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DIVISION OF OIL
GAS & MINING

SOUTHERN UTAH FUEL COMPANY

SUFCO COAL MINE

WASTE ROCK DISPOSAL SITE
M&RP MODIFICATION

COASTAL STATES ENERGY COMPANY

1987

VOLUME 9

Done on April 6

INSERTION GUIDE

1. Table of Contents: Replace page 3 with the updated page 3.

2. Text: Replace page 14 with updated page 14.

   Replace page 15 with updated page 15.

   Replace page 17 with updated page 17.

   Replace page 25 with updated page 25.

   Replace page 45-46 with updated page 45-46.

   Replace page 50 with updated page 50.

3. Maps: Replace Map 2 with revised Map 2.

   Add Map 6 behind Map 5

4. Appendixes: Appendix III Engineering Calculations.

   Replace page 3 & 4 with revised 3 & 4 "Undisturbed Area Drainage".

   Appendix V

   Add supplemental pages to Soils Report at end.

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We, the undersigned, hereby certify that the material and information contained in this application are complete and are correct to the best of our knowledge and belief.

Coastal States Energy Company

BY: _____
Senior Vice President

Southern Utah Fuel Company

BY: _____
Vice President & General Manager

State of Utah
County of Salt Lake

Subscribed and sworn to and before me this 18th day of January, 1988.

_____
Notary Public for the State of Utah

NOTARY PUBLIC
ANNETTE F. KENNETT
Commission Expires
Dec. 12, 1991
STATE OF UTAH

Residing Salt Lake County

My Commission Expires 12/12/91

SOUTHERN UTAH FUEL COMPANY

№ 007620

Phone [801] 529-7428
SALINA, UTAH 84654

DATE January 14, 1988

PAY THE SUMS DOLS 00 CTS $5.00

TO THE ORDER OF Division of Oil, Gas & Mining

SOUTHERN UTAH FUEL COMPANY

By Russel R. Wilson

VALLEY CENTRAL BANK
RICHFIELD, UTAH 84701
97-145/1243

⑈00076 20⑈ ⑆124301452⑆81 012462⑈

REMITTANCE STATEMENT DETACH BEFORE DEPOSITING

SOUTHERN UTAH FUEL COMPANY SALINA, UTAH

INVOICE NUMBER	INVOICE DATE	OUR ORDER	DESCRIPTION	AMOUNT	DEDUCTIONS	NET AMOUNT
			Application Fee for Waste Rock Disposal Site			5.00

C-77 14/761

№ 007620

Affidavit of Publication

County of Sevier, State of Utah, ss.

I, Kevin Ashby, being first duly sworn, depose and say tht I am the Publisher of the SALINA SUN, a weekly newspaper having a bona fide circulation more than 200 subscribers in the State of Utah, published every Wednesday at Salina, Sevier County, Utah;

That the notice of Public Notice of Coastal States Energy Company Waste Rock Disposal Site Act/041/002.

a copy of which is attached hereto, was published in said paper for four consecutive issues, the first publication having been made in the issue of the 20th day of April, 19 88, and the last publication in the issue of the 11 day of May, 19 88; that the said notice was published in the regular and entire issue of every number of said paper during the period of times and publication, and that the same was published in the newspaper proper and not in a supplement.

Kevin Ashby

Subscribed and sworn before me this 1st day of June, 19 88.

Luana Crane

Notary Public

My Residence is Salina, Sevier County, Utah

My Commission Expires 1-22, 19 89

STATE OF UTAH

RECEIVED 7748
JUN 8 1988
DIVISION OF
OIL, GAS & MINING

PUBLIC NOTICE
COASTAL STATES ENERGY COMPANY
WASTE ROCK DISPOSAL SITE
ACT/041/002
175 East 400 North, Suite 800
Salt Lake City, Utah 84111

Southern Utah Fuel Company (SUFCO), a subsidiary of Coastal States Energy Company has filed with the Utah Division of Oil, Gas and Mining (DOGM) for reclamation permit approval for a waste rock disposal site six miles west of the SUFCo mine. The legal description of the permit area is as follows:

Township 22 South, Range 4 East, S.L.B.M. Section 18 NW 1/4 of NE 1/4.

The Water Hollow Ridge, Utah U.S. Geological Survey 7.5 minute quadrangle map contains the area described.

Mine development waste rock will be buried in compacted lifts within 100 feet of the county road that runs from I-70, Exit 72 to the SUFCo mine on a portion of the road that passes through the above described 40 acres. The existing roadway will not be relocated.

This permit applications has been deemed complete by DOGM and is available for public review at the Division of Oil, Gas and Mining, 355 West North Temple, 3 Triad Center, Suite 350, Salt Lake City, Utah 84180-1203 and at the Sevier County Courthouse, Richfield, Utah.

Comments on the proposed reclamation permit may be addressed to Dr. Dianne Nielson, Director, Division of Oil, Gas and Mining at the above address, to the attention of Mr. Lowell Braxton.

Published in the SALINA SUN April 20, 27 and May 4, 11, 1988.

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SOUTHERN UTAH FUEL COMPANY

WASTE ROCK DISPOSAL SITE

PART 1: INTRODUCTION

Southern Utah Fuel Company (SUFCo), a subsidiary of Coastal States Energy Company, proposes to develop a waste rock disposal site at a location west of their Convulsion Canyon mine. The facility is required for disposal of underground development wastes generated during mine operation.

Many of the general requirements for an operating permit are covered in the minesite M&RP and are not repeated in this document. Only those items considered site specific or those items requested by the Division have received detailed attention in the supplemental application. Information previously submitted in the minesite M&RP application should also be considered during review of this document.

1.0 SCOPE OF OPERATION

The disposal site will be located on part of a 9,640 acre parcel of private land located within the boundaries of the Fishlake National Forest. SUFCo proposes to haul the development wastes by truck from the mine via a paved county road. Travel distance along the road is 6.4 miles from the portal to the disposal site exit. Approximately 10,000 tons of waste material will be disposed of at the site each year.

The land is currently used primarily by wildlife. A portion of the 40 acre tract has been previously disturbed to obtain fill material to repair the county road.

1.1 ACCESS AND USE

The waste rock disposal site is located on forty acres owned by Southern Utah Fuel Company. The site is located in the northwest 1/4 of the northeast 1/4 of Section 18, Township 22 South, Range 4 East, Salt Lake Base and Meridian. A copy of SUFCO's Warranty Deed is included as Exhibit 1. This location is some 6 miles west from the minesite and is within Sevier County. Access frequency would be minimal with waste rock being hauled to the site only a few times each year. It is estimated that approximately 10,000 tons of non-toxic, non-acid forming waste shale, coal, and sandstone per year will be generated by the mining operation. Life of the facility is estimated at 20 years. The design of the disposal area will conform to all State and Federal regulations.

The site will not be used as a sanitary land fill or for disposal of mining related rubbish. Efforts will be made to haul to the site only on week days. Waste rock will be contemperaneously spread and compacted. After a section of the fill site is completed, that segment will be reclaimed. It is unlikely that any structure will ever be placed on the fill area.

1.2 DISPOSAL SITE

The disposal site is located next to a paved county road that is presently used for access to the mine. Part of the site has already been disturbed for use as a borrow area for material to repair a slide on the county road in 1981. The site is situated between two natural drainages and, consequently, will cause only minimal disturbance to the existing drainage. The waste rock will be placed adjacent to the embankment of the county road and will be terraced to fit in with the natural contour to the extent allowed.

Drainage from the waste rock disposal area will be treated with a sediment pond. The drainage from the surrounding undisturbed area will be bypassed with three diversion ditches. There are no buildings or structures within 300 feet of the disposal site. The Bureau of Land Management owns any and all mineral rights to the property. There are no holders of lease hold interest or purchasers of record in the waste rock disposal area.

1.3 CONTIGUOUS OWNERS

Coastal's forty acre plot is bordered by private and Forest Service land. The Warranty Deed showing Southern Utah Fuel Company's right of ownership is included as Exhibit 1. The adjacent property owners are shown on Map 1. Table 1.3 gives the addresses of the property owners contiguous to the waste rock disposal site.

TABLE 1.3
CONTIGUOUS PROPERTY OWNERS

Howard & Janet Nielson	180 East 950 North Salina, Utah 84654
Marlin Sorensen, Jr.	37 North 100 West Salina, Utah 84654
Mount Air Oaks Corp.	37 North 100 West Salina, Utah 84654
Fishlake National Forest U.S. Department of Agriculture	115 East 900 North Richfield, Utah 84701

1.4 MINING PERMITS - COMPLIANCE INFORMATION

Southern Utah Fuel Company currently operates under approved mining permit Number ACT/041/002. Coastal States Energy Company presently holds an approved Mining Permit (Number ACT/007/005) for its Skyline Mines operation located in Carbon and Emery Counties, Utah. This permit was approved and issued by the State of Utah Division of Oil, Gas, and Mining in June of 1980. A NOV history of both of Coastal's Utah operations is attached as Table 1.4-1.

1.5 INSURANCE COVERAGE

The waste rock disposal site is included in the liability insurance coverage held by the operator.

TABLE 1.4-1

LIST OF VIOLATIONS

MD: 1/07/88

SOUTHERN UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY

JANUARY 1984 - OCTOBER 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS
		No violations in 1984			
N85-6-1-1	1/15/85	No fan small area exemption runoff sampling.	Immediately started sampling	1/21/85 Termination of notice. 1/15/85 Effective date.	5/24/85 Proposed assessment of penalties. 5/30/85 Requested assessment conference 7/16/85 Assessment conference. 7/30/85 Finalized assessment.
N85-6-4-1	3/12/85	Parking pad drainage modification to Sediment pond without approval	12/27/84 - Sent in revised plan to eliminate small area exemption and go back to previously approved plan of parking pad drainage to Sediment Pond. 3/14/85 - Sent in plans again to Division that were approved without any revisions on 4/18/85.	4/22/85 Termination of notice	3/26/85 DOGM modification of notice for 30 days for Division review 5/24/85 Proposed assessment of penalties. 5/30/85 Requested assessment conference. 7/16/85 Assessment conference 7/17/85 Follow up letter to the Division. 7/30/85 Finalized assessment.
N85-6-6-1	4/30/85	Failure to analyze for oil and grease in Sediment Pond decant sample.	None - Requested assessment conference.	4/30/85 Termination of notice 7/14/86 No penalty assessed since assessment conference officer determined that none was warranted	5/5/86 Proposed assessment. 5/19/86 Requested assessment conference. 7/2/86 Assessment conference. 7/14/86 Finalized assessment.

TABLE 1.4-1 (continued)

LIST OF VIOLATIONS

MD: 1/07/88

SOUTHERN UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY

JANUARY 1984 - OCTOBER 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS
N85-6-7-1	6/21/85	Quality of fan area discharge.	6/11/85 - Sent in request for Division approval to eliminate the main site fan small area exemption before NOV was written.	9/11/85 Termination of notice. 8/16/85 Effective date.	7/17/85 Proposed assessment. 8/15/85 Finalized assessment.
N85-6-7-1 (con't)	6/21/85	Quality of fan area discharge.	6/28/85 - Letter submitted to satisfy abatement requirements referencing 6/11/85 submitted plan modification plan. 7/18/85 - Division approval of plans. 8/16/85 - Modification implemented.	4/22/85 Termination of notice	3/26/85 DOGM modification of notice for 30 days for Division review 5/24/85 Proposed assessment of penalties. 5/30/85 Requested assessment conference. 7/16/85 Assessment conference 7/17/85 Follow up letter to the Division. 7/30/85 Finalized assessment.
N86-9-6-1	5/1/86	Bypass culvert contaminated with oil - white film on surface of water.	5/2/86 - Inspected culvert. Appeared to be coming from algae growth. 5/3/86 - Cleaned culvert and drainage basin. 5/17/86 - Repaired hole in side of culvert where contaminate was seeping in.	5/27/86 Termination of notice. 5/17/86 Effective date. 7/14/86 Notice of violation vacated as a result of finding that the subject seepage was not surface drainage as contemplated by UMC 817.42 (a) (i).	5/19/86 Proposed assessment. 6/2/86 Requested assessment conference. 7/2/86 Assessment conference. 7/14/86 Finalized assessment.

TABLE 1.4-1 (continued)

SOUTHERN UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY
JANUARY 1984 - OCTOBER 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS
N86-9-7-1	6/17/86	Failure to meet TDS Limitation for Sediment Pond discharge.	6/19/86 - Letter sent to the Division with explanation of what may have caused the high TDS levels and the steps the operator intented to take to prevent a future reoccurrence of the situation.	7/16/86 Termination of notice.	6/30/86 Proposed assessment. 7/17/86 Request for assessment conference or adjustment. 9/26/86 Finalized assessment.
N87-9-9-1	9/22/87	Failure to comply with the conditions and terms of the approved permit.	7/14/87 and 8/11/87 - Meetings held with Division personnel to discus issues. 9/30/87 - Written comments submitted.	12/11/87 NOV vacated.	10/30/87 Proposed assessment 10/27/87 Requested assessment conference. 12/11/87 Assessment conference.

LIST OF VIOLATIONS

TABLE 1.4-1 (continued)

KW: 1/07/88

UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY
JANUARY 1984 - APRIL 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS
N84-7-5-2 1 of 2	5/08/84	Failure to construct sediment control facilities in accordance with the approved design. Failure to treat water discharged from disturbed area or underground mine so that it complies with all applicable State and Federal water quality laws and regulations. Failure to construct sediment pond to prevent short circuiting to the extent possible.		NOV and penalty vacated. No further action.	10/15/84 Assessment conference
N84-7-5-2 2 of 2	5/8/84	Failure to monitor sediment pond discharge adequately to demonstrate that the water quality of the discharge from the disturbed area is in compliance with all water quality rules and regulations.	Immediately started abatement action.	NOV affirmed Penalty paid.	10/15/84 Assessment conference held in SLC/DOGM office.
N84-2-24-3 1 of 3	12/13/84	Provided false certification.		1/11/85 Vacated by issuing officer no further action.	
N84-2-24-3 2 of 3	12/13/84	Failure to operate in accordance with approved plan to adequately treat volume of mine discharge water in addition to providing adequate sediment control as approved for a 36 acre disburbance.		Violation left in place. Fine reduced to -0- with 0 points.	8/10/85 Assessment conference held in SLC/DOGM office

TABLE 1.4-1 (continued)

LIST OF VIOLATIONS KW: 1/07/88

UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY

JANUARY 1984 - APRIL 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS
N84-2-24-3 3 of 3	12/13/84	Failure to comply with all applicable water quality laws, regulations, and permits of sediment pond decant discharges.		NOV vacated. No further action.	8/10/85 Assessment conference held in SLC/DOGM office.
N85-2-5-1 1 of 1	3/5/85	Failure to prevent addition of suspended solids to stream flwo.	Established permanent sediment control measures.	NOV affirmed Penalty points and fine amount reduced and paid.	12/13/85 Assessment conference held in SLC/DOGM office.
N85-2-7-2 1 of 2	6/3/85	Failure to stockpile coal in compliance with the terms and conditions of the permit.		6/3/85 Vacated by issuing officer no further action.	
N85-2-7-2 2 of 2	6/3/85	Failure to inspect the rockwaste disposal site and provide a certified report. Failure to provide DOGM verification that the initial configuration was constructed as approved.	Made required inspection and submitted "as built" plans.	NOV affirmed and paid.	12/13/85 Assessment conference held in SLC/DOGM office.
N85-2-9-2 1 of 2	6/20/85	Failure to mark buffer zone to prevent disturbance by surface operations.	Posted required buffer zone markers.	NOV affirmed Penalty assessed and paid.	12/13/85 Assessment conference held in SLC/DOGM office.

TABLE 1.4-1 (continued)

UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY
JANUARY 1984 - APRIL 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS	
N85-2-9-2 2 of 2	6/20/85	Failure to provide and maintain appropriate sediment control measures to prevent addition of sediment to stream flow or runoff outside the permit area and to minimize erosion.	Provided necessary control measures.	NOV affirmed Penalty assessed and paid.	12/13/85	Assessment conference held in SLC/DOGM office.
N85-2-16-2 1 of 2	8/30/85	Failure to post mine identification sign.		Civil penalty vacated. No further action.	2/13/86	Assessment conference held in SLC/DOGM office.
N85-2-16-2 2 of 2	8/30/85	Failure to divert surface runoff away from fill.		NOV vacated. No further action.	2/13/86	Assessment conference held in SLC/DOGM office.
N85-2-18-2 1 of 2	9/5/85	Conducting mining operations without a permit.		9/6/85 Vacated by issuing officer and reissued as NOV 2 of 2 N85-2-19-2. No further action.		
N85-2-18-2 2 of 2	9/5/85	Conducting mining operations without a permit. Failure to comply with terms and conditions of the permit in disposal of accumulated sediment from the mine sediment pond at the Scofield Waste Rock Disposal site.		NOV vacated No further action.	2/13/86	Assessment conference held in SLC/DOGM office.

TABLE 1.4-1 (continued)

UTAH FUEL COMPANY - DIVISION OF OIL, GAS & MINING NOV HISTORY
JANUARY 1984 - APRIL 1987

NOV	DATE	VIOLATIONS DESCRIPTION	ACTIONS TAKEN TO ABATE	CURRENT STATUS	ADMINISTRATIVE OR JUDICIAL PROCEEDINGS	
N85-2-19-2 1 of 2	9/6/85	Failure to comply with terms of the permit by failing to install water discharge recording equipment.		Nov vacated No further action.	2/13/86	Assessment conference held in SLC/DOGM office.
N85-2-19-2 2 of 2	9/6/85	Failure to conduct mining activities in accordance with the terms & conditions of the permit. Conducting mining operations without a permit by discharging mine water directly into Eccles creek.		NOV vacated No further action.	2/13/86	Assessment conference held in SLC/DOGM office.
N87-9-13-1 1 of 1	10/28/87	Failure to meet effluent limitations as specified in the operator's NPDES permit.		Awaiting assessment conference.		

WASTE ROCK DISPOSAL SITE

PART 1: INTRODUCTION

1.0 SCOPE OF OPERATION

Southern Utah Fuel Company (SUFCo), a subsidiary of Coastal States Energy Company, proposes to develop a waste rock disposal site at a location west of their Convulsion Canyon mine. The facility is required for disposal of underground development wastes generated during mine operation.

The disposal site will be located on part of a 9,640 acre parcel of private land located within the boundaries of the Fishlake National Forest. The proposed disposal area is on a 40 acre tract already owned by SUFCo. The site is located approximately 6 miles west of the mine portal. SUFCo proposes to haul the development wastes by truck from the mine via a paved county road. Travel distance along the road is 6.4 miles from the portal to the disposal site exit. Approximately 10,000 tons of waste material will be disposed of at the site each year.

The land is currently used primarily by wildlife. A portion of the 40 acre tract has been previously disturbed to obtain fill material to repair the county road.

1.1 ACCESS AND USE

The waste rock disposal site is located on forty acres owned by Coastal States Energy Company. The site is located in the northwest 1/4 of the northeast 1/4 of Section 18, Township 22 South, Range 4 East, Salt Lake Base and Merdian. A copy of Coastal's Warranty Deed is included as Exhibit 1. This location is some 6 miles from the minesite and is within Sevier County. Access frequency would be minimal with waste rock being hauled to the site several times a year. The waste rock will be generated from coal mining operations. It is estimated that approximately 10,000 tons of non-toxic, non-acid forming waste shale, coal, and sandstone per year will be generated. Life of the facility is estimated at 20 years. The design of the disposal area will have to conform to all State and Federal regulations.

The site will have to provide access to dump trucks which will haul the waste rock from the mine to the disposal area. The site will not be used as a sanitary land fill or for disposal of mining related rubbish. Efforts will be made to haul to the site during the week. Waste rock will be contemperously spread and compacted. After a section of the fill site is completed, that segment will be

reclaimed. It is unlikely that any structure will ever be placed on the fill area.

1.2 DISPOSAL SITE

The disposal site is located next to a paved county road that is used for access to the mine. Part of the site has already been disturbed when used as a borrow area for material to repair a slide on the county road in 1981. The site is situated between two natural drainages and will involve minimal disturbance to the existing drainage. The waste rock will be placed adjacent to the embankment of the county road and will be graded to fit in with the natural contour to the extent allowed. Drainage from the waste rock disposal area will be treated with a sediment pond. The drainage from the surrounding undisturbed area will be bypassed with two diversions.

1.3 CONTIGUOUS OWNERS

Coastal's forty acre plot is bordered by private land on all sides. The property owners are shown on Map 1. Table 1.3 gives the addresses of the property owners contiguous to the waste rock disposal site.

TABLE 1.3
ADJACENT PROPERTY OWNERS

Howard & Janet Nielson	180 East 950 North Salina, Utah 84654
Maurice & Therresa Rasmussen	31 South 300 East Salina, Utah 84654
Marlin Sorensen, Jr.	37 North 100 West Salina, Utah 84654
Mount Air Oaks Corp.	37 North 100 West Salina, Utah 84654
Fishlake National Forest U.S. Department of Agriculture	115 East 900 North Richfield, Utah 84701

PART 2: ENVIRONMENTAL RESOURCES

2.1 GENERAL ENVIRONMENTAL RESOURCES SUMMARY

The environmental resources in the waste rock disposal area have been individually studied and are either presented in this document or are addressed in the main body of the M&RP. The Permittee has attempted to provide pertinent and complete reports for each environmental study discipline through the use of independent consultants who are recognized as experts in their individual fields. It is the Permittee's intent that by so doing, the reviewing agencies will have available to them reliable data for their environmental analysis.

The initial geotechnical/hydrological analyses were contracted to Sergent, Hauskins and Beckwith (SHB). Drs. Stanley Welsh, Joseph Murdock, and Sheldon Nelson combined their efforts on the vegetative and soils requirements. Dr. Clyde Pritchett supervised the mammals study, and Dr. Clayton White concentrated on the birds with particular emphasis on the area's raptors. (These wildlife reports cover the general permit area which is adjacent to the proposed disposal site.) An extended opinion covering wildlife use has been provided by the Division of Wildlife Resource and is appended as Exhibit 2. Drs. Welsh, Nelson, Murdock, Pritchett, and White are all associated with the faculty of Brigham Young University. The cultural resource surveys were performed by Archeological-Environmental Research Corporation of Salt Lake City with Dr. Rick Hauck serving as project director. Copies of consultant reports not included previously in the M&RP are incorporated in this document.

Sediment will be controlled by construction of a diversion ditch around the area to be disturbed and through the use of berms and silt fences. The active disposal area will be limited to approximately 2 acres at any given time and will be protected by erosion control devices located in the immediate area. Topsoil will be stored for distribution on newly filled areas. Revegetation on completed fill areas will be accomplished during the first available growing season.

The proposed site contains no springs or perennial streams. Surface flow is limited to runoff from precipitation events and is minimal because of a small upslope drainage area. Surface flow from above the site will be diverted past the disturbed area using diversion ditches and culverts.

The climate of the disposal area is similar to that found at the mine portal. No additional monitoring is proposed.

The applicant will help to prevent, control, and suppress range, forest, and coal fires in the permit area which are not approved by the Division.

2.1.1 Archeological Evaluation

A cultural resources evaluation, conducted by Dr. F.R. Hauck of Archeological-Environmental Research Corporation, resulted in negative findings. A copy of Dr. Hauck's report is attached as Appendix I.

2.1.2 Threatened & Endangered Species

The proposed waste rock disposal site is not known to provide habitat for any threatened or endangered species. A letter from the Regional Resource Analyst of the Division of Wildlife Resources confirming this opinion is included as Exhibit 2. The applicant will promptly report any threatened or endangered species in the permit area, or golden eagles not previously reported, to the Division.

2.2 GEOLOGY

The bedrock, which underlies the site and is exposed immediately to the north and east of the site, consists of massive sandstone and sandy, carbonaceous claystone of the Price River Formation. The Price River Formation is part of the Mesaverde Group which is upper Cretaceous in age. The total thickness of the Price River Formation is about 700 feet, but the thickness below the site has not been determined. Local bedrock dips do not appear to exceed 10 degrees and no major faulting is apparent in the immediate site area. There has been no underground mining beneath the site.

As encountered in the seven boreholes and five backhoe test pits performed on site by SHB, the Price River Formation is overlain by 4 to 30+ feet of unconsolidated alluvial material. An additional borehole to the north of the county road showed 59 feet of alluvial material. This overburden consists of a soft to hard clay sequence with varying amounts of sand and silt. Subordinate units of argillaceous sand are also present in the alluvial deposit. The predominant clay units are normally gray to black in color, medium in plasticity, and firm to hard in consistency.

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2.3 GROUND WATER HYDROLOGY

No free ground water was encountered in the soils overlying the bedrock. Water was encountered in the bedrock formation. Original ground water levels in the observation wells are recorded on the Well Completion Records which are included in Appendix A of the SHB report included as Appendix II. Subsequent ground water level measurements may be found in Table 4.7.2-2. A piezometric map for the area is included as Map 6. Activity at the disposal site will have no impact on the ground water system.

2.4 SURFACE WATER HYDROLOGY

Surface drainage of the immediate site area appears to be good. No existing springs are within the proposed waste rock disposal area; however, some spring activity is present to the north and east of the forty acre parcel of property. A cut section of the county road to the east of the property has experienced some localized, shallow seated instability due to spring seepage in the cut slopes.

Drainage of the area to the north of the proposed fill area is directed by culverts through the county road embankment fills. The culverts are located to the east and west of the proposed disposal area and discharge into channels which naturally isolate the area to be disturbed. Some erosion is evident in the channel below the east culvert. However, at a point approximately half way along the south side of the disposal site, the channel fades into an open grassy area and becomes almost indiscernable. The channel below the west culvert is similarly nearly indiscernable. The lack of channels through this down slope drainage area emphasizes the lack of significant surface flow in the recent past.

