, dandelion, houndstongue, povertyweed, big sagebrush, rubber rabbitbrush and snakeweed. If excessive grazing occurs, yellowbrush, rushes and sedges will increase and may become dominant plants.

The following threatened or endangered plants have occured on this range site: alkali bluegrass, tufted bluegrass, and trisetum. None were found on the C & W site.

Potential yields from an excellent condition semi-wet meadow range site are shown in the following table. This yield data is based on 41 plots in good condition, 40 in fair, and 58 in poor condition.

TOTAL POTENTIAL ANNUAL PRODUCTION OF VEGETATION
For Excellent Condition Class
Semi-wet Meadow Range Site

	Total All Vegetation	
	Kg/Ha	Lbs/Ac
Favorable Years	4700	4200
Median Years	2800	2500
Unfavorable Years	1960	1750

Mountain Loam (Fir) Range Site

This range site occurs in the area of the drill test site. Slopes are 50 to 70 percent and north facing.

Precipitation averages 41 to 51 centimeters (16 to 20 inches).

This site relates to the HIG soil.

Present Vegetation. An inventory of the mountain loam (fir) range site recorded the following plant species and percentage estimates by air dry weight.

Grass and Grass-Like Plants	Percent
Salina wildrye	25
Wheatgrass	10
Poa	5
Forbs	
Yarrow	10
Aster	1
Herbaceous sagebrush	2
Other forbs	2
Trees and Shrubs	
White fir	20
Douglas fir	5
Gambel oak	10
Snowberry	5
Oregon grape	3
Wyoming sagebrush	2

Total annual production is estimated to be 1,300 pounds per acre air dry.

Potential Vegetation. A description for potential vegetation for mountain loam (fir) is being developed by the Bureau of Land Management. Clipping data collected during the 1979 field season is being assimilated into a site description. This information should be available in the near future.

Mountain Loam (Salina wildrye) Range Site

This range site occurs on the north exposure south of the drainage. Slopes are 55 to 65 percent. Annual precipitation is 41 to 51 centimeters (16 to 20 inches).

This site relates to the GIG soil.

Present Vegetation. An inventory of the mountain loam (Salina wildrye) range site recorded the following plant species and percentage estimates by air dry weight.

Grasses and Grass-Like Plants	Percent
Salina wildrye	65
Western wheatgrass	15
Forbs	
Aster	3
Vetch	5
Yarrow	1
Herbaceous sagebrush	1
Penstemon	1
Thistle	1
Scarlet globemallow	1
Geranium	1
Gumweed	1
Trees and Shrubs	
Snowberry	1
Yellowbrush	1
Rubber rabbitbrush	1
Gambel oak	1
Shrubby buckwheat	1

Total annual production is estimated to be 1,000 pounds per acre air dry.

Potential Vegetation. A description for potential vegetation for mountain loam (Salina wildrye) is being developed by the Bureau of Land Management. Clipping data collected during the 1979 field season is being assimilated into a site description. This information should be available in the near future.

Mountain Loam Range Site

This site occurs on the valley bottom at the C & W area. Slopes are 4 to 6 percent. It occurs on all aspects. Elevation is 2,300 meters (7,640 feet).

The climate is mainly moist subhumid or humid, with cold snowy winters and warm dry summers. The average annual precipitation ranges from 41 to 51 centimeters (16 to 20 inches). Distribution is 55 to 60 percent during the plant dormant period (October to March). This is the most dependable supply for plant growth. Lower precipitation and high evapotranspiration rates during July, August and September causes slowing down in growth of all plant species and dormancy in most of the grasses and forbs.

Plants begin to grow from April 15 to May 1. The grasses have a dormancy period from July 15 to August 15, but grasses may green up again in September when fall rains occur. Shrub species grow until frost though at a reduced rate during summer months. Optimum growth period is during June. Frost-free period ranges from 60 to 70 days.

This range site relates to the JIB soil.

Present Vegetation. An inventory of the mountain loam range site recorded the following plant species and percentage estimates by air dry weight.

Grasses and Grass-Like Plants	Percent
Wheatgrass	3
Salina wildrye	10
Letterman needlegrass	2
Forbs	
Houndstongue	2
Aster	1
Other	2
Burdock	3
Stinging Nettle	2
Trees and Shrubs	
Wood's rose	15
Snowberry	5

Tree and Shrubs (Cont.)	Percent
Elderberry	5
Rubber rabbitbrush	50

Total annual production is estimated to be 1,300 pounds per acre air dry.