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At the time the exploration was made, the surface of the site was firm and the drilling equipment experienced no problems.

The only impact on the surface water hydrology will be that associated with collection of the water from the disturbed area and routing of this water through the sedimentation pond and the routing of water from the undisturbed area around the site. No perennial or intermittent streams pass through the area. Flow is limited to storm and/or snow melt runoff.

2.4.1 Diversion Ditches

Sergent, Hauskins & Beckwith's work on hydrology of the area was of an investigative nature. Subsequent designs of diversions used actual areas and runoff curve numbers that are believed to be more representative of the area. These calculations are included in Appendix III.

Diversion ditches are provided to direct runoff around the disturbed areas and sediment pond. Ditches will convey runoff from the disposal area to the sediment pond. These diversion ditches are shown on Map 2.

The maximum flow resulting from a 10 year, 24 hour storm was used as the design flow for each of the diversions. Ditches No. 1 and 2 conveying runoff to the sediment pond shall be trapezoidal shaped in cross-section. Both ditches have a bottom width of 2 feet and side slopes of 1:1.

For slopes of 5% or less, the depth is one foot. For slopes more than 5% but less than 8%, the depth is 0.8 feet. The depth is 0.7 feet for slopes greater than 8% but less than 20%. This design will carry the 4.42 cfs of runoff expected from the disturbed area with 0.3 feet of freeboard. Rip-rap with a D_{50} of 5 inches is used for ditches with a slope greater than 4%. The rip-rap layer is 12 inches thick underlain by a 6 inch filter blanket of 3/4 inch road base. Design calculations are included in Appendix III.

Undisturbed drainage is routed around the disposal site and sediment pond using Diversions No. 1, 2, and 3 as shown on Map 2. The drainage areas are shown on Map 3.Diversion No. 1 utilizes an existing culvert to convey part of the drainage area across the county road and onto an existing flood plain. This vegetated channel will adequately carry the runoff expected from the 0.19 square mile area. Another culvert will be used to collect the runoff from Area No. 2 and convey it across the county road. The diversion utilizes a vegetated ditch 0.90 feet deep and 19 feet wide of parabolic cross-section. Diversion No. 3 will route road runoff away from the facility. Design calculations for these diversions are included in Appendix III.

To prevent impounding of water on the surface of the active pad area, the pad will be sloped at about 2% to the South and East. The pad will also have a 2 ft high berm around the West and South edges as required by MSHA as a safety barrier. This berm has a slope of about 1v:2h on each of its sides. Piles of waste rock will be placed on the pad such that precipitation can drain between them to the southeast corner. The berm will be breached in the southeast corner and runoff will be diverted into an interception ditch down the slope of the fill. This interception ditch will be trapezoidal in shape with a 2 ft wide bottom and 1v:2h side slopes. The minimum depth will be 0.7 ft to convey the 100 year, 6 hour event with 0.5 ft freeboard. Riprap with a D_{50} of 6 inches will be used to stabilize the channel. Design calculations for this interception ditch are included in Appendix III.

Runoff from the westerly slope of the active pad will be collected in an interception ditch about 20 ft west of the toe of the slope. This ditch will be triangular in cross-section with 1v:2h side slopes. The minimum depth will be 1.0 ft which will allow a 0.5 ft freeboard while conveying the 100 year, 6 hour storm event. Design calculations for this interception ditch are included in Appendix III.

2.4.2 Hydrologic Design Criteria of the Sedimentation Pond

Calculations of hydrologic design criteria are presented in Appendix III. Runoff volumes were calculated using SCS procedures.

The maximum capacity of the proposed sediment pond is 33,360 cubic feet. An ultimate sediment load based on 3 year loading was determined to be 9,148 cubic feet. Sediment volume is based on 0.0697 acre-foot per year for the 7.93 acres of disturbed area. In addition, a 10 year, 24 hour storm on the area would produce 21,792 cubic feet of runoff assuming no infiltration. The total storage required for the reservoir is therefore 30,940 cubic feet.

The additional storage is to allow for detention of a 10-year, 24-hour storm should the pond have water at the beginning of the storm.

The emergency spillway was designed to convey a 25 year, 24 hour flood flow through the pond safely with one foot of freeboard, assuming the pond was full at the beginning of the storm and no routing in the pond. The emergency spillway shall consist of a rip-rap lined ditch of trapezoidal cross-section. The side slopes shall be 3h:1v. The bottom width is 3 feet with a minimum depth of 0.75 feet. Rip-rap and filter blanket shall be in accordance with the recommendations in Appendix III. The crest elevation of the emergency spillway shall be 7890.70 feet.

2.4.3 HYDROLOGIC DESIGN CRITERIA OF THE DECANTING IMPOUNDMENT

Calculations of hydrologic design criteria in accordance with UMC 817.449 are presented in Appendix III. Runoff volumes were calculated using SCS procedures.

The maximum capacity of the decanting impoundment is 5,048 cubic feet. An ultimate sediment load based on 3 year loading was determined to be 654 cubic feet. In addition, a 10 year, 24 hour storm on the area would produce 3,655 cubic feet of runoff assuming no infiltration. The total storage required for the impoundment is therefore, 4309 cubic feet.

The emergency spillway was designed to convey the 25 year, 24 hour flood flow from the sediment pond through the impoundment safely with one foot of freeboard, assuming the pond was full at the beginning of the storm and no routing in the pond. The emergency spillway consists of a rip-rap

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lined ditch of trapezoidal cross-section. The bottom width is 4.6 feet with a depth of 1.5 feet. Rip-rap and filter blanket shall be in accordance with the recommendations in Appendix III. The crest elevation of the impoundment emergency spillway shall be 7878.5 feet.

2.5 HYDROLOGICAL IMPACTS

Beyond those factors discussed in sections 2.3 and 2.4, no hydrological impacts, either surface or underground, are anticipated.

2.6 CLIMATE

The climate at the proposed site is typical of subalpine areas in the central region of Utah. Summer seasons are generally short with considerable variation in temperature. Fall and Spring are erratic in nature with snow precipitation occurring as early as September and as late as June. Snow frequently remains on the ground from November until May.

A limited amount of data is available from a climatological station recently installed at the mine. A summary of these data is presented in Table 2.6.

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Table 2.6

Climatological Data Summary

Year 1987	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temp ° F												
Max	50	50	50	71	73	83	85	83	88	74	51	44
Min	-6	1	17	21	30	39	40	38	35	30	8	-11
Ave High	30	34	39	56	60	74	74	75	70	60	39	29
Ave Low	12	16	20	32	38	47	50	49	43	37	22	13
Precipitation												
Total	1.00	0.71	1.49	0.44	2.45	0.59	2.21	1.38	0.65	1.72	1.86	1.41
# Days .01 in +	11	12	8	6	20	7	11	9	5	7	12	11
Snow Cover												
Max Depth--in	5	6	7.5	4	3	0	0	0	0	0	1	6.5

2.7 VEGETATION

An analysis of the vegetative community at the waste rock disposal site was made by Drs. Welsh and Murdock in 1983. Their measurements included information on cover, productivity and shrub density for the disposal site. An amended copy of this report is included as Appendix IV. The range condition was evaluated by the SCS in 1987. A copy of their evaluation is included as Exhibit 3.

2.8 AQUATIC WILDLIFE RESOURCES

The disposal site contains no perennial or intermittent streams. The only surface flow in the area is in the form of occasional storm runoff. Consequently there has been no analysis made of the aquatic wildlife resources.

2.9 TERRESTRIAL WILDLIFE

The disposal area is adjacent to the area investigated by Drs. Pritchett and White as reported in the M&RP. A further evaluation of the wildlife use of the site has been provided by Wes Shields, Resource Analyst, DWR, Cedar City. A copy of Mr. Shields' report is included as Exhibit 2.

The area is probably used by wintering deer and elk and by several non-game species of birds and mammals. The small area which will be disturbed at the disposal site at any given time will result in minimal disruption to the wildlife community. Revegetation of those areas currently disturbed and the sediment pond water retainage should help mitigate the impact.

Protection of the area wildlife will also be provided by the Applicant not using persistent pesticides unless approved in advance by the Division.

2.10 MAMMALS

Refer to discussion of Section 2.9.

2.11 RAPTORS

The proposed disposal site contains no suitable nesting sites for raptors. The area is probably part of the hunting territory for certain raptor species. (See DWR letter appended as Exhibit 2.)

The impact on the hunting activity of the raptors will be minimal since the area to be disturbed at any given time is small.

2.12 SOILS

Soils surveys were done for different purposes by both the engineering consultant and by a soils specialist. Seven exploratory borings were drilled with truck-mounted equipment to depths of 25 to 51 feet below existing grades at the site. The borings were performed using 6 1/2 inch O.D. hollow stem augers. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings.

In four of the borings, PVC observation wells were installed for the purpose of long term monitoring of the ground water conditions at the site.

In addition, five backhoe test pits were performed at the site to supplement the soil boring program.

The results of the field investigation are presented in Appendix A of the SHB report, which includes a brief description of drilling and sampling equipment and procedures, logs of the test borings, logs of the test pits, and records of the observation well construction details. A site plan showing the boring, test pit, and observation well locations is included in a pocket at the back of the report.

The field investigation was supervised by Paul Kaplan and Donald Curran, engineers with SHB.

Moisture content determinations were made on selected tube samples recovered, and dry densities were determined for selected 2.42 inch diameter open-end drive samples. The results of these tests are shown on the boring logs.

Grain-size analysis, Atterberg limits, and direct shear tests were performed on selected soil samples. The results of these tests are presented in Appendix B of the SHB report along with a brief description of testing procedures.

A soil survey report dated December 22, 1987 is included as Appendix V. A facilities map overlay is provided that shows the outline of the sagebrush-grass vegetative type. Essentially all of the approximately 7.5 acre waste rock disposal site is within that vegetative type. A very small proportion was mapped previously as mountain brush, and about two acres of the site was modified historically as a source of fill materials. There is an existing, revegetated soil stockpile at the east margin of the historic borrow area.

Four soil test pits were dug at the site, within the undisturbed area on 10 December 1987, and five more were dug on 16 December 1987 (to ascertain the adequacy of the first four pits). It was ascertained that the soils in the sagebrush-grass vegetative type are all sufficiently similar

as to not be further divisible into mappable units. There are no rock outcrops within the undisturbed area. Rock outcrops are exposed in the existing borrow area.

The contemporary study of soils at the waste rock disposal site indicate "that this small area is predominated by a single soil type which is classified as Typic Torrifluvents and in land capability class V with limitations due to climate and slope. Surrounding soils have been previously classified as Typic Argixerolls and the soil on the proposed soil site is small enough to have been considered an inclusion on previous soil maps." See the appended soil analysis report for additional details.

A discussion of the soil taxonomic classification availability of topsoil and other related soils discussion may be found in the report prepared by Dr. Sheldon D. Nelson located in Appendix V.

.13 LAND USE

The proposed disposal site is privately owned and is suitable primarily for summer range for cattle although the area has not been used as such in recent years. Some land in the adjacent area is being subdivided as summer home building lots of five acre minimum size. Lot sales have been slow with very few cabins having been constructed in the area.

The proposed disposal site will be visible from a few of the summer home sites, however, the terrain is such that the disposal site is somewhat isolated. The visual impact will be minimized by keeping the disturbed acreage small at any given time and by prompt revegetation of completed fill areas. Equipment activity at the site will be necessary only on an occasional basis. Efforts will be made to use the disposal site during the week, thus avoiding an impact on weekend recreational use.

The visual impact will be only temporary in nature with the site being restored to an approximation of pre-mining conditions at the completion of mining activity.

2.14 COMMUNITY INFRASTRUCTURE AND SOCIOECONOMICS

The waste disposal site will be operated by personnel from the work force as currently proposed. No additional utilities or services will be required. Consequently, there will be no community infrastructure or socioeconomic impacts.

2.15 PRIME FARM LAND INVESTIGATION

The site has no developed water supply suitable for irrigation and is located in an area not considered to be prime farm land. Soil Conservation Service confirmation of this opinion may be found as Exhibit 4.

PART 2: ENVIRONMENTAL RESOURCES

2.1 GENERAL ENVIRONMENTAL RESOURCES SUMMARY

The environmental resources in the waste rock disposal area have been individually studied and are either presented in this document or are addressed in the main body of the M&RP. The Permittee has attempted to provide pertinent and complete reports for each environmental study discipline through the use of independent consultants who are recognized as experts in their individual fields. It is the Permittee's intent that by so doing, the reviewing agencies will have available to them reliable data for their environmental analysis.

The initial geotechnical/hydrological analyses were contracted to Sergent Hauskins and Beckwith (SHB). Drs. Stanley Welsh and Joseph Murdock combined their efforts on the vegetative and soils requirements. Dr. Clyde Pritchett supervised the mammals study, and Dr. Clayton White concentrated on the birds with particular emphasis on the area's raptors. (These wildlife reports cover the general permit area which is adjacent to the proposed disposal site.) An extended opinion covering wildlife use has been provided by the Division of Wildlife Resource and is appended to Section 2.1.2. Drs. Welsh, Murdock, Pritchett, and White are all associated with the faculty of Brigham Young University. The cultural resource surveys were performed by Archeological-Environmental Research Corporation of Salt Lake City with Dr. Rick Hauck serving as project director. Copies of consultant reports not included previously in the M&RP are incorporated in this document.

Sediment will be controlled by construction of a diversion ditch around the area to be disturbed and through the use of berms and silt fences. The active disposal area will be limited to approximately 2 acres at any given time and will be protected by erosion control devices located in the immediate area. Topsoil will be temporarily stored for distribution on newly filled areas. Revegetation on completed portions will be accomplished during the first available growing season.

The proposed site contains no springs or perennial streams. Surface flow is limited to runoff from precipitation events and is minimal because of a small upslope drainage area. Surface flow from above the site will be diverted past the disturbed area using diversion ditches and culverts. Groundwater levels and subsurface flows have not been extensively studied since there will be no impact on these aquifers.

The climate of the disposal area is similar to that found at the mine portal. No additional monitoring is proposed.

2.1.1 Archeological Evaluation

A cultural resources evaluation, conducted by Dr. F.R. Hauck of Archeological-Environmental Research Corporation, resulted in negative findings. A copy of Dr. Hauck's report is attached as Appendix I.

2.1.2 Threatened & Endangered Species

The proposed waste rock disposal site is not known to provide habitat for any threatened or endangered species. A letter from the Regional Resource Analyst of the Division of Wildlife Resources confirming this opinion is included as Exhibit 2.

2.2 GEOLOGY

The bedrock, which underlies the site and is exposed immediately to the north and east of the site, consists of massive sandstone and sandy, carbonaceous claystone of the Price River Formation. The Price River Formation is part of the Mesaverde Group which is upper Cretaceous in age. The total thickness of the Price River Formation is about 700 feet, but the thickness below the site has not been determined. Local bedrock dips do not appear to exceed 10 degrees and no major faulting is apparent in the immediate site area. There has been no underground mining beneath the site.

As encountered in the seven boreholes and five backhoe test pits performed on site by SHB, the Price River Formation is overlain by 4 to 30+ feet of unconsolidated alluvial material. This overburden consists of a soft to hard clay sequence with varying amounts of sand and silt. Subordinate units of argillaceous sand are also present in the alluvail deposit. The predominant clay units are normally gray to black in color, medium in plasticity, and firm to hard in consistency.

2.3 GROUND WATER HYDROLOGY

No free groundwater was encountered in the soils overlying the bedrock. Water was encountered in the bedrock formation. Groundwater levels in the observation wells are recorded on the Well Completion Records which are included in Appendix A of the SHB report included as Appendix II. Activity at the disposal site will have no impact on the groundwater system.

2.4 SURFACE WATER HYDROLOGY

Surface drainage of the immediate site area appears to be good. No existing springs are within the proposed waste rock disposal area. Some spring activity is present to the north and east of the forty acre parcel of property. A cut section of the county road to the east of the property has experienced some localized, shallow seated instability due to spring seepage in the cut slopes.

Drainage of the area to the north of the proposed fill area is directed by culverts through the county road embankment fills. The culverts are located to the east and west of the proposed disposal area and discharge into channels which naturally isolate the area to be disturbed. Some erosion is evident in the channel below the east culvert. However, at a point approximately half way along the south side of the disposal site, the channel fades into an open grassy area and becomes almost indiscernable. The channel below the west culvert is similarly nearly indiscernable. The lack of channels through this down slope drainage area emphasizes the lack of significant surface flow in the recent past.

At the time the exploration was made, the surface of the site was firm and the drilling equipment experienced no problems.

The only impact on the surface water hydrology will be that associated with collection of the water from the disturbed area and routing of this water through the sedimentation pond and the routing of water from the undisturbed area around the site. No perennial or intermittent streams pass through the area. Flow is limited to storm and/or snow melt runoff.

2.4.1 Diversion Ditches

Sergent Hauskins & Beckwith's work on hydrology of the area was of an investigative nature. Subsequent designs of diversions used actual areas and runoff curve numbers that are believed to be more representative of the area. These calculations are included in Appendix III.

Diversion ditches shall be provided to route runoff from Areas No. 1 and No. 2, as shown on Map 2, around the disturbed areas and sediment pond. Ditches will convey runoff from the road and disposal area to the sediment pond.

The maximum flow resulting from a 10 year, 24 hour storm was used as the design flow for each of the diversions. Ditches No. 1 and 2 conveying runoff to the sediment pond shall be V shaped in cross-section. The limiting velocity approach was used in their design with a limiting velocity of 3.5 fps. Both ditches will have a width of 3 feet and

a depth of 0.75 feet with side slopes of 2:1. This design will carry the 0.75 cfs of runoff expected from the disturbed area with 0.3 feet of freeboard. Ditch No. 2 will utilize the existing natural drainage wherever it is adequate. Design calculations are included in Appendix III.

Undisturbed drainage will be routed around the disposal site and sediment pond using Diversion No. 1 and 2 as shown on Map 2. The drainage areas are shown on Map 3. Diversion No. 1 utilizes an existing culvert which will be lengthened to convey part of the drainage area across the county road and onto an existing flood plain. This vegetated channel will adequately carry the 2.96 cfs of runoff expected from the 0.17 square mile area. Another culvert will be used to collect the 2.6 cfs runoff from Area No. 2 and convey it across the county road. The diversion will utilize a vegetated ditch 0.9 feet deep and 4.24 feet wide of triangular cross-section with a side-slope to depth ratio of 2.36. Design calculations for these diversions are included in Appendix III.

2.4.2 Hydrologic Design Criteria of the Sedimentation Pond

Calculations of hydrologic design criteria are presented in Appendix D of the SHB report. Although the SHB sedimentation pond is designed for more runoff than is expected from the waste rock disposal area, SUFCo has chosen to use this design. The pond has been moved closer to the waste rock disposal area than in the SHB original work. This requires that the elevations be adjusted. Runoff volumes were calculated using SCS procedures and flow peaks were calculated using the rational method.

The maximum capacity of the proposed sediment pond is 52,000 cubic feet. An ultimate sediment load was determined to be 17,000 cubic feet. Sediment volume is based on 0.1 acre-foot for each acre of disturbed area and 1 acre foot per year for each square mile of undisturbed area. In addition, a 10 year, 24 hour storm on the area would produce 24,350 cubic feet of runoff. The total storage required for the reservoir is therefore 41,350 cubic feet. The additional storage is to allow for unforeseen site conditions.

The emergency spillway was designed to convey a 25 year, 24 hour flood flow through the pond safely with one foot of freeboard, assuming the pond was full at the beginning of the storm and no routing in the pond. The emergency spillway shall consist of a rip-rap lined ditch with a V shaped cross-section. The side slopes shall be 3h:1v and have a minimum depth of 2.0 feet. Rip-rap and filter fabric shall be in accordance with the recommendations in Section 5.3.3 of the SHB report. The crest elevation of the spillway shall be 7891.2 feet.

2.5 HYDROLOGICAL IMPACTS

Beyond those factors discussed in sections 2.3 and 2.4, no hydrological impacts, either surface or underground, are anticipated.

2.6 CLIMATE

The climate at the proposed disposal site is typical of subalpine areas in the central region of Utah. Summer seasons are generally short with considerable variation in temperature. Fall and Spring are erratic in nature with snow precipitation occurring as early as September and as late as June. Snow frequently remains on the ground from November until May.

A limited amount of data is available from a climatological station recently installed at the mine. A summary of these data is presented in Table 2.6.

Table 2.6
Climatological Data Summary

Year 1987	JAN	FEB	MAR	APR	MAY
Temp F°					
Max	50	50	50	71	73
Min	-6	1	17	21	30
Ave High	30	34	39	56	60
Ave Low	12	16	20	32	38
Precipitation					
Total	1.00	0.71	1.49	0.44	2.45
Days .01 in +	11	12	8	6	20
Snow Cover					
Max Depth--in	5	6	7.5	4	3

2.7 VEGETATION

An analysis of the vegetative community at the waste rock disposal site was made by Drs. Welsh and Murdock in 1983. Their measurements included information on cover, productivity and shrub density for the disposal site and an adjacent reference area. A complete copy of this report is included as Appendix IV.

2.8 AQUATIC WILDLIFE RESOURCES

The disposal site contains no perennial or intermittent streams. The only surface flow in the area is in the form of occasional storm runoff. Consequently there has been no analysis made of the aquatic wildlife resources.

2.9 TERRESTRIAL WILDLIFE

The disposal area is adjacent to the area investigated by Drs. Pritchett and White as reported in the M&RP. A further evaluation of the wildlife use of the site has been provided by Wes Shields, Resource Analyst, DWR, Cedar City. A copy of Mr. Shields' report is included as Exhibit 2.

The area is probably used by wintering deer and elk and by several non-game species of birds and mammals. The small area which will be disturbed at the disposal site at any given time will result in minimal disruption to the wildlife community. Revegetation of those areas currently disturbed and the sediment pond water retainage should help mitigate the impact.

2.10 MAMMALS

Refer to discussion of Section 2.9.

2.11 RAPTORS

The proposed disposal site contains no suitable nesting sites for raptors. The area is probably part of the hunting territory for certain raptor species. (See DWR letter appended as Exhibit 2.)

The impact on the hunting activity of the raptors will be minimal since the area to be disturbed at any given time is small.

2.12 SOILS

Seven exploratory borings were drilled with truck-mounted equipment to depths of 25 to 51 feet below existing grades at the site. The borings were performed using 6 1/2 inch O.D. hollow stem augers. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings.

In four of the borings, PVC observation wells were installed for the purpose of long term monitoring of the groundwater conditions at the site.

In addition, five backhoe test pits were performed at the site to supplement the soil boring program.

The results of the field investigation are presented in Appendix A of the SHB report, which includes a brief description of drilling and sampling equipment and procedures, logs of the test borings, logs of the test pits, and records of the observation well construction details. A site plan showing the boring, test pit, and observation well locations is included in a pocket at the back of the report.

The field investigation was supervised by Paul Kaplan and Donald Curran, engineers with SHB.

Moisture content determinations were made on selected tube samples recovered, and dry densities were determined for selected 2.42 inch diameter open-end drive samples. The results of these tests are shown on the boring logs.

Grain-size analysis, Atterberg limits, and direct shear tests were performed on selected soil samples. The results of these tests are presented in Appendix B of the SHB report along with a brief description of testing procedures.

A discussion of the soil taxonomic classification availability of topsoil and other related soils discussion may be found in the report prepared by Drs. Welsh and Murdock located in Appendix IV.

2.13 LAND USE

The proposed disposal site is privately owned and is suitable primarily for summer range for cattle although the area has not been used as such in recent years. Land in the general area is being subdivided as summer home build- ing lots of five acre minimum size. Lot sales have been slow with very few cabins having been constructed in the area.

The proposed disposal site will be visible from a few of the summer home sites, however, the terrain is such that the disposal site is somewhat isolated. The visual impact will be minimized by keeping the disturbed acreage small at any given time and by prompt revegetation of completed fill areas. Equipment activity at the site will be neces- sary only on an occassional basis. Efforts will be made to use the disposal site during the week, thus avoiding an impact on weekend recreational use.

The visual impact will be only temporary in nature with the site being restored to an approximation of pre-mining conditions at the completion of mining activity.

2.14 COMMUNITY INFRASTRUCTURE AND SOCIOECONOMICS

The waste disposal site will be operated by personnel from the work force as currently proposed. No additional utilities or services will be required. Consequently, there will be no community infrastructure or socioeconomic impacts.

2.15 PRIME FARM LAND INVESTIGATION

The site has no developed water supply suitable for irrigation and is located at an elevation of approximately 7,900 feet which is considerably above prime farm land elevation. Consequently no prime farm land is involved.

0.3 feet of freeboard. Rip-rap with a D_{50} of 5 inches will be used for ditches with a slope greater than 4%. The rip-rap layer shall be 12 inches thick underlain by a 6 inch filter blanket of 3/4 inch road base. A filter fabric may be utilized under the road base. Design calculations are included in Appendix III.

Undisturbed drainage will be routed around the disposal site and sediment pond using Diversions No. 1, 2, and 3 as shown on Map 2. The drainage areas are shown on Map 3. Diversion No. 1 utilizes a diversion dike and spreader ditch to direct flow from the existing intermittent channel out onto an existing flood plain. This vegetated channel will adequately carry the 3.31 cfs of runoff expected from the 0.19 square mile area. Another culvert will be used to collect the 2.4 cfs runoff from Area No. 2 and convey it across the county road. The diversion will utilize a vegetated ditch 0.95 feet deep and 3.94 feet wide of parabolic cross-section. Diversion No. 3 will route road runoff away from the facility. Design calculations for these diversions are included in Appendix III.