Potential Vegetation. This plant community is about 80 percent grasses, 7 percent forbs, and 13 percent shrubs by air dry weight. The following table lists the potential plant community for the mountain loam range site. These species have been identified on similar sites. They will not necessarily occur on every mountain loam range site. Those species occurring at higher percentages of air dry weight constitute more important species at the site.

Potential Community — Mountain Loam Range Site

Grasses and Grass-Like Plants	Percent
Basin wildrye	15
Bearded wheatgrass	10
Big bluegrass	6
Bluebunch wheatgrass	80
Bottlebrush squirreltail	1
Columbia needlegrass	3
Idaho fescue	3
Indian ricegrass	1
King's fescue	1
Kentucky bluegrass	1
Letterman needlegrass	1
Longtongue muttongrass	6
Mountain brome	1
Muttongrass	10
Needle and thread	1
Nodding brome	1
Oniongrass	1
Prairie junegrass	2
Sandberg bluegrass	5
Sedge	1
Slender wheatgrass	5
Trisetum	1
Squirreltail	3
Western wheatgrass	5

Forbs	Percent
Aster	2
Arrowleaf balsamroot	5
Astragalus	2
Bastard Toadflax	1
Cutleaf balsamroot	2
Bedstraw	1
Daisy	5
Eriogonum	1
Geranium	1
Goldenrod	1
Groundsel	1
Horsemint	5
Indian paintbrush	1
Little sunflower	1
Louisiana sagewort	1
Lupine	5
Mulesear dock	1
Others	2
Peavine	1
Penstemon	2
Phlox	2
Showy elkweed	1
Stoneseed	2
Tapertip hawksbeard	2
Timber poisonvetch	1
Yarrow	5
Yellow salsify	2
Shrubs and Trees	
Big sagebrush	5
Bigtooth maple	1
Birchleaf mountainmahogony	1
Antelope Bitterbrush	5
Chokecherry	2
Eriogonum	1
Gambel oak (Utah only)	5
Littleleaf horsebrush	1
Mountain lover	1
Mountain snowberry	5
Rose	1
Serviceberry	1
Threetip sagebrush	3
Utah snowberry	5
Woods rose	1
Yellowbrush	5

No tree species are present except Gambel oak and bigtooth maple. They sometimes attain tree size, but are primarily brush or shrub species. Overstory density is 1 to 10 percent.

Understory vegetative density by ocular estimate is 55 to 60 percent.

Plant species not a part of the climax plant community that are most likely to invade the site if plant cover deteriorates are:

Cheatgrass	Knotweed	Pinon pine
Sixweeks fescue	Mullein	Rubber rabbitbrush
Threeawn	Ragweed	Snakeweed
Annual forbs	Stickseed	Houndstongue
Dandelion	Tarweed.	Utah Juniper

Big sagebrush and yellowbrush are also likely to increase considerably and may become almost pure stands.

Potential yields from an excellent condition mountain loam range site are shown in the following table. This yield data is based on 346 plots in excellent condition, 453 plots in good condition, 339 plots in fair and 232 plots in poor condition.

TOTAL POTENTIAL ANNUAL PRODUCTION OF VEGETATION
For Excellent Condition Class
Mountain Loam Range Site

	Total All Vegetation Kg/Ha	Lbs/Ac
Favorable Years	2910	2600
Median Years	2070	1850
Unfavorable Years	1350	1200

EXPLANATION

- Proposed Disturbed Area
- Premining Disturbed Area
- VRA Vegetation Reference Area
- Permit Boundary

0 1000ft 2000ft 4000ft
SCALE

N

VEGETATION MAP
FOR
PROPOSED C & W

R,8E, T,13S,

Figure 4

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

350 NORTH 400 EAST
PRICE, UTAH 84501

May 30, 1991

Mr. William R. Skaggs
Blue Blaze Coal Company
P.O. Box 784
Price, Utah 84501

Dear Mr. Skaggs:

Here is the information on the two reference sites for the coal mine. These production figures are for a normal year.

Vegetation Type	Ecological Condition	Present Production	Potential Production
Sagebrush/ Grass/Rabbitbrush	Fair	950	1000
Oakbrush/ Salina Wildrye	Fair	900	1200

I believe this is what is needed. If you need more information please feel free to contact me at 637-0041.

George S. Cook

George S. Cook
Range Conservationist

VEGETATION SAMPLING

OF THE

BLUE BLAZE MINE SITE: 1991

Prepared by

MT. NEBO SCIENTIFIC RESEARCH & CONSULTING
Post Office Box 337
Springville, Utah 84663
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for

BLUE BLAZE COAL COMPANY
Post Office Box 784
Price, Utah 84501

Report: Patrick Collins, Ph.D.

Fieldwork: Patrick Collins
P. Dean Collins

Date: August 13, 1991

TABLE OF CONTENTS

VEGETATION SAMPLING
ON THE
BLUE BLAZE MINE SITE: 1991

SCOPE

The following is a report that describes the vegetation for the Blue Blaze Coal Company that is proposed to be disturbed by mining operations. The report provides summaries of the quantitative data, descriptive information, and raw data compilations. It also outlines the methods employed.

The study and methodologies used herein were performed in accordance with the guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM).

INTRODUCTION

The mine site lies between 7,500 ft and 7,700 ft above sea level. The climate is characterized by cold winters and warm, dry summers. Average annual precipitation ranges from 16 to 20 inches.

History

The proposed mine is located at the site where previous mining activity has occurred. Apparently abandoned in about 1953, the site was left with old mining structures, building ruins and debris. Consequently, much of the surface area has been previously disturbed. Since that time, there has been considerable interest in reactivating this area to mining.

In 1981, Mt. Nebo Scientific completed a preliminary vegetation study of the area for Sanders Exploration, Ltd. There was some interest at that time to permit the mine under the name of "C & W No. 1 Mine". Until recently, little or no information about the vegetative resources has been compiled. In 1990, Mt. Nebo Scientific again initiated another study for yet another new mine plan. The study was submitted to DOGM by the Blue Blaze Coal Company in 1990. Some changes in the proposed new mine plan since then have somewhat changed the vegetative study plan. This report will utilize some of the previous data of the study area

as well as provide new information. More details about the vegetation data are provided in the "Methodology" section of this report.

Existing Vegetation

Because revegetation was never performed, most of the area supports a host of exotic plant species on various degrees of disturbance. Present plant communities for the proposed disturbance of the mine site were designated as: 1) slightly disturbed, 2) moderately disturbed and 3) severely disturbed.

The mine permit area has been mapped with several vegetation types including: 1) oak brush, 2) Salina wildrye, 3) maple/oak/aspen, 4) fir/aspen, 5) manzanita, 6) alpine herb/grassland, 7) sagebrush/grassland, and 8) disturbed/altered communities. The map provided in the 1990 vegetation study delineates the vegetation types within and adjacent to the mine permit boundaries (see Vegetation Map 1).

As mentioned above, the proposed new disturbance will be on areas that have been previously disturbed (or at least altered) by mining activities. A description of the existing vegetation types that are proposed for new disturbance follows.

Slightly Disturbed, (Altered) Drainage Bottoms

One area proposed for new disturbance by mining is a site that has been somewhat disturbed or "altered" by previous mining activity. Because the area is near the bottom of a drainage, the vegetation community patterns are somewhat dissimilar than the adjacent slopes. The bottoms probably have somewhat deeper soils, and some of the species are more mesic. The steep side slopes of oak brush and Salina wildrye often protect the bottoms from exposure to the sun. Consequently, small stands of aspen (*Populus tremuloides*), white fir (*Abies concolor*) and oak brush (*Quercus gambelii*) can be found in and around the drainage. Muttongrass (*Poa fenderiana*) is one of the dominate grass species of the bottom lands. For a general species list, refer to Table 3.

Moderately Disturbed Areas

Some of the areas have had considerable disturbance to the vegetation and the top few inches of soil, but have had relatively little deep, subsurface disturbance. These areas are presently dominated by rabbitbrush (*Chrysothamnus nauseosus*), hound's tongue (*Cynoglossum officinale*) and stinging nettle (*Urtica dioica*) and other species that can exist on disturbed areas. For a species list of these areas, refer to Table 4.

Severely Disturbed Areas

Still other areas seem to be severely disturbed to deeper levels in the soil horizons. These soils/spoils are often compacted and intermixed with coal waste. Old mining structures and buildings can be found throughout the entire area. Much of this area is dominated by weedy species and those that thrive on disturbed areas i.e. rubber rabbitbrush (*Chrysothamnus nauseosus*), Louisiana sagewort (*Artemisia drunculus*), summercypress (*Kochia scoparia*) and ragweed (*Ambrosia psilostachya*). For a list of existing plant species, refer to Table 5.