2.4.2 Hydrologic Design Criteria of the Sedimentation Pond

Calculations of hydrologic design criteria are presented in Appendix III. Runoff volumes were calculated using SCS procedures.

The maximum capacity of the proposed sediment pond is 33,360 cubic feet. An ultimate sediment load based on 3 year loading was determined to be 9,148 cubic feet. Sediment volume is based on 0.0697 acre-foot per year for the 7.93 acres of disturbed area. In addition, a 10 year, 24 hour storm on the area would produce 21,792 cubic feet of runoff assuming no infiltration. The total storage required for the reservoir is therefore 30,940 cubic feet.

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The additional storage is to allow for detention of a 10-year, 24-hour storm should the pond have water at the beginning of the storm.

The emergency spillway was designed to convey a 25 year, 24 hour flood flow through the pond safely with one foot of freeboard, assuming the pond was full at the beginning of the storm and no routing in the pond. The emergency spillway shall consist of a rip-rap lined ditch of trapezoidal cross-section. The side slopes shall be 3h:1v. The bottom width is 3 feet with a minimum depth of 0.75 feet. Rip-rap and filter blanket shall be in accordance with the recommendations in Appendix III. The crest elevation of the emergency spillway shall be 7889.73 feet.

2.5 HYDROLOGICAL IMPACTS

Beyond those factors discussed in sections 2.3 and 2.4, no hydrological impacts, either surface or underground, are anticipated.

2.6 CLIMATE

The climate at the proposed disposal site is typical of subalpine areas in the central region of Utah. Summer seasons are generally short with considerable variation in temperature. Fall and Spring are erratic in nature with snow precipitation occurring as early as September and as late as June. Snow frequently remains on the ground from November until May.

A limited amount of data is available from a climatological station recently installed at the mine. A summary of these data is presented in Table 2.6.

PART 3: OPERATION PLAN

3.1 DEVELOPMENT PLAN

3.1.1 Runoff Control

Based on the size, configuration, and open graded structure of the waste rock fill and its location at the site, no underdrains or rock core chimney drains will be required. There were no springs or seeps within the proposed fill area at the time of the investigation which would require special treatment.

All surface precipitation falling directly on and infiltrating the underground development waste fill shall be channelled to a sedimentation pond located down gradient from the toe of the disposal area fill. The active pad area will have a berm constructed around the outside edge about 2 ft high to comply with MSHA requirements. This active pad will be slope at about 2% to the east and south. Thus precipitation falling on the pad will drain to the southeast corner where it will be routed down the slope of the fill in an interception ditch with a trapezoidal cross section. The bottom width of the ditch will be 2 ft with 1v:2h side slopes. Riprap with a D_{50} of 6 inches will be used to line the ditch. This ditch will be a minimum of 0.7 ft deep, such that it can convey the 100 year, 6 hour event with 0.5 ft freeboard. This configuragion will not allow any impounding of water on the surface of the fill. Another interception ditch will be cut about 20 ft to the west of the active fill slope. This ditch will have a triangular cross section with 1v:2h side slopes with a minimum depth of 0.9 ft. This interception ditch will route 100 year, 6 hour runoff to Ditch No. 2 which empties into the sedimentation pond. Designs for these temporary interception ditches are in Appendix III, Engineering Calculations. The sedimentation pond is designed to handle the 10 year, 24 hour precipitation event. Design criteria for the sedimentation pond are presented in Section 2.4.2.

All surface drainage from the areas above the site should be diverted around the disposal area from the

point where it enters the site through the roadway embankment culverts. Surface drainage from the county road above
the site must be controlled by a shoulder ditch and diverted away from the fill area. Design criteria for the site diversion ditches are presented in Section 2.4.1

3.1.2 Site Preparation

Prior to the placement of any underground development waste, all vegetative cover shall be removed from the site. After removal of the vegetation, the topsoil shall be removed, stockpiled, and properly protected for future reclamation purposes. It is estimated that approximately 24 inches of topsoil will removed and stockpiled for future use.

The upper 9 inches of natural soils beneath cut surfaces and in the area to receive development waste shall be scarified and recompacted to at least 95 percent of the maximum dry density as determined by ASTM D1557 procedures. Moisture contents during compaction shall be maintained within ±2 percent of the optimum moisture content for the soil as determined by ASTM D1557.

3.1.3 Stability of Fill

Static and pseudostatic stability analysis were performed on the rockfill by SHB assuming a critical surface propa- gating through both the in-situ soils and the fill, as well as through the fill alone. A maximum design embankment height of 20 feet was considered. Estimated strength parameters for the rock fill and in-situ soils are shown on the stability calculations sheets in Appendix C of the SHB report. Due to the open graded nature of the fill material, no pore pressure was assumed in the waste rock in the stability analysis.

The analyses performed by SHB indicate the likely deformation of the embankment structure during a seismic event would be sloughing of surface material. Deep seated deformations would be a maximum of a few inches.

Case history data indicates stability of rolled earth dams bearing on relatively stiff foundations have withstood extremely strong shaking ranging from 0.35g to 0.8g from earthquakes having magnitudes as large as 8.25. These data provide high confidence in the stability of the rockfill under similar extreme conditions.

A slope stability calculation using the fill configuration shown on Map 2 is included in Appendix III. The slope safety factor is 2.62. This indicates that the fill will be very stable.

3.1.4 Waste Rock Fill Construction Criteria

The waste rock generated at the mine at this time consists of a black to gray shale with some sandstone. Plasticity index, slake durability tests, and point load index tests performed on the present waste rock indicate it to be a sound, durable rock. It is anticipated that the waste rock will be flat, elongated pieces with a maximum size of 12 to 18 inches. The gradation of this material will most likely be coarse and poorly graded with a small percentage of sand size or smaller material.

Atterberg limits, slake durability, and point load index tests were performed on samples of waste rock from the mine. The results of these tests are also presented in Appendix B of the SHB report. If the characteristics of the waste rock change at a future time, the design of the fill should be reviewed for possible alterations. Based on the life of the facility, the amount of waste produced yearly and the proposed plan area to be covered, the maximum depth of the fill is estimated at 30 feet.

Non-coal waste will not be deposited at the waste rock disposal site. Final disposal of non-coal wastes shall continue to be in an approved sanitary land fill. Durable rock type construction materials such as cinder block, however, will be deposited at the disposal site.

Any slide or other damamge at the disposal site which may have a potential adverse affect on public property, health, safety, or the environment will be reported to the Division by the fastest available means and will be remediated in compliance with Division instructions.

3.1.5 Acid and Toxic Forming Materials

Based on preliminary analyses of material similar to that which will be placed in the waste rock disposal site, no acid forming problems are anticipated. There is a potential for borderline toxicity problems from boron and selenium. Samples of the waste material will be collected quarterly when the site is receiving material and will be analyzed for acid or toxic forming potential. Should a problem be identified, a mitigation plan will be prepared and submitted to the Division for approval within 30 days of receipt of the analysis. All identified potential acid or toxic forming materials will be buried within 30 days after the material is first exposed on the minesite.

Copies of laboratory reports on toxicity/acid-base accountability from representative waste samples are included as Exhibit 5.

3.1.6 Subsoil Stockpile

Excess subsoil material from the minesite is stockpiled at the Waste Rock Disposal Site for possible use during final reclamation of SUFCo minesite facilities. The location of the subsoil material is shown on Map 2. Total acreage of the subsoil stockpile and associated topsoil pile is 0.51 acres. Approximately 4,500 cubic yards of subsoil material is stockpiled at the site. The associated topsoil pile contains about 1,100 cubic yards. The top 24 inches of soil material was removed from the subsoil stockpile area as described in Section 3.1.2, Site Preparation. This topsoil was stored along the westerly boundary of the subsoil stockpile as shown on Map 2. Topsoil handling procedures complied with those described in Section 3.2.~~3~~4, Topsoil Handling. This topsoil stockpile will be stored and seeded using the grasses and forbes of the standard seed mix, Table 4.6.1-1. When the subsoil is removed the topsoil will be redistributed and the area reclaimed and seeded in accordance with sections 4.5 and 4.6.

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Subsoil material was placed in 2-3 ft. lifts using dump trucks and a D-7 Cat dozer. Exterior slopes of the subsoil stockpile are 1:1.25v:h. At this slope the material will be stable as placed. The subsoil stockpile is to be seeded using the grasses and forbes of the standard seed mix, Table 4.6.1-1. This subsoil may be taken to the minesite and used for fill material during final reclamation of the minesite.

Run off from the subsoil and associated topsoil stockpile is collected and routed through a silt fence treatment located on the southeast corner as shown on Map 2. The total acreage of the two stockpiles is 0.51 acres. Alternate sediment control measures are in place as described above. This area is classified as an approved Alternate Sediment Control Area (ASCA).

3.2 COMPONENTS OF OPERATION

3.2.1 Sedimentation Pond

A sedimentation pond shall be constructed down gradient from the rock fill area to control sediment removed from the disturbed areas by surface runoff in accordance with UMC 817.46. The pond shall be constructed prior to disturbing any other areas of the site. It must remain in place until the waste rock disposal area has been completely restored.

The pond shall consist of an excavated storage basin. Suitable material removed from the excavation shall be used to construct an embankment on the downstream perimeter of the excavation to yield a maximum storage depth in the pond of 5.70 feet.

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The embankment shall have a top width of 10 feet, a mimimum height of 6.8 feet with exterior side slopes of 2.5h:1v. The bottom of the pond will be constructed at an elevation of 7885.00 feet.

In accordance with Section 73-5-12 of the Utah Code Annotated 1953, before commencing construction of the sediment pond for the project, written notice should be given to the State Engineer, Division of Water Rights. The following information for the low height, small capacity, low hazard impoundment needs to be included in the submittal:

1) Name of the impoundment.

2) General location with reference to section, township, and range.

3) Approximate capacity.

4) Height of the embankment.

5) Plans and specifications for construction.

The embankment and excavated pond area shall be grubbed of all organic material and the topsoil removed and stored for future use. It is estimated that 24 inches of topsoil will have to be removed from the area.

The top 9 inches of the grubbed and stripped area for embankment construction shall be scarified and recompacted to 90 percent of the maximum dry density as determined by ASTM D1557 procedures. Moisture content during compaction should be maintained at -1 to +3 percent of the optimum as determined by ASTM D1557.

Embankment fill material shall be placed in horizontal lifts not exceeding nine inches in thickness prior to compaction. Embankment material shall be compacted to 90 percent of the maximum dry density as determined by ASTM D1557.

Embankment material shall be free of organic material. It shall have a plasticity index as determined by ASTM D423 and D424 of not less than five. Waste rock shall not be used for embankment fill for the settling pond.

The embankment shall be constructed with interior and exterior slopes of 2.5h:1v. The top of the embankment shall be constructed at an elevation 7892.14 feet, providing 1.0 foot of freeboard above the maximum water surface and five percent for settlement. To prevent erosion, the exterior slopes should be vegetated and the interior slopes covered with rip-rap and filter fabric in accordance with the recommendation presented in Section 5.3.3 of the SHB report.

The principal spillway shall consist of a 12 inch diameter corrugated metal pipe (CMP) with the inlet at an elevation of 7889.5 feet. A 36 inch CMP skimmer shall be placed around the inlet as shown on Section E-E' of Figure 1.

The CMP shall be placed at an average gradient of 4.4 percent through the embankment. Structural fill within 2.0 feet of the CMP shall be hand compacted to a dry density of at least 90 percent of ASTM D1557 at a moisture content of -1 to +3 percent of optimum. During placement and compaction of the fill along the CMP, the pipe should be preloaded to prevent it from pushing up and out of alignment. Preload should be maintained until at least 1/2 the pipe diameter has been placed and compacted. Two anti-seep collars with minimum dimensions of three feet high by three feet wide shall be placed around the CMP as shown in Figure 1. The anti-seep collars shall have water-tight connections to the CMP.

At the outlet of the principal spillway, there shall be a rip-rap apron as shown on Figure 1 to prevent damage to the downstream embankment slope.

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Rip-rap shall conform to the following gradation:

Size, Inches	Percent Passing
18	100
9	45-35
4	15-0

Rip-rap shall be hard, durable, and free from rocks having a maximum dimension three or more times greater than the minimum dimension of the particle.

Prior to rip-rap placement, a filter fabric such as Phillips 66 SUPAC 5NP, Mirafi 140N, Dupont TYPAR 3401 or an approved equivalent, may be placed on the prepared soil surface to prevent erosion and undermining of the rip-rap. If mechanical equipment is used to place rip-rap, the stones should be dropped from a height of no more than one foot to prevent puncturing of the fabric. A sand or 3/4 inch road base blanket could also be placed over the fabric to protect it from punctures during rip-rap placement.

3.2.2 Operating Pond Requirements

The sediment pond provides capacity in excess of requirements with present project conditions. The principle maintenance requirement will be sediment removal. When the sediment storage area is 60 percent full, which is at an average elevation of 7886.00 feet, sediment must be removed from the pond.

3.2.3 Decanting Impoundment

A decanting impoundment shall be constructed down gradient from the sedimentation pond in accordance with UMC 817.49 to be used for decanting of the sediment pond during sediment removal. It must remain in place until the waste rock disposal area has been completely restored.

The impoundment shall consist of an excavated storage basin. Suitable material removed from the excavation shall be used to construct an embankment on the downstream perimeter of the excavation to yield a maximum storage depth in the impoundment of 2.5 feet.

The top of the embankment shall have a top width of 8 feet and will be constructed at an elevation of 7880.00 feet, providing 1.0 feet of freeboard above the maximum water surface and five percent for settlement with interior and exterior side slopes of 2.5h:1v. The bottom of the impoundment will be constructed at an elevation of 7876.00 feet.

The embankment and excavated impoundment area shall be grubbed of all organic material and the topsoil removed and stored for future use. It is estimated that 24 inches of topsoil will have to be removed from the area.

The top 9 inches of the grubbed and stripped area for embankment construction shall be scarified and recompacted to 90 percent of the maximum dry density as determined by ASTM D1557 procedures. Moisture content during compaction should be maintained at -1 to +3 percent of the optimum as determined by ASTM D1557.

Embankment fill material shall be placed in horizontal lifts not exceeding nine inches in thickness prior to compaction. Embankment material shall be compacted to 90 percent of the maximum dry density as determined by ASTM D1557.

Embankment material shall be free of organic material. It shall have a plasticity index as determined by ASTM D423 and D424 of not less than five. Waste rock shall not be used for embankment fill for the impoundment.

To prevent erosion, the interior and exterior slopes should be vegetated in accordance with the recommendation presented in Section 5.3.3 of the SHB report.

Rip-rap shall conform to the following gradation:

Size, Inches	Percent Passing
18	100
9	45-35
4	15-0

Rip-rap shall be hard, durable, and free from rocks having a maximum dimension three or more times greater than the minimum dimension of the particle.

Prior to rip-rap placement, a filter fabric such as Phillips 66 SUPAC 5NP, Mirafi 140N, Dupont TYPAR 3401 or an approved equivalent, may be placed on the prepared soil surface to prevent erosion and undermining of the rip-rap. If mechanical equipment is used to place rip-rap, the stones should be dropped from a height of no more than one foot to prevent puncturing of the fabric. A sand or 3/4 inch road base blanket could also be placed over the fabric to protect it from punctures during rip-rap placement.

3.2.4 Topsoil Handling

After vegetative matter has been removed from the site, topsoil shall be removed and stockpiled, and properly protected for future reclamation purposes. The topsoil storage piles will be located on site and will be protected as necessary with silt fences to help prevent erosion of the topsoil. The topsoil that is expected to be stored for less than two years, will not be revegetated.

The sediment pond topsoil stockpile will be revegetated with the grasses and forbs of the standard seed mix to help control erosion. A berm that will contain a 10 year, 24 hour precipitation event will be built around the sediment pond topsoil pile. This stockpile will have runoff controlled by alternate sediment controls as described above. This stockpile is designated as an Alternate Sediment Control Area (ASCA).

Two additional soil stockpile storage areas will be established in a portion of the waste rock disposal area away from the areas of initial use.

For reclamation purposes it is proposed that the top 45 inches should be removed for stockpiling. Samples for lab analysis will be collected from the mixture in the stockpile. The soil pits sampled demonstrate an A horizon about 4 inches in thickness underlain by 12-14 inches of stratified C horizon material. Below that is a prominent buried A horizon. Present vegetation indicates that this is a very fertile soil on a slightly eroded landscape but present conditions suggest that this has been a stable landscape for several decades with slow runoff but which is subject to periods of erosional deposition during high storm runoff events. Present erosion hazard is slight (Class 1) with existing vegetation but could be moderate to severe if vegetation is removed. This soil is moderately well drained, has moderate permeability and medium available water within 3 feet but has low water holding capacity within the C horizon material from 4-18 inches. Because there is a prominent buried A horizon starting at 16-20 inches, with excellent chemical and physical properties for plant growth, this material will be mixed with the top 18 inches of soil and will make a better plant growth medium than the surficial material alone.

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The initial lift of waste material will be covered by topsoil from the adjacent existing topsoil stockpile. Topsoil from the second lift area will be placed in long term storage in the northwest stockpile. Subsequent lifts will be covered with topsoil removed from the succeeding lift area. Sediment pond area topsoil will be placed in long term storage in the stockpile site located immediately east of the sediment pond.

Topsoil removal will be primarily by front-end loader. The volume of topsoil removed will be monitored by a grid stake method.

The 45 inches of available topsoil is more than adequate for revegetation purposes. Consequently, the topsoil will be redistributed to a minimum depth of 30 inches with sufficient surplus placed in the long term storage stockpiles to ensure the same minimum topsoil depth on the final lift and 12 inches over the sedimentation pond.

3.2.5 Methods of Waste Transport

Waste rock will be loaded into dump trucks at the minesite using a front-end loader. The trucks will transport the waste rock 6.4 miles to the disposal site. Trucks will not be overloaded. Because of the steep uphill grade and damp nature of the waste rock any wind losses will be minimal. If any spillage should occur in route to the disposal site, it will be cleaned up and transported to the disposal site as soon as practical.

Haulage to the disposal site will be on an intermittent basis. In all likelihood, the site will not be used more than five times per year. Haulage and compaction activities will be scheduled during the week whenever possible. Entrance to the waste rock disposal site will be as shown on Map 4.

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3.2.6 Methods of Waste Placement

The waste rock material shall be placed in horizontal lifts not to exceed three feet in thickness. The material shall be dumped from the haul trucks in such a manner that any precipitation falling on the piles can drain off the pad. The active pad area will be sloped at approximately 2% to the south and east to promote drainage of precipitation off the pad area. An interception ditch will be routed down the slope of the fill from the southeast corner of the active pad to the base of the fill where runoff will be collected by Ditch No. 2. This interception ditch will be extended up the slope as each lift is completed. The waste rock material shall be reworked with suitable sized, compaction equipment which has a push blade suitable for moving the material and leveling the lifts. When the material is dry moisture will be added as required by the Air Quality Approval Order. This method will assist in achieving desired densities and prevent the formation of large voids. Additional compaction of each lift should be accomplished by routing the loaded trucks in a pattern over the lift surface in such a manner as to cover the entire area uniformly.

Loads of noncemented, soft shale, clay spoil, or fine grained material shall be mixed with coarser graded loads in a controlled manner to limit concentrations of fine materials in the fill. This is particularly true for sediment pond waste either from the minesite pond or the adjacent pond.

Due to the anticipated coarse, open graded nature of the waste rock material, most quality control work for the fill will have to be on a visual basis. Conventional in-place density tests will not give reliable results under these circumstances.

All intermittent construction slopes and the final exterior slopes of the fill should not be steeper than 2h:1v. For reclamation purposes, a final exterior slope of 3h:1v may facilitate reseeding of the area.

Final slopes of the top surface of the waste rock area will be contoured to blend into the natural contour of the area. The final fill slope will be terraced on 20 feet elevation increments as shownin Map 2. These terraces will be about 10 feet wide with a V shaped ditch near the center placed on a 1-2% grade draining towards diversion Ditch No. 2. The ditch will be 1 foot deep with 1.5h:1v sides.

3.2.7 Signs and Markers

The site will be properly posted with signs in accordance with UMC 817.11.

The extent of the disturbed area will be marked with delimiters. The topsoil storage piles will be labeled as such.

3.2.8 Inspections

In accordance with UMC 817.71, the sediment pond, diversion ditches, and waste rock fill shall be inspected on at least a quarterly basis throughout construction by a qualified engineer. The sedimentation pond will be inspected and certified in accordance with the requirements of UMC 817.46(r). Reports are to be provided to the mine office and the Utah Division of Oil, Gas and Mining as to compliance with the project specifications.

3.3 TIMING OF OPERATION

Since the proposed waste rock disposal area is relatively small and relatively small volumes of fill are placed annually, the fill will be constructed in segments. The 200 feet wide strips will be placed beginning along the southern boundary and extend between the drainage diversion ditches. The eastern half of the disposal area will be completed first. Map 4 shows the areas that would be completed based on a waste rock volume of 10,000 tons per year. It should be noted that the active fill area will extend beyond the area shown for each year. This is best seen in cross-section G-G' of Figure 2 which shows the active fill areas in relation to the reclaimed area, topsoil removal area, and undisturbed area.

3.4 AREA AFFECTED BY EACH PHASE OF OPERATION

The eastern half of the waste rock disposal site will be built up first. Approximately 4.5 acres will be disturbed. Once the eastern portion is to design height, the fill will be extended to the western boundary by extending the fill in segments. As each segment of the fill is brought to final design height, it will be contoured to the approximate contours shown on Map 2. Once this has been accomplished, topsoil will be distributed and revegetation will proceed as indicated in the Revegetation Plan contained in Section 4.6.

3.5 MAJOR EQUIPMENT LIST

The waste rock will be loaded at the mine by a front-end loader, such as a 988 Cat. Transport to the disposal site will be by dump trucks. Two types may be utilized, 25 ton end-dumps or 40 ton bottom-dumps. The waste rock will be spread and compacted by a self powered compactor of suitable size, a dozer with a towed compactor of a suitable size, or with a large front-end loader such as a 988 Cat.

PART 4:

RECLAMATION PLAN

4.1 INTRODUCTION

The operation of the waste rock disposal site is designed for minimal areal disturbance at any given time. The waste material will be placed in compacted lifts and will be covered with topsoil and revegetated in the first available growing season following completion. Routes required for access to active disposal areas will be revegetated as soon as practical. The final contours will be as shown on Map 2.

4.2 TIME TABLE

The waste rock disposal site will be used on an infrequent basis as required to dispose of rock generated during mining. The fill area will eventually encompass about 8 acres and contain an estimated 204,700 tons of waste rock. Because of the irregularity of use, the fill will be constructed in segments envisioned to be about 300 feet long by 150 feet wide. As segments are complete, they will be graded and vegetated as set forth in Sections 4.4-4.6. Final grading, topsoil application, seeding and other revegetation activities will be done in the Fall, preferably during late September or early October.

The fill volume is estimated at 10,000 tons or 8,200 cubic yards per year. At this projected rate, once the fill bench-slope configuration is established about 0.5 acres should be filled and reclaimed each year. The fill is expected to be completed in 2008.

After vegetation and monitoring requirements have been fulfilled, the sediment pond will be leveled. This is expected to occur in 2018. This Phase II reclamation will consist of dozing the embankment into the pond and re-establishing the original contour as shown on Map 5.

Topsoil will be placed over the area from the dedicated stockpile prior to reseeding according to Section 4.6. The monitoring bore holes will also be closed as part of the Phase II reclamation. The shallow pipes will be pulled from the ground and the wells buried. These well areas will then be reseeded by hand broadcasting and raking.

4.3 COST ESTIMATE FOR PERFORMANCE BOND

The Surface Mining Control and Reclamation Act of 1977 requires the operator of a coal mine to file with the Office of Surface Mining, a bond payable to the regulatory authority in the amount equal to the estimated cost of completing the work described in the operator's reclamation plan. The purpose of the bond provision is to ensure the State of Utah that in the event of the operator being financially unable to reclaim the disturbed areas, such areas can and will be restored by the proper regulatory authority at no cost to state residents.

Reclamation will consist of grading and revegetating the waste rock disposal fill area and removing the sediment pond once vegetation has been established as required in Section 4.6. The waste rock disposal area consists of 7.32 acres. The pond area consists of one acre. The estimate reclamation cost is $42,791. Appendix III contains the calculations for reclamation costs.

4.4 BACKFILL SOIL STABILIZATION, COMPACTION, CONTOURING & GRADING

The fill area will be built up using waste rock generated during the mining operation at Southern Utah Fuel Company's Mine No. 1. The waste rock will consist of shales, sandstones, mudstones, and some coal. Prior to fill placement, all vegetative cover will be removed from the area where fill is to be placed. Topsoil will then be removed, stockpiled, and reseeded. Fill will be placed in

segments using trucks and compaction equipment. These segments are envisioned to be about 300 feet long by 200 feet wide. The first segment will be placed on the southeast side of the disposal area. Additional segments will be placed beginning on the east side and working to the west. The fill will be built up to approximate the final contours shown on Map 2. The active area of the fill will consist of a pad where the haul road and compaction activities are taking place with an associated upslope and down slope. The upslope will be to the east adjacent to a previously established segment. The down slope will be to the west and will be the face of the present segment. All slopes will be less than 2h:1v. As a segment is completed, it will be graded to blend into the contours shown on Map 2. After grading, a layer of topsoil will be added and the completed segment will be seeded as required in the revegetation plan of Section 4.6 and in accordance with the revegetation timetable in Section 4.2.