Vegetation Patterns Prior to Existing Disturbances

Areas proposed for new disturbances are on valley bottom lands and adjacent side slopes. Prior to disturbance, the drainages were probably dominated by big sagebrush/grass/rabbitbrush communities. These communities likely had small, isolated patches of aspen, oak brush, fir and/or maple. Although a small stream fed by springs and runoff sometimes dissects the bottom lands, no developed riparian community has been established. The slopes that surround the valley bottom lands are dominated by Salina wildrye and oak brush communities.

METHODS

Because the area was disturbed by mining prior to current DOGM requirements and consequently was not reclaimed to the current state rules described in R614-200 through R614-203 and R614-301 through R614-302 of those requirements, standards for vegetative ground cover will be based on current ground cover for the new mine (refer to State of Utah, Coal Mining Rules R614-301-356.250).

As mentioned previously, the mine area supports different weedy communities with diversity probably dictated by the degree of disturbance at each site. In other words, some areas have been disturbed more severely that other areas. The disturbance areas were ranked by their relative degree of disturbance (i.e. slightly disturbed, moderately disturbed or severely disturbed).

Quantitative and qualitative data were taken on the vegetation of the three disturbance types. Sampling was accomplished on July 23, 1991. Number of samples were based on the relative amount of surface area for each disturbance type (more area = more samples). Final data were combined to provide the overall mean of the disturbance areas for the ground cover standard. Raw data, however, is supplied with this report to enable one to summarize each type of disturbance independently if desired. Transect lines are labeled on the raw data sheets.

These labels correspond with a map that shows the location of these transects.

Cover and Composition

Random/regular placement of sampling plots were designed to provide unbiased accuracy of the data compiled. This was accomplished by establishing transect lines on the areas to be sampled. These transect lines were placed over the various disturbance areas to adequately represent the area as a whole. Regular points on the transect lines were then marked. At these regular points, random numbers were used to generate sample locations perpendicular to the transect lines.

Cover estimates were made using ocular methods with meter square quadrats. Species composition was also assessed from the quadrats. Additional information recorded on data sheets were: estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes. Plant nomenclature follows "A Utah Flora", Welsh et al. (1987).

Woody Species Density

Density of woody plant species were not recorded on this area because it was previously disturbed by mining activity.

Sample Adequacy

Sample adequacy for cover was achieved by employing formulas approved by the State of Utah, Division of Oil, Gas & Mining at 80% confidence (90% confidence was actually achieved) by the sample size. For the formulas used, refer to the summary tables. All sample means, standard deviations, raw data, and sample sizes were included in this report to enable the reviewers to apply further statistical tests if desired.

Photographs

Photographs were taken at each of the areas where transects for sampling were placed.

RESULTS

The Disturbed Areas

When the 3 disturbance types (slight, moderate and severe) were combined, the total living cover was estimated as nearly 55 percent (Table 1). Of that cover 52.43% were shrubs, 21.53% were forbs and 26.04% were grasses (Table 1). Photographs of each sample area for the disturbance types are included in this report.

Cover by species indicated rubber rabbitbrush (*Chrysothamnus nauseosus*) to be the dominate shrubs species, followed by snowberry (*Symphoricarpus oreophilus*). Hound's tongue (*Cynoglossum officinale*), a weedy species, was the dominate forb species, whereas, muttongrass (*Poa fendleriana*) dominated the grasses in the sample areas (Table 2). For species lists of the disturbance types, refer to Tables 3-5.

PHOTOGRAPHS

(Original report shows color photographs)

RAW DATA

Blu[illegible]e 1991
N = 51
Previous Disturbances
Sample Date: 23 July 1991
Exposure: Mostly Southern Slightly Disturbed; Transect B = Nos. 1-10
Slope: 1-10 deg.