4.5 SOIL PREPARATION AND FERTILIZATION PLAN

Soil will be spread to a minimum depth of approximately 30 inches. Heavier soil cover will be applied, if necessary, to avoid plant toxicity problems. The first lift will be covered with topsoil from the existing adjacent stockpile. Subsequent lifts will be covered with topsoil from the next lift site. Sufficient topsoil will be placed in the longterm storage stockpile to ensure minimum depth coverage of the final lift and the sediment pond area.

Upon phase II final reclamation, the banks of the sediment pond will be pushed over the existing pond residue and the site will be covered with topsoil.

The soil will be spread in a manner to provide a roughened surface so that seed and mulch can remain during germination

and initial growth of the seedlings. Nitrogen fertilization will be applied at the rate determined by need and will be drilled to a depth one inch below the seed. Topsoil redistribution will be accomplished when soil is dry or merely damp (not wet) to avoid excessive compaction.

Should rills or gullies deeper than nine inches develop in areas that have had topsoil redistributed, such damage shall be corrected by hand repair to avoid excessive compaction. These repaired areas shall be reseeded, also by hand, with the standard seed mixture on a schedule consistent with the proposed revegetation plan - see Section 4.6.

4.6 REVEGETATION PLAN

Revegetation efforts will follow, insofar as possible, those procedures recommended by the consultant, Dr. Stanley Welsh.

4.6.1 Species and Amount Per Acre

After proper soil preparation, the seed mix listed on Table 4.6.1-1 will be drilled over the area. The sediment pond topsoil stockpile will also use the seed mix listed on Table 4.6.1-1 except that the shrub seed will not be included.

Since the area to be reseeded is relatively flat, the proposed seeding rate of 21.4 lbs per acre seems adequate. Previous experience with reseeding attempts show that similar rates provide good revegetation success. The seed will be drilled where possible with cyclone spreaders being used as necessary on steep slooes or for touch-up effort. When broadcast seeding methods are used the seeding rate will be doubled to 42.8 lbs. per acre.

4.6.2 Seeding, Tillage and Mulching

The soil will be roughened prior to planting by scarifying with appropriate equipment to a minimal depth of six inches. Raking the surface prior to planting seeds will be

TABLE 4.6.1-1
RECOMMENDED SEED MIX
WASTE ROCK DISPOSAL SITE
SUFCO (ACT/041/002)

Species	Rate
Grasses:	
Elymus lanceolatus Thickspike wheatgrass	3.0
Elymus smithii Western wheatgrass	3.0
Elymus spicatus Bluebunch wheatgrass	3.0
Bromus marginatus Mountain brome	3.0
Elymus cinereus Great Basin wildrye	2.0
Forbs:	
Archillea millefolium Western yarrow	0.1
Artemisia ludoviciana Louisiana wormwood	0.1
Linum perenne Blue flax	1.0
Melilotus officinalis Yellow sweetclover	1.0
Penstemon strictus Rocky Mountain Penstemon	0.5
Shrubs:	
Amelanchier alnifolia Serviceberry	2.0
Artemisia tridentata var. *pauciflora* Mountain big sagebrush	0.2
Chrysothamnus nauseosus var. *albicaulis* Whitestem rubber rabbitbrush	0.5
Sambucus caerulea Blue elderberry	1.0
Symphoricarpos oreophilus Snowberry	1.0
Total	21.4

NOTE: The rate of seeding is in pounds of pure live seed per acre; application will be by drilling. The Division has determined that *Melilotus officinalis* meets the criteria of UMC 817.112. Scientific names are adapted from Welsh et al., 1987. a Utah FLora. Me. Great Basin Naturalist 9: 1-894.

accomplished as necessary to roughen the surface. Because of the small areas involved, hydro seeders will probably not be used. The seed will be drilled and held in place with crimped straw. On slopes where crimping in straw may not be practical, appropriate well anchored matting may be used as an alternative. Straw mulch will be applied at the rate of 2,000 lbs. per acre.

Irrigation is not considered to be necessary for revegetation of this site. Pest/disease control is not anticipated as a problem in this area. However, if serious weedy species such as Carduus nutans or Onopordum acanthium are noted following reclamation they will be removed mechanically.

4.6.3 Monitoring Procedures

Success of revegetation will be measured using statistically acceptable techniques for the determination of percent cover, shrub density and productivity. The baseline data will be used in evaluating the revegetation success. Since the area normally has less than 26.0 inches of annual precipitation, the liability period will be 10 years.

Revegetation success will be determined using ocular estimates of vegetative cover, with estimates made to the nearest percent. Plot size used previously was a 2 x 5 dm plot. However, plot size will be adjusted to fit the vegetation being measured, should the 2 x 5 dm plot size be judged not to be adequate. Shrub density will be determined by use of 9.6 square foot metal hoop.

The level of confidence will continue to be 80% for shrublands, such as on the land in question, and 90% for grasslands. The revegetation monitoring schedule is shown on Table 4.6.3-1.

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Sampling will be undertaken on or about the first week of July each year (as specified above), for each reclaimed waste rock segment, when the vegetation is at or near its peak of growth.

Methodology will be consistent from year to year, with plots randomly located each year; with the area to be surveyed divided into quadrants and a quarter of the plots placed randomly within each quadrant.

Reconnaissance survey and quantitative sampling will include the items noted in the Division's revegetation monitoring guidelines and in the Division's vegetation information guidelines for permanent program submissions for coal mines. For future reference, a copy of the Division's guidelines have been attached as Appendix VI.

TABLE 4.6.3-1
REVEGETATION MONITORING SCHEDULE

Qualitative observations:

Reclamation type	1	2	3	4	5	6	7	8	9	10
Permanent reclamation	x	x	x	x	x	x	x	x	x	x

Quantatative observation:

Parameter	1	2	3	4	5	6	7	8	9	10
Cover		x	x		x				x	x
Frequency		x	x		x				x	x
Woody plant density		x	x		x				x	x
Productivity									x	x

4.6.4 Soil Testing

The topsoil will be tested for need of nutrients and soil amendments prior to the first topsoil distribution effort. Application will be on an as needed basis as determined by

Revised 9/88

the tests. Tests will not be repeated for subsequent topsoil distributions unless lack of revegetation success indicates a need to do so.

4.7 PROTECTION OF HYDROLOGIC BALANCE

There are no streams, springs or seeps within the proposed fill area. Based on the consultant's report, no underdrains or rock core chimney drains will be required. Consequently, there will be no disruption of any underground aquifer.

The only surface flow in the area is that associated with storm or snow melt runoff. The proposed disposal site lies between the natural runoff courses. Therefore, the only disruption of surface flow will be that associated with directing surface runoff from the undisturbed area to the sedimentation pond. Discharge, if any, from the sedimentation pond will be returned to the natural drainage.

The existing wells have been drilled and completed using techniques designed to prevent transfer between acquifiers. Should additional wells be required, the hydrologic balance will continue to be protected through the use of approved construction methods. Upon abandonment, all water monitoring wells will be removed in compliance with the Administrative Rules for Water Well Drillers as published by the Utah Division of Water Rights.

Beyond these required diversions and well construction techniques, no additional effort is planned to protect the hydrologic balance.

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4.7.1 Water Rights

Water rights in the area adjacent to the disposal site are shown on Table 4.7.1-1. Right 95-1006 is identified in the Division of Water Rights documents as a pond used for stockwatering under a 1879 priority. There is no evidence that this pond is currently in use.

The Exchange rights E 2118 and E 2119 were transferred from the Salina Trunk Canal for the purpose of supplying water to a recreational subdivision. A new well site was approved at a location, approximately 600 feet down drainage from the sedimentation pond. However, the well was drilled at a location approximately 1,000 feet east of the approved site. This well failed to deliver an adequate water supply and the site was abandoned. The water level in the abandoned well is at 228.8 feet. A new well has been drilled at a location N 1737 ft, E 1166 ft from the S 1/4 Cor of Sec 6, T 22 S, R 4 E, SLBM. An application is currently being processed to again transfer these water rights. This new well is far beyond a point of potential impact from the disposal site activity.

TABLE 4.7.1-1

WATER RIGHTS

WATER USE CLAIM NO.	OWNER	SOURCE	FLOW (cfs)	PURPOSE OF USE	PERIOD OF USE
95-1006	USFS	Surface	510 Livestock units	Livestock Watering	6-1 to 10-5
E 2118	Howard W. Nielson	Under-ground	0.046	Recreation	5-1 to 10-31
E 2119	Marlin Sorensen, Jr.	Under-ground	0.46	Recreation	3-15 to 10-15

LOCATION

95-1006	SE SW Sec 18, T 22 S, R 4 E, SLBM
E 2118	S 1820 ft W 240 Ft from N 4 Cor, Sec 18, T 22 S, R 4 E, SLBM
E 2119	S 1820 ft W 240 ft from N 4 Cor, Sec 18, T 22 S, R 4 E, SLCM

4.7.2 Ground Water Monitoring

Water quality and ground water levels will be monitored monthly for the first six months to accelerate data collection. Thereafter, monitoring shall follow the guidelines in Table 4.7.2-1 and the parameter list as shown on Table 4.7.2-2. The adequacy of the operational parameter list will be reviewed at the completion of baseline data collection.

There is no evidence that ground water in the area rises high enough to interfere with the proposed sediment pond. While sample sites are rather minimal, the data show that the piezometric surface dips to the southwest as shown on Map 6. No seeps or springs have been identified to the west along the Salina Canyon. The ground water level slope to the southwest is verified by recent water level data taken in the wells. Well locations are shown on Map 2.

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TABLE 4.7.2-1
GROUND WATER SAMPLING

	Baseline Monitoring	Operational Monitoring	Postmining Monitoring
Type of Sampling Site	Observation Wells	Observation Wells	Observation Wells
Field Measurements	Yes	Yes	Yes
Sampling Frequency Each Site	At least four samples per annum, at fixed monthly intervals.	Four samples per annum at fixed monthly intervals.	One sample per annum
Sampling Duration	Two years (six months of data before approval of PAP).	Every year until two years after surface reclamation activities have ceased.	Every year until termination of bonding.
Type of Data Collected and Reported	Water levels and water quality.	Water levels and water quality per operational parameters.	Water levels and water quality per operational parameters.
Comments		During the year preceding repermitting. One sample per baseline parameter.	

Monitoring data will be submitted to the division within 90 days of the end of each quarter.

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TABLE 4.7.2-2
GROUND WATER BASELINE, OPERATIONAL AND
POSTMINING WATER QUALITY PARAMETER LIST

Field Measurements:

* - Water Levels or Flow
* - pH
* - Specific Conductivity (umhos/cm)
* - Temperature (C°)

Laboratory Measurements: (mg/l) (Major, minor ions and trace elements are to be analyzed in dissolved form only.)

* - Total Dissolved Solids
* - Total Hardness (as $CaCO_3$)
- Aluminum (Al)
- Arsenic (As)
- Barium (Ba)
- Boron (B)
* - Carbonate (CO_3 -2)
* - Bicarbonate (HCO_3 -)
- Cadmium (Cd)
* - Calcium (Ca)
* - Chloride (CL-)
- Chromium (Cr)
- Copper (Cu)
- Fluoride (F-)
* - Iron (Fe)
- Lead (Pb)
* - Magnesium (Mg)
* - Manganese (Mn)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)
- Nitrogen: Ammonia (NH_3)
- Nitrite (NO_2)
- Nitrate (NO_3 -)
* - Potassium (K)
- Phosphate (PO_4 -3)
- Selenium (Se)
* - Sodium (Na)
* - Sulfate (SO_4 -2)
- Sulfide (S-)
- Zinc (Zn)

Sampling Period:

-Baseline
*Operational, Postmining

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4.7.3 Water Quality

Tabulated copies of water quality data collected to date may be found in Exhibit 6. Data collected at the disposal site will be reported quarterly with the data from the minesite monitoring stations.

Water quality at the disposal site is saline with sulfate and chloride being the dominant contributors. Drill holes number three and six are currently the only holes below the road providing water quality data with quality at these holes being rather consistent. Drill holes number five, seven, and nine have not had either sufficient water or a recharge rate which would facilitate water quality sampling. Drill hole number eight located above the road appears to have tapped an acquifier which does not continue to the disposal site. This well has a total dissolved solids concentration of approximately 40% of that found in wells three and six and a recharge rate sufficient to preclude detectable draw-down with a bailer.

At the conclusion of site operation but prior to removal of the sedimentation pond, water flowing into the pond will be monitored on a seasonal basis for those constituents monitored under the NPDES permit if one is required. No water quality monitoring beyond that required by the NPDES permit is planned.

4.8 POST MINING LAND USE

The land will be returned to essentially the same condition as was found prior to usage as a rock disposal site. The land will remain a private holding and will continue to serve as winter range for big game animals.

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It is anticipated that over the years some of the surrounding land will be subdivided into 5 acre development lots for summer homes. Although there are currently no plans to eventually subdivide the rock disposal site, its final configuration will be compatible with this usage should such a decision be made.

4.9 SEDIMENTATION POND

The sedimentation pond will remain in a functional condition until the disposal site has been reclaimed and the revegetation effort deemed successful in accordance with the standards established in UMC 817.116. At this point, the discharge structure will be removed, the site leveled to approximate original contours and the site revegetated using the same methods as previously used during reclamation of the disposal site.

4.10 SUBSIDENCE

Since no underground mining activity has occurred beneath the site, settlement of the fill will result only from the consolidation of the surface soils and elastic compression of the underlying bedrock. It is expected that total settlements on the order of 0.5 to 1.0 inches will occur upon completion of the disposal area.

4.11 FISH AND WILDLIFE PLAN

There are no streams in the disposal area. Consequently, protection of fish is not a consideration.

The disposal activities shall be conducted in such a manner as to minimize the disturbance and adverse impact on wildlife.

The area disturbed by roads and by placement of waste material will be kept at a minimum. Revegetation will be prompt to provide food and cover. No power lines or other such utilities are planned in the area.

4.12 STREAM DIVERSIONS

There will be no stream diversions in connection with the operation of the rock disposal site.

Diversions ditches separating the disturbed and the undisturbed areas will be left in place at the conclusion of mining activities. Reclaiming these ditches would disturb the existing vegetation and would result in unnecessary soil and vegetation disturbance.

4.13 TRANSPORTATION FACILITIES

Access to the site is via an adjacent county road. Access on the site will be by a short haul road (less than 1/4 mile in length). When no longer needed, the haul road will be promptly reclaimed. This haul road is shown in its initial location on Map 4. Trucks will come down the county road in a westerly direction and exit down the ramp yielding to the uphill traffic lane. The truck will then proceed along the haulage road to the active fill area. In the fill area, the truck will be unloaded and return back up the haulage road and merge with any uphill traffic in the easterly lane.

4.14 AIR POLLUTION CONTROL PLAN

Air pollution at the disposal site is expected to be minimal with the only potential problem being that of fugitive dust emissions. An Air Quality Permit for these emissions was requested from the Bureau of Air Quality on November 9, 1987.

The wet nature of the waste material helps to minimize the fugitive emissions problem as does the small area to be disturbed at any given time. Also the area is not known to be subject to windy conditions. However, to monitor

potential fugitive dust problems, an observer from the mine staff has been trained and certified by the Bureau of Air Quality. This certification will be kept current during the summer season when the potential problem exists.

Should observation indicate a need, fugitive dust emissions will be controlled through the use of water spray.

4.15 ALLUVIAL VALLEY FLOORS

The disposal area has no Alluvial Valley Floors as defined by UMC 700.5.

LIST OF ATTACHMENTS

Exhibit 1	-	Warranty Deed
Exhibit 2	-	DWR Letter
Exhibit 3	-	SCS Range Condition Survey
Exhibit 4	-	SCS Prime Farmland Determination
Map 1	-	Property Ownership
Map 2	-	Waste Rock Disposal Site
Map 3	-	Drainage Areas
Map 4	-	Operating Plan
Map 5	-	Phase II Reclamation
Map 6	-	Piezometric Surface
Figure 1	-	Sediment Pond Details
Figure 2	-	Cross-Sections A-A', B-B' and G-G'
Appendix I	-	AERC Report
Appendix II	-	SHB Report
Appendix III	-	Engineering Calculations
Appendix IV	-	Welsh Report
Appendix V	-	Soils Report
Appendix VI	-	Revegetation Monitoring Guidelines

Revised 3/88

Recorded at Request of _____

at _____ M. Fee Paid $ _____

by _____ Dep. Book _____ Page _____ Ref.: _____

Mail tax notice to _____ Address _____

WARRANTY DEED

Dale H. Petersen and Mary P. Petersen grantor s
of American Fork, County of Utah, State of Utah, hereby
CONVEY and WARRANT to
Southern Utah Fuel Company division of Costal States Energy Company

Entry No. 185470
Recorded 9-2-1976 11:50 Book 112 Page 796
Bessie N. Curtis, Recorder, Sevier County
Request of Southern Utah Fuel Company Fee $2.00

grantee s
of 5 Greenway Plaza East Houston, Texas 77046 for the sum of
Ten and no/100----------DOLLARS,
and other valuable consideration.
the following described tract of land in Sevier County,
State of Utah:

The Northwest ¼ of the Northeast ¼ of Section 18, Township 22 South, Range 4 East, Salt Lake Base and Meridian. Containing 40 acres more or less.

This conveyance is subject to a road-right-of-way easement granted to the United States of America.

Also subject to a road right-of-way 50 feet wide for access to the following described property:
The Sothwest ¼ of the Southeast ¼, of Section 7, Township 22 South, Range 4 East, Salt Lake Meridian.
Which road right-of-way is described as follows:
Beginning at a point on Forest Service Road Number 40010 which lies N. 56° 20' 48" E. and 4207.87 feet, more or less, from the West ¼ corner of Section 18, T. 22 S., R. 4 E., S. L. B. & M. and proceding thence: N. 14° 43' 23" W. for 300 feet, thence: N. 38° 38' 38" E. for 110.95 feet to the intersection of the North Section line of Section 18, T. 22 S., R. for E., S. L. B. & M. This intersection point lying N. 52° 13' 46" E. and 4422.32 feet, more or less, from the West ¼ corner of Section 18, T. 22 S., R. for E., S. L. B. & M.

DHP
MPP

WITNESS, the hands of said grantor s, this Eleventh day of August, A. D. 19 76

Signed in the Presence of

Dale H. Petersen
Mary P. Petersen

STATE OF UTAH,
County of Sevier } ss.

On the Eleventh day of August, A. D. 1976 personally appeared before me Dale H. Petersen and Mary P. Petersen his wife the signer s of the within instrument, who duly acknowledged to me that they executed the same.

NOTARY PUBLIC

Howard W. Nielson
Notary Public.

My commission expires July 30, 1977 Residing in Salina, Utah

BLANK #101—WARRANTY DEED— © GEM PTG. CO. — 3215 SO. 2600 EAST — SALT LAKE CITY

EXHIBIT 2

STATE OF UTAH
NATURAL RESOURCES & ENERGY
Wildlife Resources

1596 West North Temple • Salt Lake City, UT 84116 • 801-533-9333

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Douglas F. Day, Division Director

Reply To SOUTHERN REGIONAL OFFICE
622 North Main Street, Box 606, Cedar City, Utah 84720
(801) 586-2455

March 29, 1983

Keith W. Welch
Environmental Coordinator
Coastal States Energy Company
411 West 7200 South
Midvale, Utah 84047

Dear Keith;

I have considered the potential impacts on wildlife in the area proposed as an overburden dump site in T22s, R4e, Sec. 18, NW¼ NE¼. We have no indication that this site provides important habitat for a threatened or endangered species. The area is probably used by wintering deer and elk. Two golden eagle aeries have been documented within one mile of the proposed site. The area would be included within this species hunting territory. Several nongame birds and mammals occupy the proposed site.

Because this particular drainage enters Salina Creek, the materials to be dumped at the proposed site should be seriously considered. Fine silts and toxicants should not be allowed to enter this class III trout stream. Thorough materials analysis should be made prior to any decision to begin dumping at the proposed site.

Sincerely,

Wes Shields

Wes Shields
Resource Analysist

F. Clair Jensen

F. Clair Jensen
Regional Supervisor

FCJ/WS/kkc

Board Warren T. Harward, Chairman • L. S. Skaggs • Lewis C. Smith • Jack T. World • Roy L. Young

an equal opportunity employer • please recycle paper

EXHIBIT 3

United States Department of Agriculture
Soil Conservation Service
Richfield Field Office
P.O. Box 534
Richfield, Utah 84701

10-28-87

Wes Sorensen
Southern Utah Fuel Company
Salina, UT 84654

As per your request I have inventoried your company's property in SEC 18, T22S, R4E.

The area contains three different range sites, on two soils. As indicated on the enclosed map the area was cut on the range site lines for the purpose of this survey. Each area is numbered from one to three for identification.

AREA	RANGE SITE	CONDITION	TREND
1	mountain loam	good	static
2	mountain stony loam	good	static
3	high mt loam (aspen)	good	static

Our condition rating system is based on the amount and kind of plant species present as compared with what has been determined to be the amount present in a climax site. This system also considers the erosion, plant diversity, and plant density. Based on these factors sites may be rated to be in excellent, good, fair, or poor condition. Trend is an indication of the direction the site is moving in the condition classes. Trend may be either up, down, or static. Static indicates the area is stable or trend is not apparent.

Area 1 has been seeded to introduced species and therefore doesn't fit the criteria of the mountain loam range site. However, based on the kind and amount of vegetation, plant density and current erosion; I have determined this area is in good condition.

If you have questions concerning this inventory or methods used contact our office.

Blake Walbeck

Blake Walbeck
Range Conservationist

EXHIBIT 3

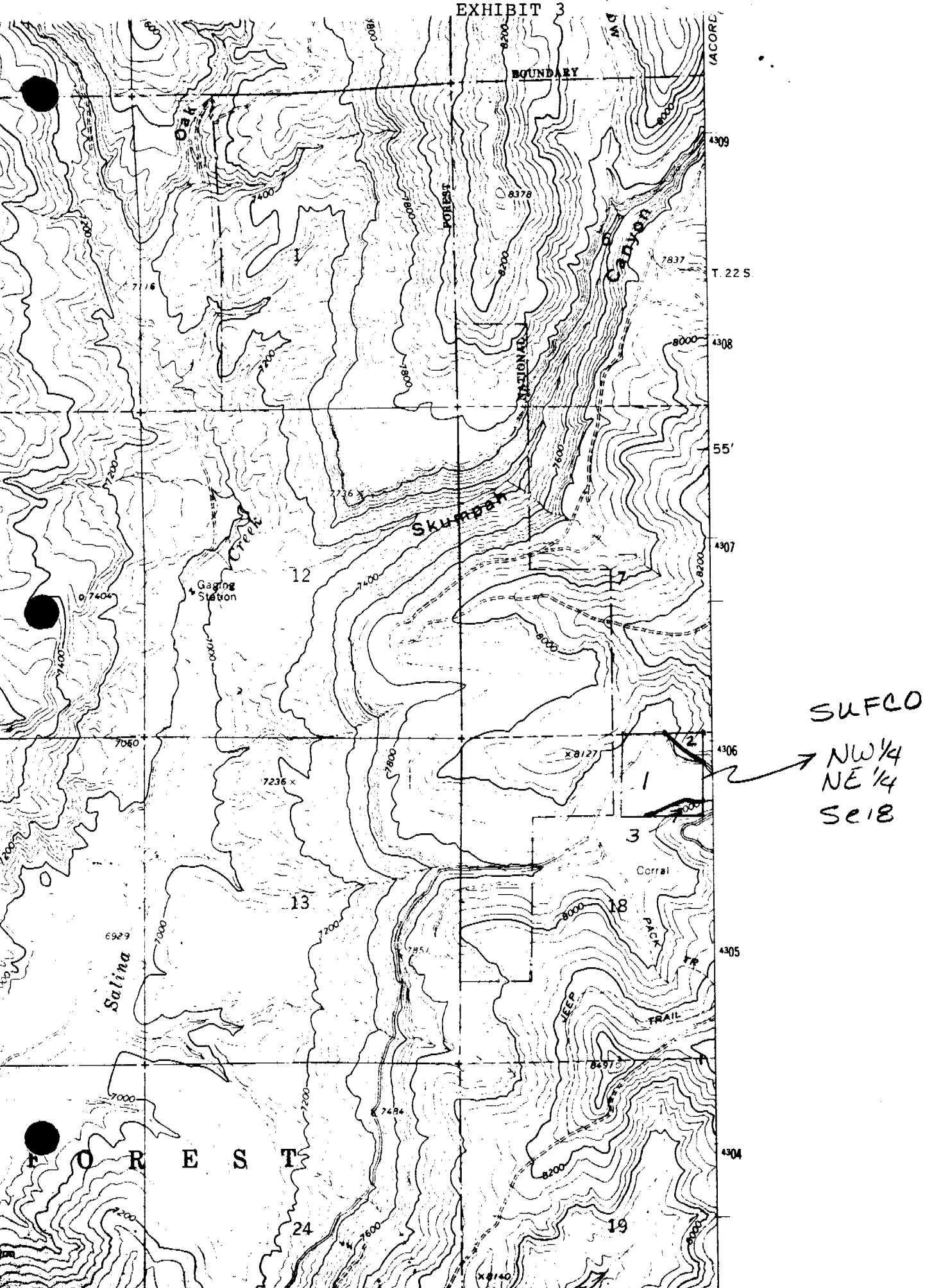
BOUNDARY
Oak
FOREST
NATIONAL
Canyon
Skumpah
Creek
Gaging Station
Salina
Corral
PACK
TR
JEEP
TRAIL
T. 22 S.
55'
4309
4308
4307
4306
4305
4304
12
13
18
24
19
1
2
3
7
8378
7837
7116
7736
7404
7060
7236
8127
6929
7851
7484
8491
8140
SUFCO
NW 1/4
NE 1/4
Se 18

EXHIBIT 4

United States Department of Agriculture

Soil Conservation Service

P. O. Box 11350
Salt Lake City, UT 84147

December 10, 1987

Keith Welch
Coastal State Senergy Company
175 East 400 South, Suite 800
Salt Lake City, Utah 84111

Dear Mr. Welch:

This letter is in response to your inquiry of prime farmland to Victor Parslow, Soil Scientist, Soil Conservation Service, Richfield, Utah regarding your project - Waste Rock Disposal Site, Convulsion Canyon.

The property located in the NW¼ of the NE¼ of Section 18, Township 22 South, Range 4 East does not meet the criteria for prime farmland.

The soil mapping units involved are: Freece cobbly clay loam, 30 to 50 percent slopes, eroded; and Hume loam, 4 to 16 percent slopes.

The main reasons these soils do not qualify are the steep slopes on which both soils occur, and the cobbly surface of the Freece soil.

If you should have any additional inquiries please contact us at the address above or on (801) 524-5064.

Sincerely,

FERRIS P. ALLGOOD
State Soil Scientist

cc: Victor Parslow, SS, SCS, Richfield, UT

EXHIBIT 5

Branch Code 43

Lab. No. 72524

Date Rec'd. 9.18.87

Date Sampled

Sampled By

STANDARD LABORATORIES, INC.

SAMPLE ID:

SUTHERN UTAH FUEL COMPANY
COASTAL STATES ENERGY
P.O. BOX P
SALINA, UTAH 84654

ACID-BASE ACCOUNTABILITY
CACO3 EQUIV. (TONS/1000 TONS OF MATERIAL)

COLOR	FIZZ	% SUL.	MAX FROM % SUL.	AMOUNT PRESENT	MAX NEEDED pH 7	EXCESS	PASTE pH
5Y 4/1	3	0.239	7.47	310.82		303.35	8.35

ELECTRICAL CONDUCTANCE	5,800 µMHOS/CM
TOTAL SELENIUM	<0.08 PPM
TOTAL BORON	6.13 PPM (WATER SOLUBLE)
SODIUM-ADSORPTION-RATIO	0.51 MEQ/L
SATURATED WATER PERCENTAGE	36.57 %

PARTICLE SIZE ANALYSIS

% SAND	54.60
% SILT	34.00
% CLAY	11.40

FOR YOUR PROTECTION THIS DOCUMENT HAS BEEN PRINTED ON CONTROLLED PAPER STOCK

Respectfully Submitted, Ray A. Simpson

EXHIBIT 5
Con't

Branch Code 30

Lab. No. S-10612

Date Rec'd. 5/3/88

Date Sampled ----

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

SAMPLE ID: 5R5E FLOOR
LAB NO. 526/88

SOUTHERN UTAH FUEL COMPANY
P.O. BOX P
SALINA, UT 84654

ATTN: CHRIS M. KRAVITS

ACID-BASE ACCOUNTABILITY

CACO3 EQUIV. (TONS/1000 TONS OF MATERIAL)

COLOR	FIZZ	% SUL.	MAX FROM % SUL.	AMOUNT PRESENT	MAX NEEDED PH 7	EXCESS	PASTE PH
5Y 3/1	1	0.480	15.00	37.46		22.46	7.50

ELECTRICAL CONDUCTIVITY - 3,330 µMHOS/CM

SODIUM ABSORPTION RATIO - 0.421 MEQ/L

SATURATED WATER PERCENTAGE - 55.25%

WATER SOLUBLE SELENIUM - 0.014 PPM *

WATER SOLUBLE BORON - 2.8 PPM

* REVISED 6/20/88

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Respectfully Submitted, Sharon Baker

EXHIBIT 5
Con't

Branch Code 30

Lab. No. S-10610

Date Rec'd. 5/3/88

Date Sampled ----

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

SAMPLE ID: WASTE ROCK PILE
LAB NO. 524/88

SOUTHERN UTAH FUEL COMPANY
P.O. BOX P
SALINA, UT 84654

ATTN: CHRIS M. KRAVITS

ACID-BASE ACCOUNTABILITY

CACO3 EQUIV. (TONS/1000 TONS OF MATERIAL)

COLOR	FIZZ	% SUL.	MAX FROM % SUL.	AMOUNT PRESENT	MAX NEEDED PH 7	EXCESS	PASTE PH
7.5YR 3/0	2	0.996	31.13	87.21		56.08	8.15

ELECTRICAL CONDUCTIVITY - 3,600 µMHOS/CM

SODIUM ABSORPTION RATIO - 1.31 MEQ/L

SATURATED WATER PERCENTAGE - 54.61%

WATER SOLUBLE SELENIUM - 0.005 PPM *

WATER SOLUBLE BORON - 3.8 PPM

* REVISED 6/20/88

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Respectfully Submitted, Sharon Baker

EXHIBIT 5
Con't

Branch Code 30

Lab. No. S-10611

Date Rec'd. 5/3/88

Date Sampled ----

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

SAMPLE ID: CAVE Z WEST
LAB NO. 525/88

SOUTHERN UTAH FUEL COMPANY
P.O. BOX P
SALINA, UT 84654

ATTN: CHRIS M. KRAVITS

ACID-BASE ACCOUNTABILITY

CACO3 EQUIV. (TONS/1000 TONS OF MATERIAL)

COLOR	FIZZ	% SUL.	MAX FROM % SUL.	AMOUNT PRESENT	MAX NEEDED PH 7	EXCESS	PASTE PH
5Y 4/1	0	0.570	17.81	13.89	3.92		6.20

ELECTRICAL CONDUCTIVITY - 2,950 µMHOS/CM

SODIUM ABSORPTION RATIO - 0.456 MEQ/L

SATURATED WATER PERCENTAGE - 50.17%

WATER SOLUBLE SELENIUM - 0.011 PPM *

WATER SOLUBLE BORON - 5.4 PPM

* REVISED 6/20/88

FOR YOUR PROTECTION THIS DOCUMENT HAS BEEN PRINTED ON CONTROLLED PAPER STOCK

Respectfully Submitted, Sharon Baker

Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

RECEIVED
MAY 25 1989
SOUTHERN UTAH
FUEL COMPANY

SOUTHERN UTAH FUEL COMPANY
SALINA, UTAH

May 22, 1989

Lab No.	Location	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
28822	Rom Storage Pile Subsoil	8.2	5.83	39.3	32.4	62.6	21.9	3.18	22.7	43.3	35.1	21.6	LOAM

Lab No.	Location	Organic Matter %	Total Sulfur %	T.S. AB t/1000t	Neut. Pot. t/1000t	T.S. ABP t/1000t	P ppm	Boron ppm	Selenium ppm	K PE meq/l	Alkalinity PE meq/l	Total Kjeldahl Nitrogen %	1/3 bar % Moisture	15 bar % Moisture
28822	Rom Storage Pile Subsoil	2.3	0.08	2.50	413.	411.	2.38	0.44	<0.02	18.2	1.46	0.08	21.1	9.6

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available
Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble,ABPTA= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

EXHIBIT 6

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 3

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	08/12/87	10/27/87	12/09/87	02/16/88	02/25/88	03/07/88	04/12/88	05/11/88
PHYSICAL PARAMETERS								
AIR TEMPERATURE (C)			0			-1	18	10
WATER LEVEL (FT)	7864.2	7863.9	7863.7	7863.1	7859.4	7863	7863.1	7863.1
WATER TEMPERATURE (C)			7	6.5		7	7	9
SPEC. COND. (UMHOS/CM) FIELD			7440	7200		7300	7300	7200
PH (SU) FIELD			6.8	7.65		7.05	7.05	6.8
TURBIDITY (NTU) FIELD			3			458		
COMMON IONS								
ALKALINITY AS CACO3 (LAB)			301					
BICARBONATE (HCO3) (LAB)			367	373		416	366	416
CALCIUM (CA)			663.4	613.8		557.6	720	835.2
CARBONATE AS CO3				<0.1		<0.1	<0.1	<0.1
CHLORIDE (CL)			1475	1475		1330	1530	1565
FLUORIDE (FL)				0.17		0.16	0.24	0.25
HARDNESS (CACO3) TOTAL			3410	3350		3350	3360	3366
MAGNESIUM (MG)			410.2	455.7		432.4	374.4	306.5
POTASSIUM (K)				21.3		5.4	5.42	4.88
SODIUM (NA)			595.2	574.5		508.6	558.5	518.4
SULFATE (SO4)			2115	2190		2010	1940	1820
SULFIDE (S)				<0.1		<0.01	<0.01	<0.01
TOTAL DISS. SOLIDS MEAS.			6052	5535		5085	5350	5260
NUTRIENTS								
AMMONIA (NH3-N)				0.05		<0.03	0.07	0.08
NITRATE (NO3-N)			3.55	3.25		4.2	3.6	2.85
NITRITE (NO2-N)				<0.02		0.03	<0.01	<0.02
TOTAL PHOSPHATE (PO4)			2	1.85		0.08	<0.04	<0.04
TRACE ELEMENTS								
ALUMINUM (AL) DISS				<0.001		<0.001	<0.001	<0.001
ARSENIC (AR) DISS				<0.001		<0.002	<0.001	<0.001
BARIUM (BA) TOTAL			0.06					
BARIUM (BA) DISS				0.05		0.01	0.02	0.01
BORON (B) TOTAL			0.45					
BORON (B) DISS				0.14		0.19	0.13	0.14
CADMIUM (CD) DISS				<0.001		<0.001	<0.001	<0.001
CHROMIUM (CR) DISS				<0.002		0.002	<0.001	<0.001
COPPER (CU) DISS				<0.01		0.02	<0.01	0.02
IRON (FE) TOTAL			10.45					
IRON (FE) DISS			1.65	<0.01		<0.01	<0.01	<0.01
LEAD (PB) DISS				<0.001		<0.001	<0.001	<0.001
MANGANESE (MN) TOTAL			0.46					
MANGANESE (MN) DISS			0.03	0.03		<0.02	<0.03	0.02
MERCURY (HG) DISS				<0.0002		<0.0002	<0.0002	<0.0002
MOLYDENUM (MO) DISS				<0.01		<0.001	<0.001	<0.001
NICKEL (NI) DISS				0.03		0.02	<0.01	<0.01
SELENIUM (SE) TOTAL			0.009					
SELENIUM (SE) DISS				0.018		0.01	0.023	0.028
ZINC (ZN) DISS				0.018		0.015	0.012	0.018

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 3

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	06/08/88
PHYSICAL PARAMETERS	
AIR TEMPERATURE (C)	13
WATER LEVEL (FT)	7863.8
WATER TEMPERATURE (C)	12
SPEC. COND. (UMHOS/CM) FIELD	7670
PH (SU) FIELD	6.7
TURBIDITY (NTU) FIELD	
COMMON IONS	
ALKALINITY AS CACO3 (LAB)	
BICARBONATE (HCO3) (LAB)	420
CALCIUM (CA)	828
CARBONATE AS CO3	<0.1
CHLORIDE (CL)	1480
FLUORIDE (FL)	0.22
HARDNESS (CACO3) TOTAL	3370
MAGNESIUM (MG)	312
POTASSIUM (K)	4.38
SODIUM (NA)	579.2
SULFATE (SO4)	2072
SULFIDE (S)	<0.01
TOTAL DISS. SOLIDS MEAS.	5399
NUTRIENTS	
AMMONIA (NH3-N)	0.04
NITRATE (NO3-N)	5
NITRITE (NO2-N)	<0.02
TOTAL PHOSPHATE (PO4)	0.15
TRACE ELEMENTS	
ALUMINUM (AL) DISS	<0.001
ARSENIC (AR) DISS	<0.001
BARIUM (BA) TOTAL	
BARIUM (BA) DISS	0.02
BORON (B) TOTAL	
BORON (B) DISS	0.12
CADMIUM (CD) DISS	0.001
CHROMIUM (CR) DISS	<0.001
COPPER (CU) DISS	0.02
IRON (FE) TOTAL	
IRON (FE) DISS	<0.03
LEAD (PB) DISS	<0.001
MANGANESE (MN) TOTAL	
MANGANESE (MN) DISS	<0.01
MERCURY (HG) DISS	<0.0002
MOLYDENUM (MO) DISS	<0.001
NICKEL (NI) DISS	<0.01
SELENIUM (SE) TOTAL	
SELENIUM (SE) DISS	0.017
ZINC (ZN) DISS	0.014

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 5

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	08/12/87	10/27/87	12/09/87	02/25/87	03/07/88	04/13/88	05/11/88	05/11/88
PHYSICAL PARAMETERS				STATION NOT ACCESSIBLE	STATION NOT ACCESSIBLE			
AIR TEMPERATURE (C)								
DEPTH (FT)	7941.6	7941.1	7940.7			7940.3	7940.4	7941.4
WATER TEMPERATURE (C)								
SPEC. COND. (UMHOS/CM) FIELD								
PH (SU) FIELD								
TURBIDITY (NTU) FIELD								
COMMON IONS								
ALKALINITY AS CACO3 (LAB)								
BICARBONATE (HCO3) (LAB)								
CALCIUM (CA)								
CARBONATE AS CO3								
CHLORIDE (CL)								
FLUORIDE (FL)								
HARDNESS (CACO3) TOTAL								
MAGNESIUM (MG)								
SODIUM (NA)								
SULFIDE (S)								
SULFATE (SO4)								
TOTAL DISS. SOLIDS MEAS.								
NUTRIENTS								
AMMONIA (NH3-N)								
NITRATE (NO3-N)								
NITRITE (NO2-N)								
TOTAL PHOSPHATE (PO4)								
TRACE ELEMENTS								
ALUMINUM (AL) DISS								
ARSENIC (AR) DISS								
BARIUM (BA) TOTAL								
BARIUM (BA) DISS								
BORON (B) TOTAL								
BORON (B) DISS								
CADMIUM (CD) DISS								
CHROMIUM (CR) DISS								
COPPER (CU) DISS								
IRON (FE) TOTAL								
IRON (FE) DISS								
LEAD (PB) DISS								
MANGANESE (MN) TOTAL								
MANGANESE (MN) DISS								
MERCURY (HG) DISS								
MOLYDENUM (MO) DISS								
NICKEL (NI) DISS								
SELENIUM (SE) TOTAL								
SELENIUM (SE) DISS								
ZINC (ZN) DISS								

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 5

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	08/09/88
PHYSICAL PARAMETERS	
AIR TEMPERATURE (C)	
DEPTH (FT)	7941.1
WATER TEMPERATURE (C)	
SPEC. COND. (UMHOS/CM) FIELD	
PH (SU) FIELD	
TURBIDITY (NTU) FIELD	
COMMON IONS	
ALKALINITY AS CACO3 (LAB)	
BICARBONATE (HCO3) (LAB)	
CALCIUM (CA)	
CARBONATE AS CO3	
CHLORIDE (CL)	
FLUORIDE (FL)	
HARDNESS (CACO3) TOTAL	
MAGNESIUM (MG)	
SODIUM (NA)	
SULFIDE (S)	
SULFATE (SO4)	
TOTAL DISS. SOLIDS MEAS.	
NUTRIENTS	
AMMONIA (NH3-N)	
NITRATE (NO3-N)	
NITRITE (NO2-N)	
TOTAL PHOSPHATE (PO4)	
TRACE ELEMENTS	
ALUMINUM (AL) DISS	
ARSENIC (AR) DISS	
BARIUM (BA) TOTAL	
BARIUM (BA) DISS	
BORON (B) TOTAL	
BORON (B) DISS	
CADMIUM (CD) DISS	
CHROMIUM (CR) DISS	
COPPER (CU) DISS	
IRON (FE) TOTAL	
IRON (FE) DISS	
LEAD (PB) DISS	
MANGANESE (MN) TOTAL	
MANGANESE (MN) DISS	
MERCURY (HG) DISS	
MOLYBDENUM (MO) DISS	
NICKEL (NI) DISS	
SELENIUM (SE) TOTAL	
SELENIUM (SE) DISS	
ZINC (ZN) DISS	

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

12-Sep-88 KWW

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 6

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	08/12/87	10/27/87	12/09/87	02/16/88	02/25/88	03/07/88	04/13/88	05/11/88
PHYSICAL PARAMETERS								
AIR TEMPERATURE (C)			1			-1	17	12
WATER LEVEL (FT)	7886.0	7886.2	7886.1	7884.6	7890.1	7889.7	7886.1	7890.3
WATER TEMPERATURE (C)			9	6.5		7	9	9
SPEC. COND. (UMHOS/CM) FIELD			7400	7100		7300	7200	7100
PH (SU) FIELD			6.7	7.6		7.05	6.7	6.9
TURBIDITY (NTU) FIELD			3					
COMMON IONS								
ALKALINITY AS CACO3 (LAB)			322					
BICARBONATE (HCO3) (LAB)			393	386		434	392	427
CALCIUM (CA)			624.6	583.7		525.8	636	1388
CARBONATE AS CO3				0.10		<0.10	<0.10	<0.10
CHLORIDE (CL)			1240	1300		1130	1185	1170
FLUORIDE (FL)				0.16		0.14	0.15	0.15
HARDNESS (CACO3) TOTAL			3850	3750		3730	3750	4100
MAGNESIUM (MG)			544	580.1		569.6	518.4	60.48
POTASSIUM (K)				17.5		13.21	13.54	12.16
SODIUM (NA)			536.3	503.1		465.2	519	506.4
SULFATE (SO4)			2700	2680		2655	2675	2730
SULFIDE (S)				<0.10		<0.01	<0.01	<0.01
TOTAL DISS. SOLIDS MEAS.			6918	6216		5535	5751	6100
NUTRIENTS								
AMMONIA (NH3-N)				0.08		<0.03	0.09	0.08
NITRATE (NO3-N)			2.5	2.7		2.55	2.7	1.8
NITRITE (NO2-N)				<0.02		0.03	<0.01	<0.02
TOTAL PHOSPHATE (PO4)			0.26	0.45		0.16	0.21	0.1
TRACE ELEMENTS								
ALUMINUM (AL) DISS				<0.001		<0.001	<0.001	<0.001
ARSENIC (AR) DISS				<0.001		<0.002	<0.001	<0.001
BARIUM (BA) TOTAL			0.07					
BARIUM (BA) DISS				0.06		0.01	0.02	0.01
BORON (B) TOTAL			0.42					
BORON (B) DISS				0.1		0.14	0.100	0.1
CADMIUM (CD) DISS				<0.001		<0.001	<0.001	<0.001
CHROMIUM (CR) DISS				0.003		0.004	<0.001	<0.001
COPPER (CU) DISS				0.02		0.02	0.03	0.03
IRON (FE) TOTAL			20					
IRON (FE) DISS			1.4	<0.01		<0.01	<0.01	<0.01
LEAD (PB) DISS				<0.001		<0.001	<0.001	<0.001
MANGANESE (MN) TOTAL			0.26					
MANGANESE (MN) DISS			0.02	0.02		0.02	0.03	0.02
MERCURY (HG) DISS				<0.0002		<0.0002	<0.0002	<0.0002
MOLYDENUM (MO) DISS				<0.010		<0.001	<0.001	<0.001
NICKEL (NI) DISS				0.02		<0.01	<0.01	<0.01
SELENIUM (SE) TOTAL			0.009					
SELENIUM (SE) DISS				0.013		0.009	0.010	<0.001
ZINC (ZN) DISS				0.010		0.019	<0.005	0.015

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 6

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	06/08/88
PHYSICAL PARAMETERS	
AIR TEMPERATURE (C)	14
WATER LEVEL (FT)	7891.3
WATER TEMPERATURE (C)	9
SPEC. COND. (UMHOS/CM) FIELD	7570
PH (SU) FIELD	6.7
TURBIDITY (NTU) FIELD	
COMMON IONS	
ALKALINITY AS CACO3 (LAB)	
BICARBONATE (HCO3) (LAB)	432
CALCIUM (CA)	692
CARBONATE AS CO3	<0.10
CHLORIDE (CL)	1142
FLUORIDE (FL)	0.18
HARDNESS (CACO3) TOTAL	3360
MAGNESIUM (MG)	463.2
POTASSIUM (K)	12.11
SODIUM (NA)	554.5
SULFATE (SO4)	2730
SULFIDE (S)	0.8
TOTAL DISS. SOLIDS MEAS.	5821
NUTRIENTS	
AMMONIA (NH3-N)	0.08
NITRATE (NO3-N)	3.1
NITRITE (NO2-N)	<0.02
TOTAL PHOSPHATE (PO4)	<0.04
TRACE ELEMENTS	
ALUMINUM (AL) DISS	<0.001
ARSENIC (AR) DISS	<0.001
BARIUM (BA) TOTAL	
BARIUM (BA) DISS	0.02
BORON (B) TOTAL	
BORON (B) DISS	0.1
CADMIUM (CD) DISS	0.002
CHROMIUM (CR) DISS	0.003
COPPER (CU) DISS	0.03
IRON (FE) TOTAL	
IRON (FE) DISS	<0.03
LEAD (PB) DISS	<0.001
MANGANESE (MN) TOTAL	
MANGANESE (MN) DISS	0.03
MERCURY (HG) DISS	<0.0002
MOLYDENUM (MO) DISS	<0.001
NICKEL (NI) DISS	<0.01
SELENIUM (SE) TOTAL	
SELENIUM (SE) DISS	0.009
ZINC (ZN) DISS	0.01

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 7

SAMPLE DATE	10/27/87	12/09/87	02/25/88	03/07/88	04/13/88	05/11/88
PHYSICAL PARAMETERS						
AIR TEMPERATURE (C)						
DEPTH (FT)	7898.9	7898.9	7898.8	7900.1	7902.3	7903.1
WATER TEMPERATURE (C)						
SPEC. COND. (UMHOS/CM) FIELD						
PH (SU) FIELD						
TURBIDITY (NTU) FIELD						
COMMON IONS						
ALKALINITY AS CACO3 (LAB)						
BICARBONATE (HCO3) (LAB)						
CALCIUM (CA)						
CARBONATE AS CO3						
CHLORIDE (CL)						
FLUORIDE (FL)						
HARDNESS (CACO3) TOTAL						
MAGNESIUM (MG)						
SODIUM (NA)						
SULFIDE (S)						
SULFATE (SO4)						
TOTAL DISS. SOLIDS MEAS.						
NUTRIENTS						
AMMONIA (NH3-N)						
NITRATE (NO3-N)						
NITRITE (NO2-N)						
TOTAL PHOSPHATE (PO4)						
TRACE ELEMENTS						
ALUMINUM (AL) DISS						
ARSENIC (AR) DISS						
BARIUM (BA) TOTAL						
BARIUM (BA) DISS						
BORON (B) TOTAL						
BORON (B) DISS						
CADMIUM (CD) DISS						
CHROMIUM (CR) DISS						
COPPER (CU) DISS						
IRON (FE) TOTAL						
IRON (FE) DISS						
LEAD (PB) DISS						
MANGANESE (MN) TOTAL						
MANGANESE (MN) DISS						
MERCURY (HG) DISS						
MOLYDENUM (MO) DISS						
NICKEL (NI) DISS						
SELENIUM (SE) TOTAL						
SELENIUM (SE) DISS						
ZINC (ZN) DISS						

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

01-Aug-88 KNW

EXHIBIT 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS #8

STATION LOCATION - WASTE ROCK DISPOSAL SITE

SAMPLE DATE	02/25/88	03/07/88	04/13/88	05/11/88	06/08/88
PHYSICAL PARAMETERS					
AIR TEMPERATURE (C)		-2	18	7	13
WATER LEVEL (FT)	7911.0	7911.3	7910.8	7913.5	7913.5
WATER TEMPERATURE (C)		8	9	9	14
SPEC. COND. (UMHOS/CM) FIELD		7200	7300	3200	3470
PH (SU) FIELD		6.6	7.05	7.05	6.9
TURBIDITY (NTU) FIELD					
COMMON IONS					
ALKALINITY AS CACO3 (LAB)					
BICARBONATE (HCO3) (LAB)		348	328	354	353
CALCIUM (CA)		299	344	299.2	528
CARBONATE AS CO3		<0.10	<0.10	<0.10	<0.10
CHLORIDE (CL)		510	534	538	544
FLUORIDE (FL)		0.28	0.29	0.08	0.27
HARDNESS (CACO3) TOTAL		1380	1340	1304	1400
MAGNESIUM (MG)		134.4	115.2	133.44	19.2
POTASSIUM (K)		5.81	5.86	5.43	5.54
SODIUM (NA)		212.2	240	214.23	249.5
SULFATE (SO4)		760	780	695	830
SULFIDE (S)		<0.01	<0.01	<0.01	<0.01
TOTAL DISS. SOLIDS MEAS.		2110	2188	2065	2355
NUTRIENTS					
AMMONIA (NH3-N)		<0.03	0.14	0.05	0.1
NITRATE (NO3-N)		0.06	0.12	0.1	0.35
NITRITE (NO2-N)		0.03	<0.01	<0.02	<0.02
TOTAL PHOSPHATE (PO4)		0.93	0.36	0.3	0.08
TRACE ELEMENTS					
ALUMINUM (AL) DISS		<0.001	<0.001	<0.001	<0.001
ARSENIC (AR) DISS		<0.002	<0.001	<0.001	<0.001
BARIUM (BA) TOTAL					
BARIUM (BA) DISS		0.01	0.02	0.01	0.01
BORON (B) TOTAL					
BORON (B) DISS		0.14	0.110	0.12	0.01
CADMIUM (CD) DISS		<0.001	<0.001	<0.001	<0.001
CHROMIUM (CR) DISS		<0.001	<0.001	<0.001	<0.001
COPPER (CU) DISS		<0.01	<0.01	0.02	<0.01
IRON (FE) TOTAL					
IRON (FE) DISS		<0.01	<0.01	<0.01	<0.03
LEAD (PB) DISS		<0.001	<0.001	<0.001	<0.001
MANGANESE (MN) TOTAL					
MANGANESE (MN) DISS		<0.01	<0.01	<0.01	<0.01
MERCURY (HG) DISS		<0.0002	<0.0002	<0.0002	<0.0002
MOLYDENUM (MO) DISS		<0.001	<0.001	<0.001	<0.001
NICKEL (NI) DISS		<0.01	<0.01	<0.01	<0.01
SELENIUM (SE) TOTAL					
SELENIUM (SE) DISS		0.003	<0.001	<0.001	<0.001
ZINC (ZN) DISS		0.008	<0.005	0.016	0.006