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
TREES & SHRUBS										
Symphoricarpos oreophilus	58.00	0.00	0.00	5.00	0.00	25.00	10.00	0.00	0.00	0.00
Chrysothamnus viscidiflor	0.00	5.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chrysothamnus nauseosus	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00
Artemisia tridentata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Populus treuloides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rosa woodsii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Artemisia nova	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eriogonum corymbosum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FORBS										
Artemisia dracunculus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aster foliaceus	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Rumex crispus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
Cynoglossun officinale	5.00	10.00	0.00	5.00	10.00	5.00	10.00	3.00	15.00	5.00
Urtica dioica	15.00	0.00	0.00	0.00	0.00	5.00	0.00	2.00	15.00	0.00
Ma[illegible] anthera canescens	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible] millefolium	0.00	10.00	0.00	0.00	10.00	0.00	5.00	10.00	10.00	0.00
Hymenoxys richardsonii	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Geranium richardsonii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lepidium montanum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iva axillaris	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Circium spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machaeranthera grindelioi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Epilobium angustifolium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gayophytum racemissimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Comandra umbellatum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Salsola iberica	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GRASSES										
Elymus lanceolatus	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	5.00	5.00
Elymus salinus	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poa fendleriana	0.00	15.00	20.00	55.00	20.00	55.00	45.00	70.00	5.00	40.00
Elymus trachycaulus	7.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hordeum jubatum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stipa lettermanii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bromus tectorum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COVER										
Total Living Cover	90.00	90.00	50.00	65.00	55.00	90.00	80.00	85.00	55.00	55.00
Litter	2.00	8.00	10.00	32.00	5.00	1.00	17.00	13.00	5.00	5.00
Ba[illegible]und	5.00	1.00	15.00	1.00	39.00	1.00	2.00	1.00	20.00	35.00
Ro[illegible]	3.00	1.00	25.00	2.00	1.00	8.00	1.00	1.00	20.00	5.00
COMPOSITION										
Shrubs	64.44	5.56	40.00	7.69	27.27	27.78	12.50	0.00	0.00	0.00
Forbs	27.78	33.33	10.00	7.69	36.36	11.11	18.75	17.65	81.82	18.18
Grasses	7.78	61.11	50.00	84.62	36.36	61.11	68.75	82.35	18.18	81.82

Slightly Disturbed; Transect C = Nos. 11-18

11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
0.00	40.00	25.00	25.00	22.00	28.00	10.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00
0.00	10.00	5.00	3.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	3.00	5.00	5.00	25.00	10.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	10.00	0.00	3.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	5.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	20.00	5.00	17.00	15.00	20.00	20.00	30.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50.00	90.00	60.00	55.00	55.00	55.00	60.00	55.00
5.00	5.00	10.00	30.00	5.00	15.00	25.00	10.00
[illegible]	1.00	5.00	14.00	5.00	20.00	2.00	30.00
[illegible]	4.00	25.00	1.00	35.00	10.00	13.00	5.00
60.00	55.56	41.67	58.18	40.00	50.91	16.67	9.09
0.00	11.11	33.33	10.91	32.73	12.73	50.00	36.36
40.00	33.33	25.00	30.91	27.27	36.36	33.33	54.55

Moderately Disturbed; Transect D = Nos. 19-29

19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00
45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25.00	70.00	85.00	55.00	60.00	55.00	65.00	5.00	45.00	20.00	35.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	25.00	0.00	60.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	10.00	5.00	10.00	20.00	10.00	15.00	0.00	15.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80.00	80.00	90.00	70.00	80.00	90.00	80.00	70.00	60.00	35.00	65.00
1.00	5.00	8.00	20.00	4.00	2.00	5.00	24.00	30.00	5.00	5.00
[illegible]	14.00	1.00	9.00	15.00	3.00	1.00	5.00	5.00	55.00	25.00
[illegible]	1.00	1.00	1.00	1.00	5.00	14.00	1.00	5.00	5.00	5.00
93.75	87.50	94.44	78.57	75.00	88.89	81.25	92.86	75.00	71.43	53.85
6.25	12.50	5.56	14.29	25.00	11.11	18.75	0.00	25.00	14.29	0.00
0.00	0.00	0.00	7.14	0.00	0.00	0.00	7.14	0.00	14.29	46.15