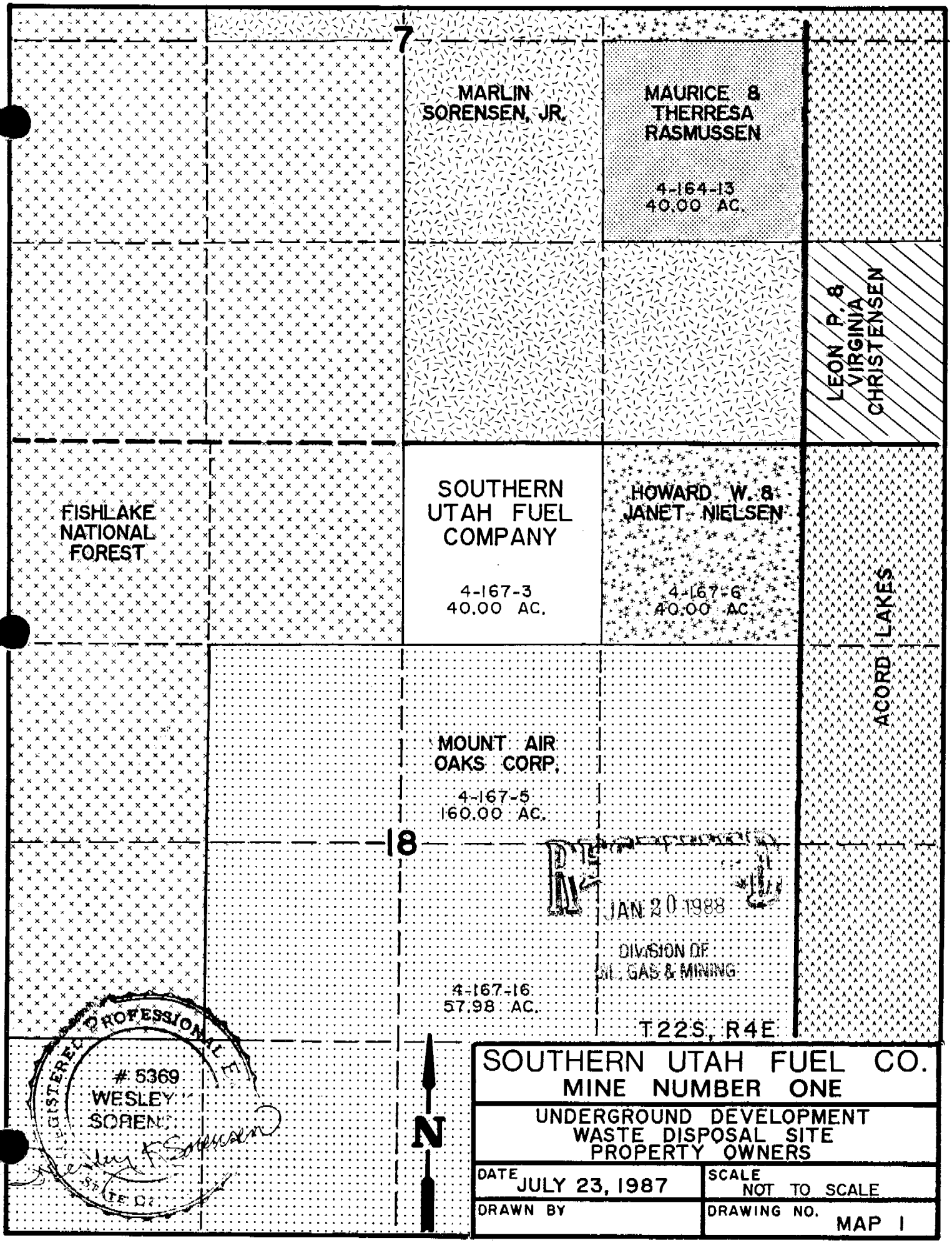
ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.

Exhibit 6
Con't

SUMMARY OF WATER QUALITY
ANALYSES SUFCO - WRDS # 9

SAMPLE DATE	02/25/88	03/07/88	04/13/88	05/11/88	06/08/88	08/09/88
PHYSICAL PARAMETERS						
AIR TEMPERATURE (C)						
DEPTH (FT)	7879.7	7874.8	7877.7	7877.1	7876.5	7874.6
WATER TEMPERATURE (C)						
SPEC. COND. (UMHOS/CM) FIELD						
PH (SU) FIELD						
TURBIDITY (NTU) FIELD						
COMMON IONS						
ALKALINITY AS CACO3 (LAB)						
BICARBONATE (HCO3) (LAB)						
CALCIUM (CA)						
CARBONATE AS CO3						
CHLORIDE (CL)						
FLUORIDE (FL)						
HARDNESS (CACO3) TOTAL						
MAGNESIUM (MG)						
SODIUM (NA)						
SULFIDE (S)						
SULFATE (SO4)						
TOTAL DISS. SOLIDS MEAS.						
NUTRIENTS						
AMMONIA (NH3-N)						
NITRATE (NO3-N)						
NITRITE (NO2-N)						
TOTAL PHOSPHATE (PO4)						
TRACE ELEMENTS						
ALUMINUM (AL) DISS						
ARSENIC (AR) DISS						
BARIUM (BA) TOTAL						
BARIUM (BA) DISS						
BORON (B) TOTAL						
BORON (B) DISS						
CADMIUM (CD) DISS						
CHROMIUM (CR) DISS						
COPPER (CU) DISS						
IRON (FE) TOTAL						
IRON (FE) DISS						
LEAD (PB) DISS						
MANGANESE (MN) TOTAL						
MANGANESE (MN) DISS						
MERCURY (HG) DISS						
MOLYDENUM (MO) DISS						
NICKEL (NI) DISS						
SELENIUM (SE) TOTAL						
SELENIUM (SE) DISS						
ZINC (ZN) DISS						

ALL QUANTITIES IN MILLIGRAMS PER LITER UNLESS OTHERWISE NOTED.



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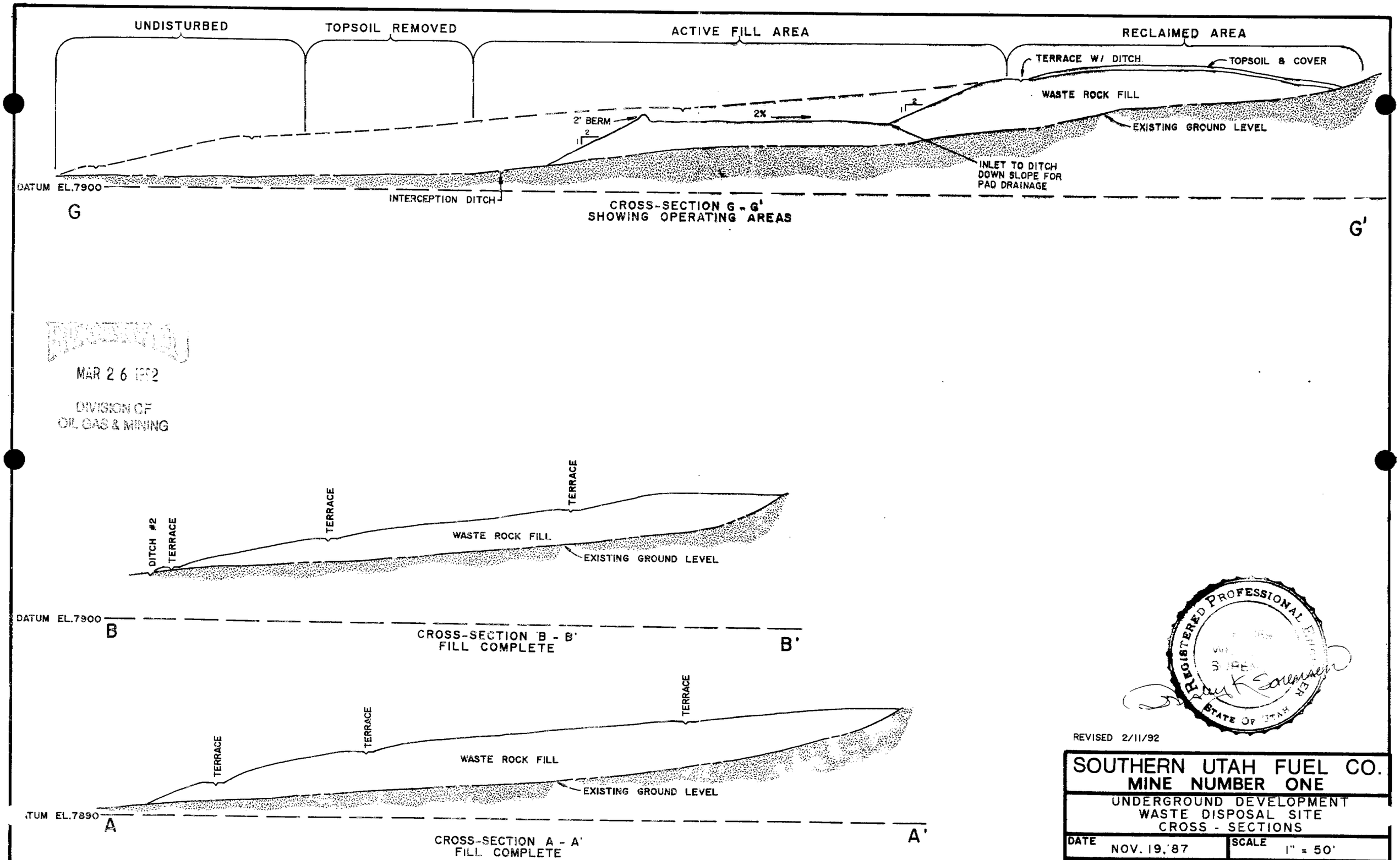
OIL, GAS & MINING



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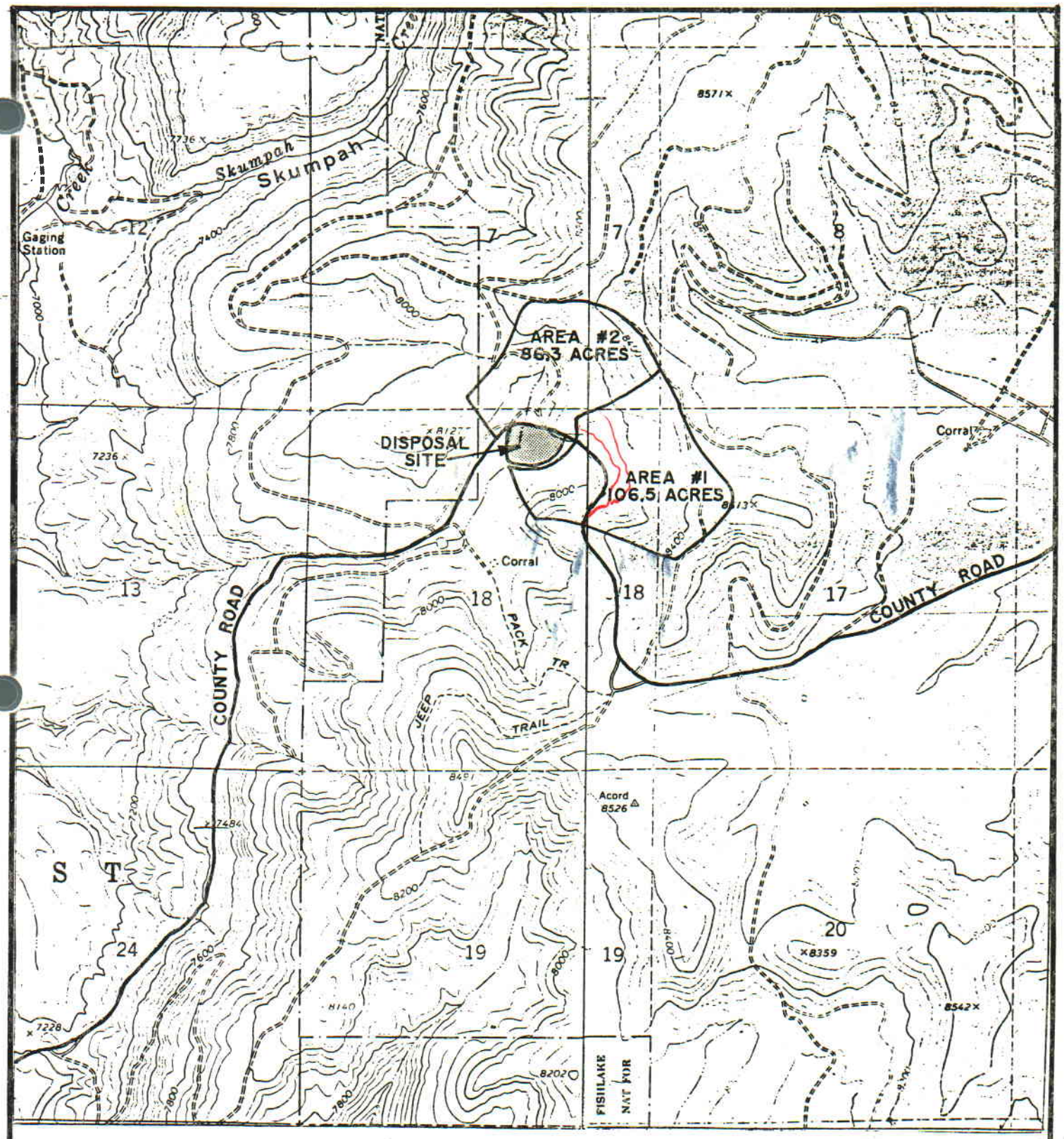
MAR 26 1992
DIVISION OF
OIL GAS & MINING

REVISED 2/11/92

SOUTHERN UTAH FUEL CO. MINE NUMBER ONE	
UNDERGROUND DEVELOPMENT WASTE DISPOSAL SITE CROSS - SECTIONS	
DATE NOV. 19,'87	SCALE 1" = 50'
DRAWN BY S.K.S.	DRAWING NO. FIGURE 2



SOUTHERN UTAH FUEL CO. MINE NUMBER ONE	
UNDERGROUND DEVELOPMENT WASTE DISPOSAL SITE DRAINAGE AREAS	
DATE JULY 23, 1987	SCALE
DRAWN BY	DRAWING NO. MAP 3

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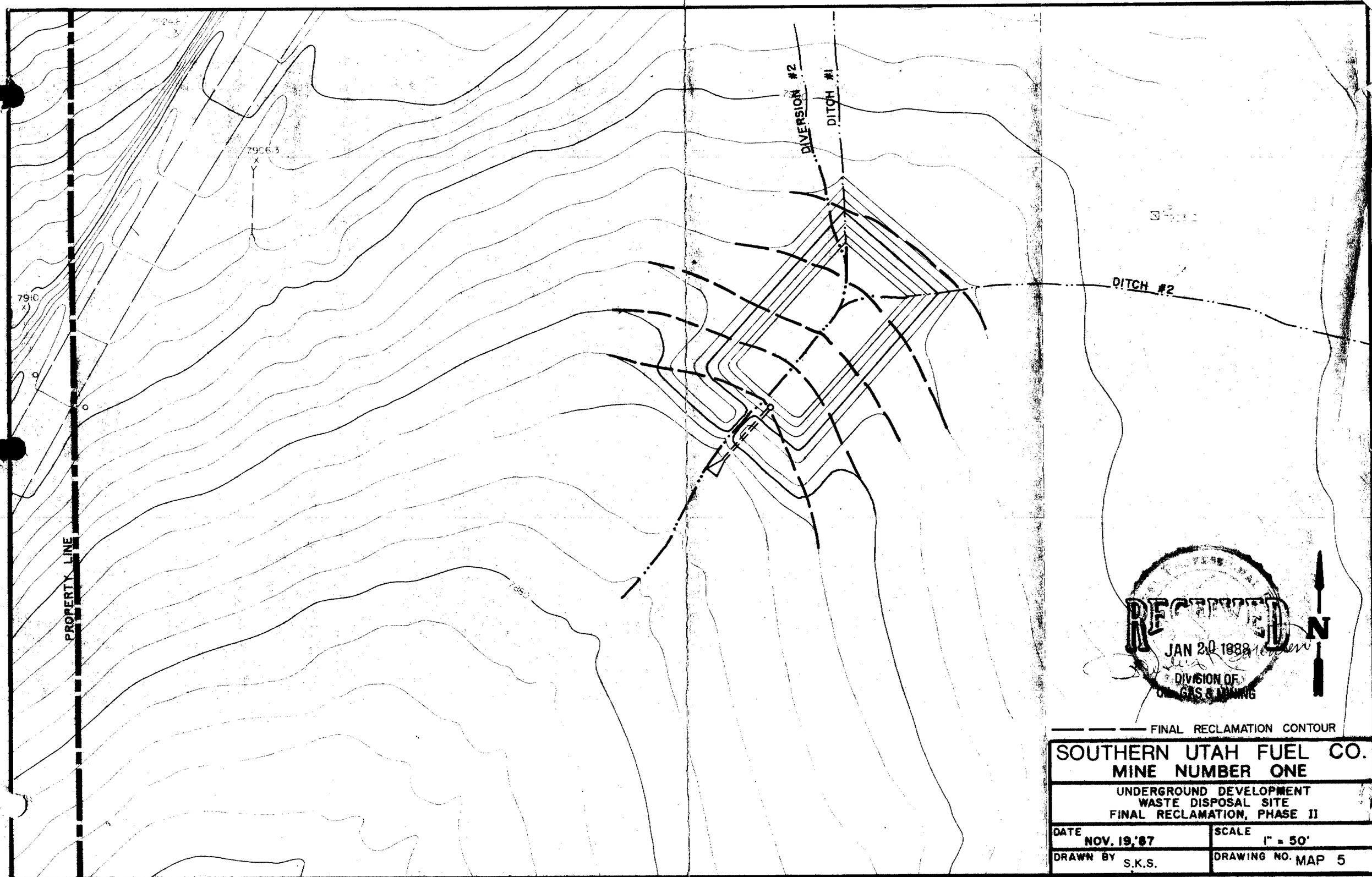
SOUTHERN UTAH FUEL CO. MINE NUMBER ONE	
UNDERGROUND DEVELOPMENT WASTE DISPOSAL SITE DRAINAGE AREA	
DATE NOV. 6,'87	SCALE 1" = 1000'
DRAWN BY	DRAWING NO. MAP 3



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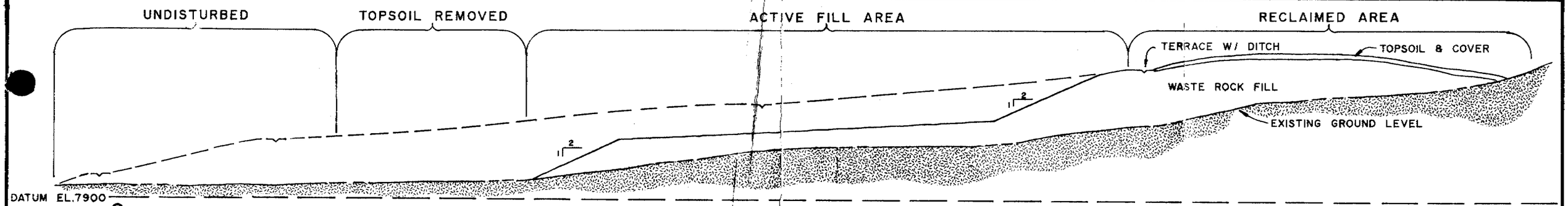
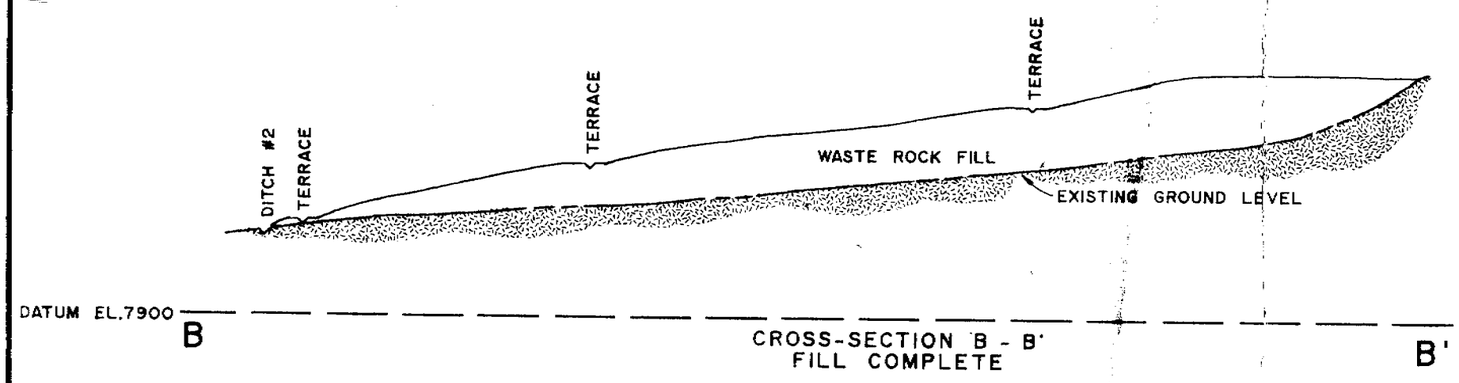
SOUTHERN UTAH FUEL CO.
MINE NUMBER ONE

UNDERGROUND DEVELOPMENT
WASTE DISPOSAL SITE
FINAL RECLAMATION, PHASE II

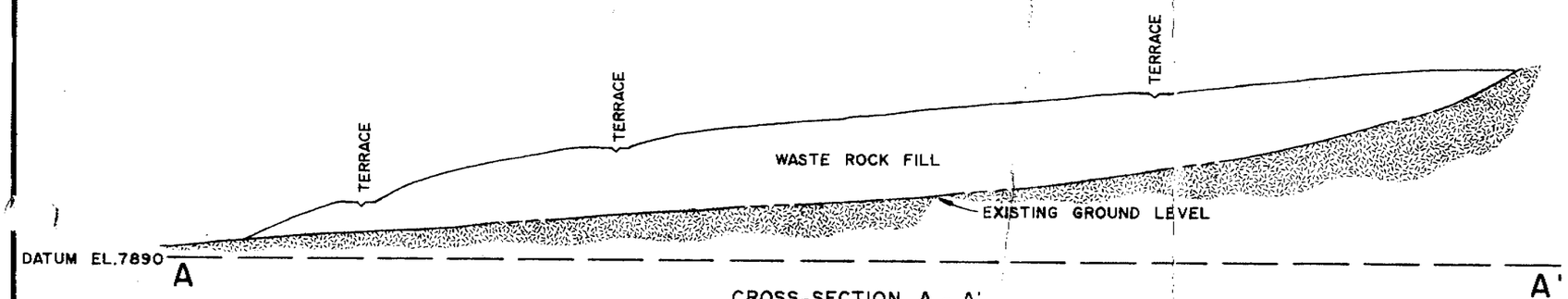
DATE NOV. 19,'87	SCALE 1" = 50'
DRAWN BY S.K.S.	DRAWING NO. MAP 5



CROSS-SECTION G - G'
SHOWING OPERATING AREAS



CROSS-SECTION B - B'
FILL COMPLETE



CROSS-SECTION A - A'
FILL COMPLETE

RECEIVED
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SOUTHERN UTAH FUEL CO. MINE NUMBER ONE	
UNDERGROUND DEVELOPMENT WASTE DISPOSAL SITE CROSS - SECTIONS	
DATE NOV. 19,'87	SCALE 1" = 50'
DRAWN BY S.K.S.	DRAWING NO. FIGURE 2