Moderately Disturbed; Transect E = Nos. 30-36

30.00	31.00	32.00	33.00	34.00	35.00	36.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.00	50.00	45.00	10.00	15.00	0.00	5.00
0.00	5.00	0.00	0.00	0.00	0.00	10.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	10.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	0.00	0.00	0.00	0.00	0.00
[illegible]	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00
5.00	10.00	0.00	30.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	10.00	5.00	0.00	10.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	15.00	15.00	0.00	0.00	50.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	10.00
55.00	90.00	60.00	50.00	25.00	50.00	50.00
5.00	1.00	5.00	5.00	5.00	5.00	5.00
[illegible]	8.00	30.00	40.00	45.00	25.00	40.00
[illegible]	1.00	5.00	5.00	25.00	20.00	5.00
63.64	61.11	75.00	20.00	60.00	0.00	30.00
9.09	22.22	0.00	60.00	20.00	0.00	10.00
27.27	16.67	25.00	20.00	20.00	100.00	60.00

Severely Disturbed; Transect A = Nos. 37-51

37.00	38.00	39.00	40.00	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00	50.00
0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00	0.00	0.00	64.00
0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	3.00	4.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00
0.00	0.00	0.00	2.00	0.00	5.00	3.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	10.00	7.00	5.00	2.00	0.00	0.00	0.00	16.00	0.00	0.00	3.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	1.00
1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	5.00
0.00	0.00	0.00	3.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
15.00	35.00	30.00	30.00	25.00	5.00	10.00	5.00	25.00	10.00	75.00	15.00	15.00	75.00
2.00	25.00	10.00	5.00	15.00	20.00	5.00	1.00	3.00	2.00	23.00	10.00	10.00	10.00
1 ^0	35.00	10.00	10.00	1.00	10.00	15.00	25.00	20.00	10.00	1.00	30.00	50.00	13.00
	5.00	50.00	55.00	59.00	65.00	70.00	69.00	52.00	78.00	1.00	45.00	25.00	2.00
93.33	71.43	33.33	20.00	60.00	100.00	30.00	100.00	8.00	0.00	100.00	60.00	100.00	85.33
6.67	28.57	33.33	36.67	40.00	0.00	30.00	0.00	84.00	100.00	0.00	26.67	0.00	1.33
0.00	0.00	33.33	43.33	0.00	0.00	40.00	0.00	8.00	0.00	0.00	13.33	0.00	13.33

51.00	Mean	SDev	Freq	
				TREES & SHRUBS
0.00	9.16	17.97		Symphoricarpos oreophilus
0.00	0.63	2.98		Chrysothamnus viscidiflorus
53.00	15.27	23.38		Chrysothamnus nauseosus
0.00	0.92	4.40		Artemisia tridentata
0.00	0.20	1.39		Populus treuloides
0.00	2.18	9.13		Rosa woodsii
0.00	0.29	2.08		Artemisia nova
0.00	0.29	1.07		Eriogonum corymbosum
	ERR	ERR		FORBS
0.00	0.88	2.83		Artemisia dracunculus
2.00	0.88	2.31		Aster foliaceus
0.00	0.10	0.69		Rumex crispus
0.00	4.35	5.90		Cynoglossun officinale
0.00	0.73	2.98		Urtica dioica
0	0.20	0.97		Machaeranthera canescens
	1.22	3.03		Achillea millefolium
0.00	0.20	0.97		Hymenoxys richardsonii
0.00	0.29	1.18		Geranium richardsonii
0.00	0.14	0.74		Lepidium montanum
0.00	0.38	4.43		Iva axillaris
0.00	0.18	1.12		Circium spp.
0.00	0.08	0.44		Machaeranthera grindelioides
0.00	0.02	0.14		Epilobium angustifolium
0.00	0.04	0.19		Gayophytum ramosissimum
2.00	0.18	1.00		Comandra umbellatum
0.00	0.06	0.42		Salsola iberica
	ERR	ERR		GRASSES
0.00	1.61	3.20		Elymus lanceolatus
0.00	0.24	0.96		Elymus salinus
0.00	11.80	17.44		Poa fendleriana
0.00	1.02	5.64		Elymus trachycaulus
0.00	0.10	0.69		Hordeum jubatum
0.00	0.39	1.67		Stipa lettermanii
0.00	0.33	1.56		Bromus tectorum
				COVER
57.00	54.94	25.39		Total Living Cover
3.00	9.55	8.36		Litter
0	16.96	14.63		Bareground
	18.55	23.03		Rock
				% COMPOSITION
92.98	52.43	32.93		Shrubs
7.02	21.53	21.97		Forbs
0.00	26.04	26.72		Grasses

(Proposed redisturbance)

T. 13S. R. 8E. Sec. 17
VEGETATION SAMPLING
TRANSECT LINES (A,B,C,D & E)