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JUN 10 1988
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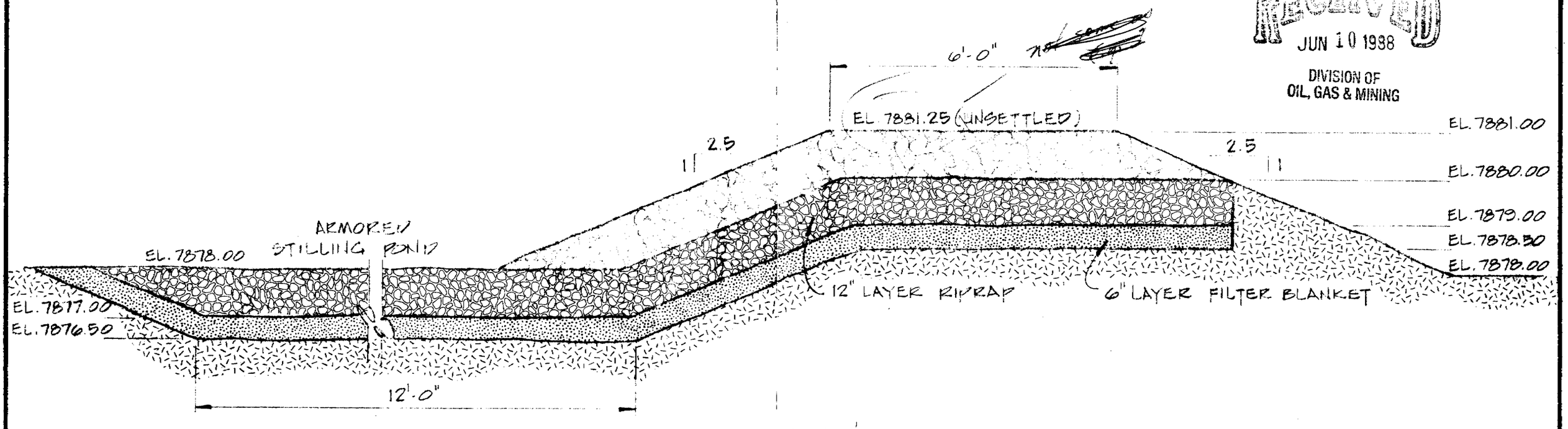
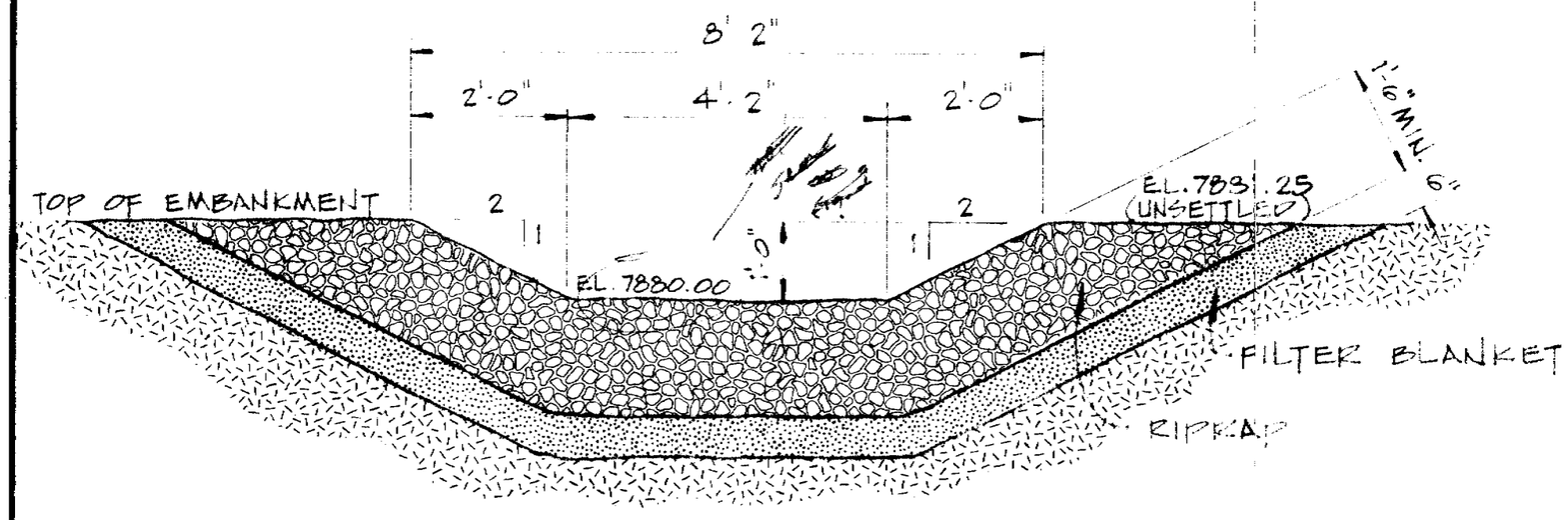
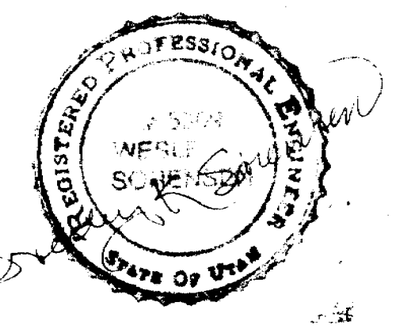


SECTION H-H'



CROSS-SECTION
SPILLWAY IN EARTH BERM



NOTE:
RIPRAP D_{50} = 9"
FILTER BLANKET
3/4" ROAD BASE

Detail of stilling basin below S.E.D. POND

SOUTHERN UTAH FUEL CO. MINE NUMBER ONE	
UNDERGROUND DEVELOPMENT WASTE DISPOSAL SITE - DETAILS	
DATE JUNE 7, 88	SCALE 1" = 2'-0"
DRAWN BY S.K.S.	DRAWING NO. FIG 3

APPENDIX I

Cultural Resource Evaluations
In the Accord Lakes
Locality of Sevier County, Utah

ARCHEOLOGICAL - ENVIRONMENTAL RESEARCH CORPORATION

588 West 800 South Bountiful, Utah 84010
Tel: (801) 292-7061 or 292-9668

September 15, 1983

Subject: Cultural Resource Evaluations in the Acord Lakes Locality of Sevier County, Utah

Project: Southern Fuel Company, Waste Rock Disposal Site

Project No.: SUFC-83-2

Permit: NA

To: Mr. Keith Welch, Coastal States Energy Company, 1354 E. 3300 South, Suite 303, Salt Lake City, Utah 84106

Mr. Michael Davis, Southern Utah Fuel Company, P.O. Box P, Salina, Utah 84654

GENERAL INFORMATION:

On September 14 and 15, 1983, F. R. Hauck of AERC conducted an intensive cultural resource evaluation of the proposed waste rock dump site for Southern Fuel Company. The company requested that an archeological examination of the site be conducted as required in the general preparation of an EAR. The project area is situated on private land in the Acord Lakes locality, drained by the Salina Creek system. The parcel where the dump site will be situated covers from 20 to 30 acres in the northern half of the northeast quarter of Section 18, Township 22 South, Range 4 East. The area consists of a sediment basin adjacent to the south fill slope of the paved highway that links the Southern Fuel Company mine in Convulsion Canyon with Interstate 70 in Salina Canyon. Primary vegetation in the valley is Artemisia tridentata, which, because of its density, obscures from 80% to 90% of the surface. The mean elevation of the study tract is 7900 feet above sea level.

METHODOLOGY:

The archeologist walked a series of 10 to 20 meter wide transects within the proposed dump area and the containment reservoir site. Transects were expanded in size in those areas where surface visibility was most favorable. The majority of the study tract was examined by walking narrow transects so that a high proportion of the exposed surface areas could be evaluated.

An evaluation of the National Register indicates that no registered properties will be adversely affected by the proposed development.

CONCLUSION AND RECOMMENDATIONS:

No cultural resource sites or materials of any historic or prehistoric period were observed during the survey. If significant prehistoric resources exist in the valley, they have been covered by alluvium.

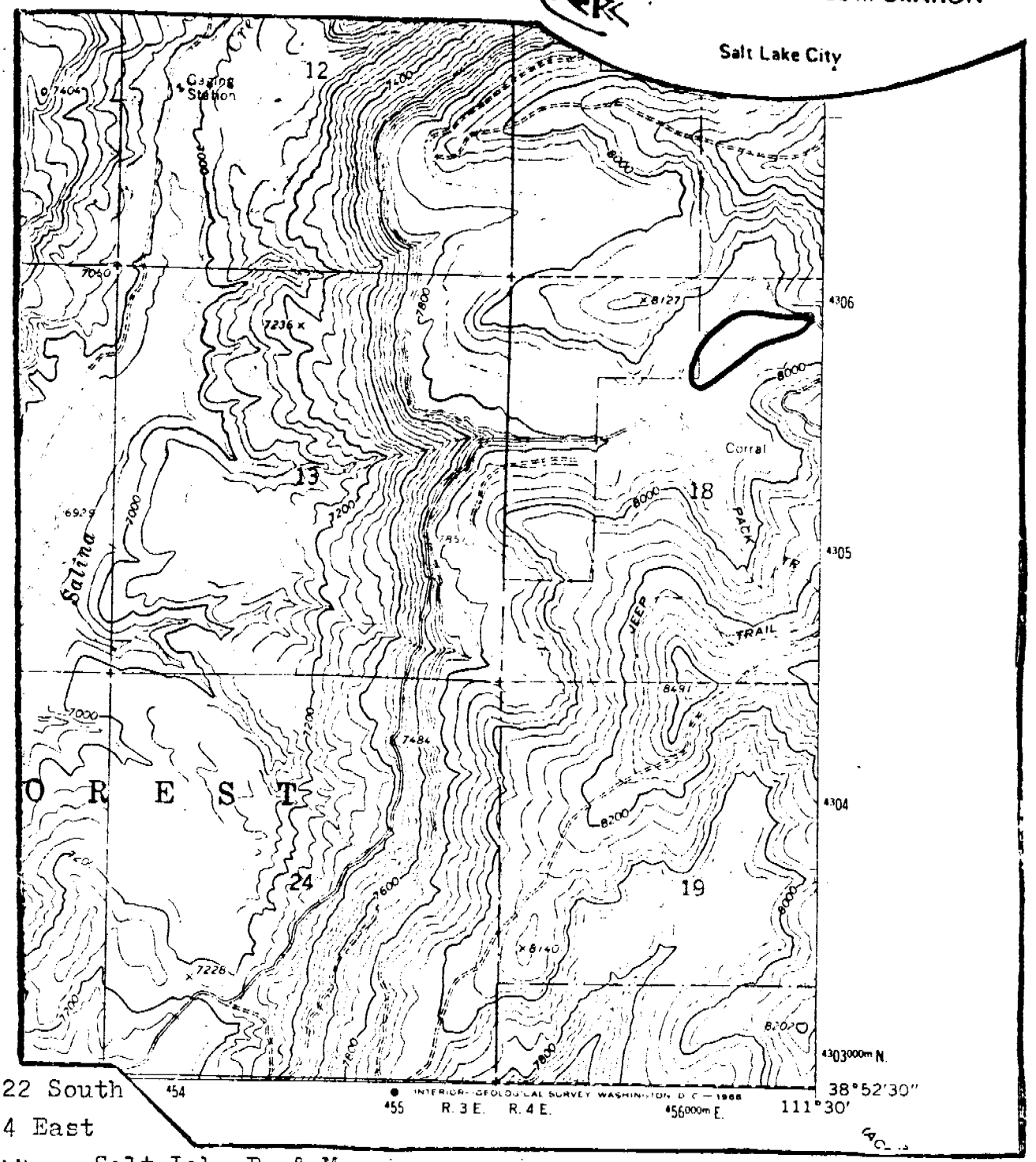
AERC recommends that to minimize adverse impact on buried cultural resources during surface and subsurface development, the following stipulations be considered by the Southern Utah Fuel Company:

1. All construction be confined to the area evaluated;
2. all personnel refrain from disturbing cultural materials uncovered by any construction; and
3. a qualified archeologist should be consulted should cultural materials be exposed during the project development.

F. R. Hauck, Ph.D.
President

ARCHEOLOGICAL-ENVIRONMENTAL RESEARCH CORPORATION

Salt Lake City



T. 22 South

R. 4 East

Meridian: Salt Lake B. & M.

Quad: Water Hollow Ridge Utah 7.5 minute-USGS

Project: SUFC-83-2

Series: Central Utah

Date: 9-15-83

Cultural Resource Survey of a Proposed Waste Rock Disposal Site in the Acord Lake Locality of Sevier County, Utah

Legend: Waste Rock Disposal Site

0 .5 1 Mi.

.5 0 .5 1 Km.

Scale

Appendix II

APPENDIX II

Geotechnical/Hydrological Investigation Report
Waste Rock Disposal Site

SERGENT, HAUSKINS & BECKWITH CONSULTING GEOTECHNICAL ENGINEERS

APPLIED SOIL MECHANICS • ENGINEERING GEOLOGY • MATERIALS ENGINEERING

B. DWAINE SERGENT, P.E.
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JOHN B. HAUSKINS, P.E.
DALE V. BEDENKOP, P.E.
ROBERT L. FREW
DONALD L. CURRAN, P.E.
GEORGE H. BECKWITH, P.E.
ROBERT R. KOONS, P.E.
DONALD G. METZGER, P.G.
ALLON C. OWEN, JR., P.E.
ROBERT D. BOOTH, P.E.
ROBERT W. CROSSLEY, P.E.
RALPH E. WEEKS, P.G.

April 20, 1984

Southern Utah Fuel Company
P.O. Box P.
Salina, Utah 84654

SHB Job No. E83-2011

Attention: Mr. Wesley Sorenson

Re: Waste Rock Disposal Site
Sevier County, Utah
SUFCO Authorization No. 6103

Gentlemen,

Our Geotechnical/Hydrological Investigation Report for the referenced project is herewith submitted. The report includes results of test drilling, laboratory analysis and our design criteria for construction of the facility.

Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,
Sergent, Hauskins & Beckwith Engineers

By Donald L. Curran
Donald L. Curran, P.E.

REGISTERED PROFESSIONAL ENGINEER
No. 6444
DONALD L. CURRAN
State of Utah

By Allon C. Owen
Allon C. Owen, P.E.

Reviewed By Lawrence A. Hansen
Lawrence A. Hansen, Ph.D., P.E.

DLC/clc

Copies: Addressee (3)

REPLY TO: 7117 SOUTH 400 WEST · SUITE 4, MIDVALE, UTAH 84047

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SALT LAKE CITY (801) 566-5411

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MAP POCKET

Site Plan

SHB Job No. E83-2011

1. INTRODUCTION

This report is submitted pursuant to a soil and hydrological investigation made by this firm of the site of the proposed waste rock disposal area in Sevier County, Utah. The object of the investigation was to evaluate the physical properties of the subsoils underlying the site and to determine the groundwater conditions at the site in order to provide criteria for the design of the facility.

2. PROPOSED CONSTRUCTION

Preliminary details of the proposed facility were provided by Mr. Kerry Frame, Mr. Wesley Sorenson and Mr. Mike Davis of Southern Utah Fuel Company.

It is understood that a 40 acre site is being considered for the location of a waste rock disposal area. The waste rock will be generated from coal mining operations. It is estimated that approximately 10,000 tons of non-toxic, non-acid forming waste shale and sandstone per year will be generated. Life of the facility is estimated at 20 years. The design of the disposal area will have to conform to all state and federal regulations. The site will have to provide access to 25 ton end-dump trucks which will haul the waste rock from the mine to the disposal area. It has been indicated to us that it is unlikely that any structure will ever be placed on the fill area.

Should details involved in the final design of the facility vary significantly from those outlined above, this firm should be notified for review and possible revision.

3. INVESTIGATION

3.1 Preliminary Studies

A review of geologic and geohydrologic literature and mapping published by government agencies pertaining to local conditions of the project area was made during the initial phase of this investigation.

3.2 Subsurface Exploration

Seven exploratory borings were drilled with truck-mounted equipment to depths of 25 to 51 feet below existing grades at the site. The borings were performed using 6 1/2 inch O.D. hollow stem augers. Standard penetration testing and open-end drive

sampling were performed at selected intervals in the borings.

In four of the borings, PVC observation wells were installed for the purpose of long term monitoring of the groundwater conditions at the site.

In addition, five backhoe test pits were performed at the site to supplement the soil boring program.

The results of the field investigation are presented in Appendix A, which includes a brief description of drilling and sampling equipment and procedures, logs of the test borings, logs of the test pits and records of the observation well construction details. A site plan showing the boring, test pit and observation well locations is included in a pocket at the back of the report.

The field investigation was supervised by Paul Kaplan and Donald Curran, engineers with this firm.

3.3 Laboratory Analysis

Moisture content determinations were made on selected tube samples recovered, and dry densities were determined for selected 2.42 inch diameter open-end drive samples. The results of these tests are shown on the boring logs.

Grain-size analysis, Atterberg limits and direct shear tests were performed on selected soil samples. The results of these tests are presented in Appendix B along with a brief description of testing procedures.

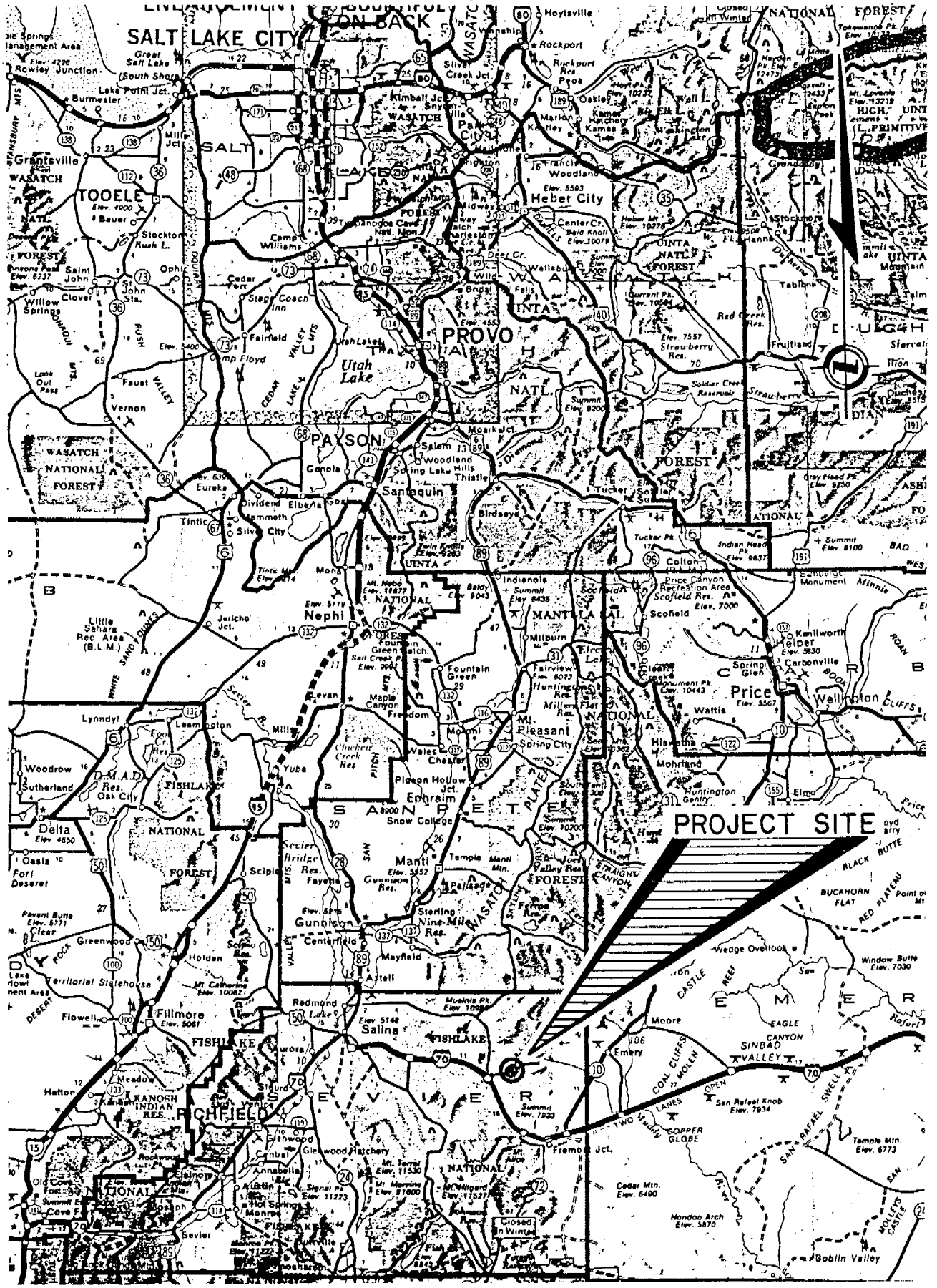
In addition, Atterberg limits, slake durability and point load index tests were performed on samples of waste rock from the mine. The results of these tests are also presented in Appendix B.

4. SITE DESCRIPTION

4.1 Site Location

The location of the site is shown on the Vicinity Map, Figure 1. Specifically, it is located on a 40 acre parcel of property in the northwest 1/4 of the northeast 1/4 of Section 18 and the southwest 1/4 of the southeast 1/4 of Section 7, Township 22 South, Range 4 East, in Sevier County, Utah. The proposed location of the waste rock area will be bounded on the north by the existing county road which goes to the mine and as indicated on the site plan.

FIGURE 1



VICINITY MAP

JOB No. E 83-2011
Nov. 29/83

Scale: Approx. 17.4 Miles

SERGENT, HAUSKINS & BECKWITH

4.2 Geological Setting

The bedrock, which underlies the site and is exposed immediately to the north and east of the site, consist of massive sandstone and sandy, carbonaceous claystone of the Price River Formation (Williams and Hackman, 1971)*. The Price River Formation is part of the Mesaverde Group which is upper Cretaceous in age. The total thickness of the Price River Formation is about 700 feet (Williams and Hackman, 1971), but the thickness below the site has not been determined. As indicated by our reconnaissance, local bedrock dips do not appear to exceed 10 degrees and no major faulting is apparent in the immediate site area. It is our understanding that there has been no underground mining beneath the site.

4.3 Site Topography and Vegetation

The majority of the specific waste rock disposal site is sloping down towards the southwest at a grade which varies from 6 to 10 percent.

The surface is covered with grass, weeds and sagebrush. The heavy sage brush growth over the majority of the site made moving around the area with the truck mounted equipment somewhat difficult.

4.4 Site Drainage

At the time of the site exploration, surface drainage of the immediate site area appeared to be good. No existing springs were noted within the proposed waste rock disposal area. Some spring activity was observed to the north and east of the forty acre parcel of property. It was noted that a cut section of the county road to the east of the property has experienced some localized, shallow seated instability due to spring seepage in the cut slopes.

Drainage of the area to the north of the proposed fill area is directed by culverts through the county road embankment fills. The culverts are located to the east and west of the proposed disposal area.

At the time the exploration was made, the surface of the site was firm and the drilling equipment experienced no problems.

---

* References are listed at the end of the report.

4.5 Geotechnical Profile

As encountered in the seven boreholes and five backhoe test pits performed on site, the Price River Formation is overlain by 4 to 30+ feet of unconsolidated alluvial material. This overburden consists of a soft to hard clay sequence with varying amounts of sand and silt. Subordinate units of clayey sand are also present in the alluvial deposit. The predominant clay units are normally grey to black in color, medium in plasticity and firm to hard in consistency.

4.6 Groundwater & Soil Moisture Conditions

No free groundwater was encountered in the soils overlying the bedrock. Water was encountered in the bedrock formation. Groundwater levels in the observation wells are recorded on the Well Completion Records which are included in Appendix A.

Soil moisture contents were relatively low at the time of the investigation.

4.7 Ground Surface Elevations

The elevation of the ground surface shown on the boring and backhoe test pit logs was determined by interpolation from a two foot interval topographic plot of the site furnished by Southern Utah Fuel Company and is presumably accurate to within ± 1 foot.

4.8 Seismic Zoning Studies

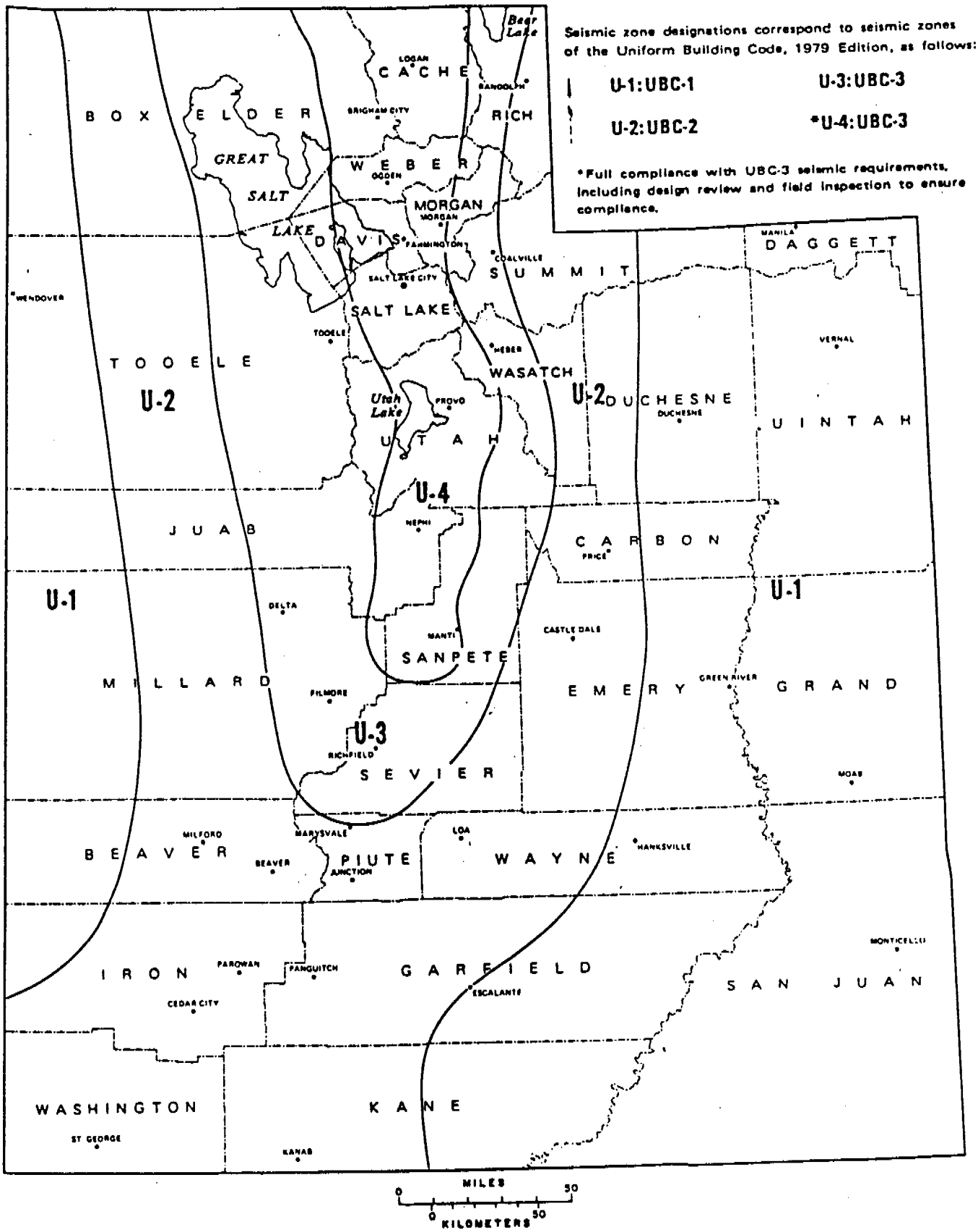
The Utah Seismic Safety Advisory Council (Ward, 1981) has modified the initial studies of Algermissen and Perkins (1976) by considering geologic investigations of the Wasatch Front. The product of this modification is presented in Figure 2, and gives seismic zones delineated throughout Utah. The site area falls near the boundary of UBC zones 2 and 3, but is within the UBC-2 zone.

5. DISCUSSION & RECOMMENDATIONS

The following sections present design criteria for construction of the waste rock disposal area.

Design of the facility must be in accordance with the appropriate regulations contained in "Regulations Pertaining to Surface Effects of Underground Coal Mining Activities", Final Rules of the Utah Borard and Division of Oil, Gas and Mining, Revised September 20, 1982.

FIGURE 2



SEISMIC ZONES
January 1980
(Recommended by the Utah Seismic Safety Advisory Council)

In accordance with UMC 817.71, the sediment pond, diversion ditches and waste rock fill shall be inspected on at least a quarterly basis throughout construction by the geotechnical engineer. Reports are to be provided to the mine office and the Utah Division of Oil, Gas and Mining as to compliance with the project specifications.

5.1 Site Preparation

5.1.1 Surface Treatment

5.1.1.1 Site Clearing

Prior to the placement of any waste rock fill, all vegetative cover shall be removed from the site. After removal of the vegetation, the topsoil shall be removed, stockpiled and properly protected for future reclamation purposes in accordance with the requirements contained in UMC 817.21 through UMC 817.25. It is estimated that approximately 30 inches of topsoil would be removed and stockpiled for future use.

5.1.1.2 Compaction of Natural Soils

The upper 9 inches of natural soils beneath cut surfaces and in the area to receive waste rock fill shall be scarified and recompacted to at least 95 percent of the maximum dry density as determined by ASTM D1557 procedures. Moisture contents during compaction shall be maintained within ± 2 percent of the optimum moisture content for the soil as determined by ASTM D1557.

5.1.2 Site Drainage

Based on the proposed size, configuration and open graded structure of the waste rock fill and its location at the site, no underdrains or rock core chimney drains will be required. There were no springs or seeps within the proposed fill area at the time of the investigation which would require special treatment.

All surface precipitation falling directly on and infiltrating the waste rock fill shall be channelled to a sedimentation pond located down gradient from the toe of the fill by proper contouring of the subgrade prior to placing fill. The sedimentation pond should be designed to handle the 10 year, 24 hour [redacted]. Design criteria for the sedimentation pond are presented in Section 5.3.

5.1.3 Area Drainage

All surface drainage from the areas above the site should be diverted around the fill from the point where it enters the site through the roadway embankment culverts. Surface drainage from the county road above the site must be controlled by a shoulder ditch and diverted away from the fill area. The ditch must comply with section UMC 817.43 (f). Design criteria for the site diversion ditches are presented in Section 5.4.

5.2 Waste Rock Fill Construction Criteria

The waste rock generated at the mine at this time consists of a black to grey shale with some sandstone. Plasticity index, slake durability tests and point load index tests performed on the present waste rock indicate it to be a sound, durable rock. Based on the original mine permit data, the waste rock is non-toxic and non-acid forming. It is anticipated that the waste rock will be flat, elongated pieces with a maximum size of 12 to 18 inches. The gradation of this material will most likely be coarse and poorly graded with a small percentage of sand size or smaller material.

If the characteristics of the waste rock change at a future time, the design of the fill should be reviewed for possible alterations. Based on the life of the facility, the amount of waste produced yearly and the proposed plan area to be covered, the height of the fill is estimated at 13 to 15 feet.

5.2.1 Placement and Compaction

The waste rock material shall be placed in horizontal lifts not to exceed 3 feet in thickness. The material shall be end-dumped from the haul trucks and reworked with suitable sized, self propelled, vibrating compaction equipment which has a push blade suitable for moving the material and leveling the lifts. This method will assist in achieving desired densities and prevent formation of large voids. Additional compaction of each lift should be accomplished by routing the loaded trucks in a pattern over the lift surface in such a manner as to cover the entire area uniformly.

Loads of noncemented, soft shale, clay spoil or fine grained material shall be mixed with coarser graded loads in a controlled manner to limit concentrations of fine materials in the fill.

Due to the anticipated coarse, open graded nature of the waste rock material, most quality control work for the fill will

have to be on a visual basis. Conventional inplace density tests will not give reliable results under these circumstances.

5.2.2 Stability Analysis

Static and pseudostatic stability analysis were performd on the rockfill assuming a critical surface propagating through both the insitu soils and the fill, as well as through the fill alone. A maximum embankment height of 20 feet was considered. Estimated strength parameters for the rock fill and insitu soils are shown on the stability calculations sheets in Appendix C. Due to the open graded nature of the fill material, no pore pressure was assumed in the waste rock in the stability analysis.

Preliminary static analyses were performed using the ordinary method of slices presented in Duncan and Buchignani (1975). The estimated angle of internal friction of 40 degrees is conservative considering the low confining stresses in the shallow rockfill embankment and is supported by rock strength tests cited in Embankment-Dam Engineering, Casagrande, Volume (1973). Trial slip surface generations indicate the most critical case to be the infinite slope condition with a factor of safety of 1.7. Calculations indicate an increase in stability for deeper seated failure surfaces.

Pseudostatic analyses were performed using horizontal acceleration coefficients for the Sevier County site. The following listing enumerates estimated EPA values for the site based on charts presented in Algermisseh and others. (1982).

EPA	Remarks
0.08g	90 Percent probability of not being exceeded in 10 years
0.18g	90 percent probability of not being exceeded in 50 years.
0.40g	90 percent probability of not being exceeded in 250 years.

The yield acceleration, or horizonatal acceleration required to reduce the factor of safety to a value of 1.0 can be estimated from Figure 3, which has been developed from pseudostatic analyses of several similar embankment structures. Design for an earthquake event with a 50 year reoccurence interval results in a pseudostatic safety factor of 1.1 for the infinite slope case. Analyses of deeper seated failures have higher safety factors.

The analyses performed indicate the likely deformation of the embankment structure during a seismic event would be sluffing of surface material. Deep seated deformations would be a maximum of a few inches. Case history data (Seed and others, 1978) indicates stability of rolled earth dams bearing on relatively stiff foundations have withstood extremely strong shaking ranging from 0.35g to 0.8g. from earthquakes having magnitudes as large as 8.25. These data provide high confidence in the stability of the rockfill under similar extreme conditions.

5.2.3 Subsidence

Since no underground mining activity has occured beneath the site, settlement of the fill will result only from the consolidation of the surface soils and elastic compression of the underlying bedrock. It is expected that total settlements on the order of 0.5 to 1.0 inches will occur upon completion of the disposal area.

5.2.4 Construction Schedule

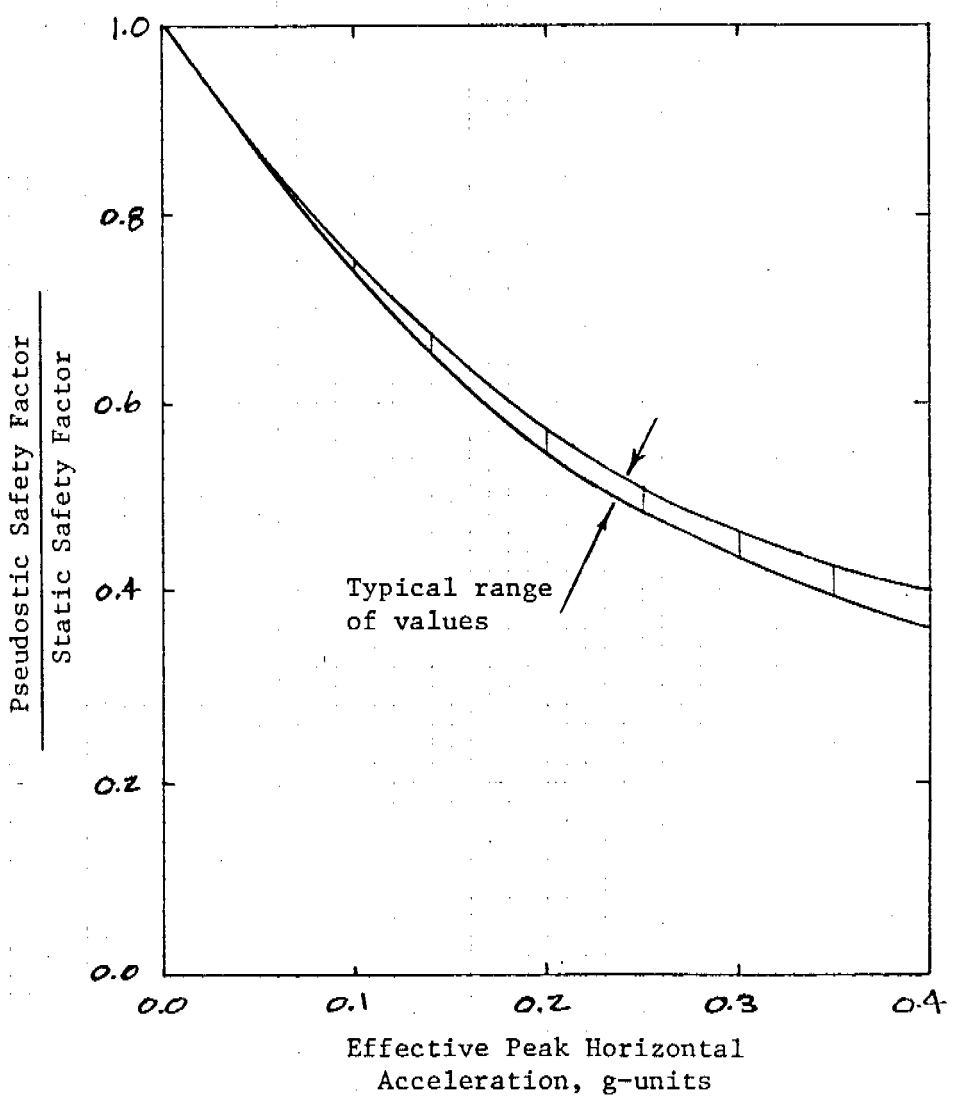
Since the proposed waste rock disposal area is relatively small and access to the haul trucks is limited, horizontal lifts covering the entire proposed site would minimize construction effort and insure continuous stability throughout the mass. If, due to the proposed life of the filling operations (20 years) and the relatively small volumes of fill placed annually, it is required to construct the fill in segments, it is recommended that the construction take place in 75 foot wide strips. The strips should begin along the county road and extend between the drainage diversion ditches.

5.2.5 Fill Contours

All intermittent construction slopes and the final exterior slopes of the fill should not be steeper than 2h:1v. For reclamation purposes, a final exterior slope of 3h:1v may facilitate reseeding of the area.

FIGURE 3

RELATIONSHIP BETWEEN EPA
& PSEUDOSTATIC SAFETY FACTOR



Final slopes of the top surface of the waste rock area shall not exceed 20h:1v, and in no case shall drainage of the precipitation falling on the surface be directed over the outside slope of the fill. Surface runoff should be handled by a diversion ditch at the back of the fill which will collect it and route it into the area diversion ditches adjacent to the site.

5.3 Sedimentation Pond

A sedimentation pond shall be constructed down gradient from the rock fill area to control sediment removed from the disturbed areas by surface runoff in accordance with UMC 817.46. The pond shall be constructed prior to disturbing any other areas of the site. It must remain in place until the waste rock disposal area has been completely restored.

The pond shall consist of an excavated storage basin with slopes not steeper than 2.5h:1v. Suitable material removed from the excavation shall be used to construct an embankment on the downstream perimeter of the excavation to yield an average storage depth in the pond of 5.5 feet. The embankment shall have a top width of 10 feet, a maximum height of 7.3 feet with exterior side slopes of 2.5h:1v.

In accordance with Section 73-5-12 of the Utah Code Annotated 1953, before commencing construction of the sediment pond for the project, written notice should be given to the State Engineer, Division of Water Rights. The following information for the low height, small capacity, low hazard impoundment needs to be included in the submittal:

1) Name of the impoundment.
2) General location with reference to section, township and range.
3) Approximate capacity.
4) Height of the embankment.
5) Plans and specifications for construction.

5.3.1 Site Preparation

The embankment and excavated pond area shall be grubbed of all organic material and the topsoil removed and stored for future use. It is estimated that 30 inches of topsoil will have to be removed from the area.

5.3.2 Embankment

The top 9 inches of the grubbed and stripped area for embankment construction shall be scarified and recompacted to 90 percent of the maximum dry density as determined by ASTM D1557 procedures. Moisture content during compaction should be maintained at -1 to +3 percent of the optimum as determined by ASTM D1557.

Embankment fill material shall be placed in horizontal lifts not exceeding 9 inches in thickness prior to compaction. Embankment material shall be compacted to 90 percent of the maximum dry density as determined by ASTM D1557. Moisture content during compaction shall be maintained at -1 to +3 percent of the optimum as determined by ASTM D1557.

Embankment material shall be free of organic material. It shall have a plasticity index as determined by ASTM D423 and D424 of not less than 5. Waste rock shall not be used for embankment fill for the settling pond.

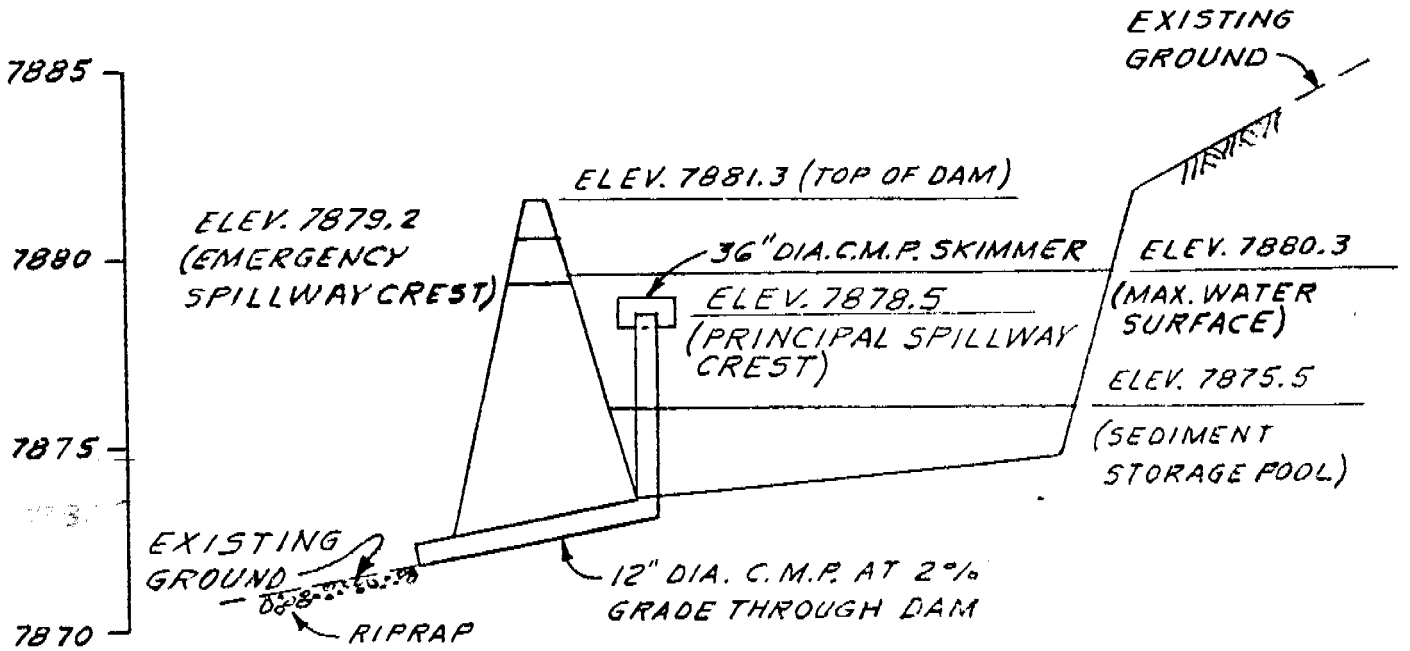
The embankment shall be constructed with interior and exterior slopes of 2.5h:1v. Minimum width of the top of the embankment shall be 10 feet. The top of the embankment shall be constructed at an elevation of 7881.3 feet, providing 1.0 foot of freeboard above the maximum water surface. To prevent erosion the exterior slopes should be vegetated and the interior slopes covered with rip rap and filter fabric in accordance with the recommendation presented in Section 5.3.3.

5.3.3 Principal Spillway

The principal spillway shall consist of a 12 inch diameter corrugated metal pipe (CMP) with the inlet at an elevation of 7878.5 feet. A 36" CMP skimmer shall be placed around the inlet as shown in Figure 4.

The CMP shall be placed at an average gradient of 2 percent through the embankment. Structural fill within 2.0 feet of the CMP shall be hand compacted to a dry density of at least 90 percent of ASTM D1557 at a moisture content of -1 to +3 percent of optimum. During placement and compaction of the fill along the CMP, the pipe should be preloaded to prevent it from pushing up and out of alignment. Preload should be maintained until at least 1/2 the pipe diameter has been placed and compacted. One anti-seep collar with minimum dimensions of 3 feet high by 3 feet wide shall be placed around the CMP at a location near the center of the embankment. The anti-seep collar shall have a water-tight connection to the CMP.

FIGURE 4



SECTION THROUGH SEDIMENT POND

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 5'

WASTE ROCK DISPOSAL SITE
SEVIER COUNTY, UTAH
S.H.B. JOB NO. E83-2011

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At the outlet of the principal spillway there shall be a rip rap apron as shown on the site plan to prevent damage to the downstream embankment slope.

Rip rap shall conform to the following gradation:

Size, Inches	Percent Passing
9	100
4	45-35
2	15-0

Rip rap shall be hard, durable and free from rocks having a maximum dimension three or more times greater than the minimum dimension of the particle. The percent wear when subjected to the Los Angeles abrasion test (ASTM C131) shall be no more than 45 and the percent loss when subjected to the sodium sulfate soundness test (ASTM C88) shall be no more than 15.

Prior to rip rap placement, a filter fabric such as Phillips 66 SUPAC 5NP, Mirafi 140N, DuPont TYPAR 3401 or an approved equivalent, shall be placed on the prepared soil surface to prevent erosion and undermining of the rip rap. If mechanical equipment is used to place rip rap, the stones should be dropped from a height of no more than 1 foot to prevent puncturing of the fabric. A sand blanket could also be placed over the fabric to protect it from punctures during rip rap placement.

5.3.4 Hydrologic Design Criteria of the Sedimentation Pond

Calculations of hydrologic design criteria are presented in Appendix D. Runoff volumes were calculated using SCS procedures and flow peaks were calculated using the rational method (Barfield et al., 1981).

The maximum capacity of the proposed sediment pond is 52,000 cubic feet. An ultimate sediment load was determined to be 17,000 cubic feet. Sediment volume is based on 0.1 acre-foot for each acre of disturbed area and 1 acre-foot per year for each square mile of undisturbed area. In addition, a 10 year, 24 hour storm on the area would produce 22,000 cubic feet of runoff. The total storage required for the reservoir is therefore 39,000 cubic feet. The additional storage is to allow for unforseen site conditions.

The emergency spillway was designed to convey a 25 year, 24 hour flood flow through the pond safely with one foot of freeboard, assuming the pond was full at the beginning of the storm and no routing in the pond. The emergency spillway shall consist of a rip rap lined ditch with a V shaped cross-section. The side slopes shall be 3h:1v and have a minimum depth of 2.0 feet. Rip rap and filter fabric shall be in accordance with the recommendations in Section 5.3.3. The crest elevation of the spillway shall be 7879.2 feet.

5.3.5 Operating Pool Requirements

The sediment pond provides capacity in excess of requirements with present project conditions. The principle maintinance requirement will be sediment removal. When the sediment storage area is 60 percent full, which is at elevation 7874.6 feet, sediment must be removed from the pond. Figure D-1 in Appendix D presents the elevation versus storage volume curve for the sediment pond.

5.4 Diversion Ditches

Diversion ditches shall be provided to route runoff from watersheds No. 1 and No. 2, as shown on Figure 5, around the disturbed areas and sediment pond. Ditch No. 3 will convey runoff from the road and disposal area to the sediment pond.

The maximum flow resulting from a 100 year, 24 hour storm was used as the design flow for each of the diversions. Ditches No. 1 & 3 shall be V shaped in cross section with rip rap protection and 3h:1v slopes. Depths of 2.25 feet and 1.20 feet will permit passage of 51 cfs and 5.4 cfs, respectively, with 0.5 foot of freeboard. Ditch No. 2 shall be trapezoidal in section with a bottom width oof 9 feet, side slopes of 3h:1v and a depth of 1.40 feet to safely convey the flow of 51 cfs with a freeboard of 0.5 feet. Design calculations are included in Appendix D.

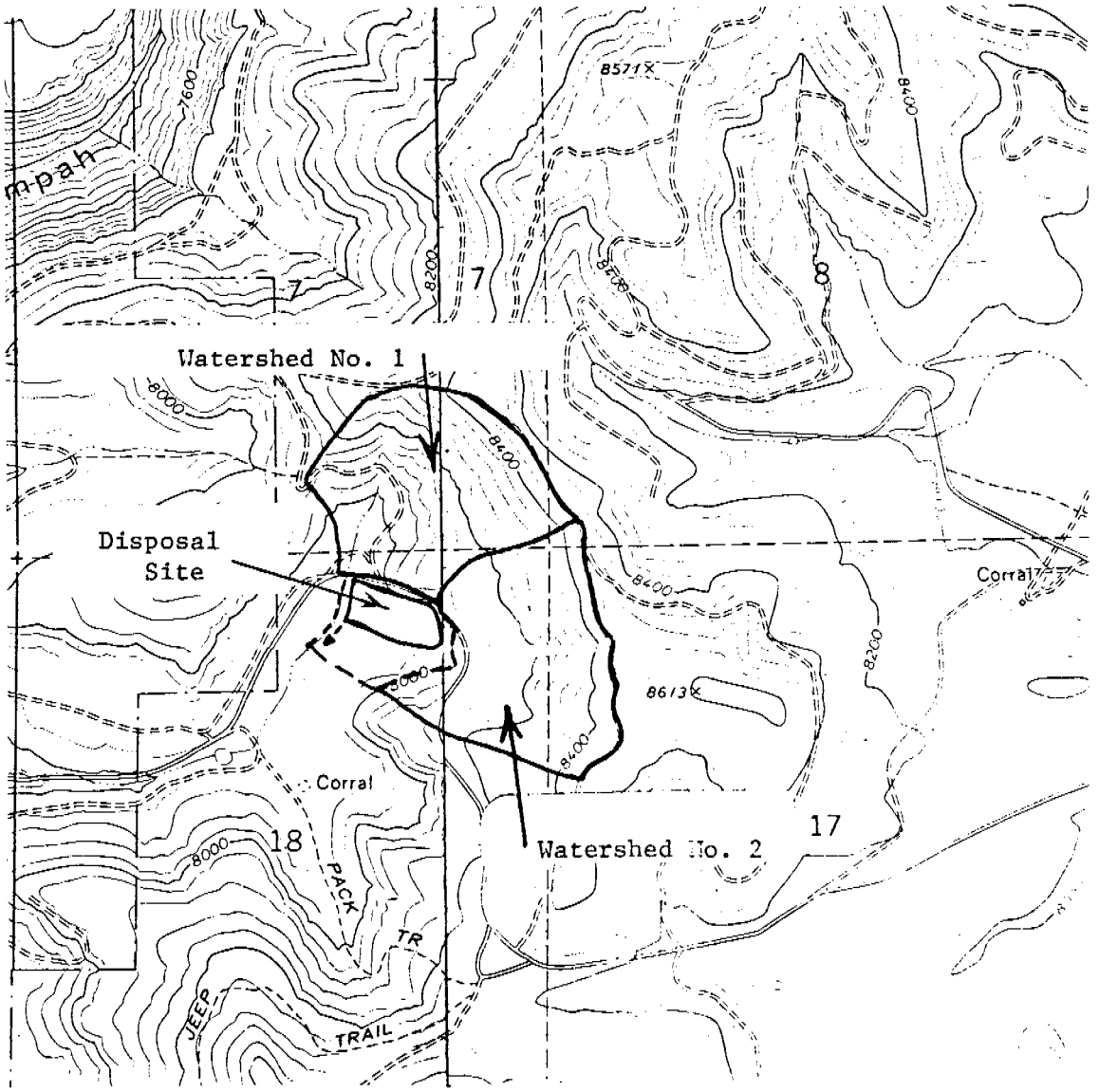
The channel invert shall be prepared in accordance with the typical cross sections as shown on Figure 6. Rip rap and filter fabric shall be placed in accordance with the recommendation in Section 5.3.3.

5.5 Reclamation

Reclamation of the fill area will be required as per UMC 817.101 and UMC 817.111.

The disturbed areas shall be graded, reseeded and restored to resemble as closely as reasonable the surrounding terrain.

FIGURE 5



Reference Drawing: USGS Quad Maps, 7.5 Minute Series, Accord Lakes, Utah and Water Hollow Ridge, Utah.

N

Not to scale

WATERSHED PLAN

Waste Rock Disposal Site
Sevier County, Utah
SHB Job No. E83-2011

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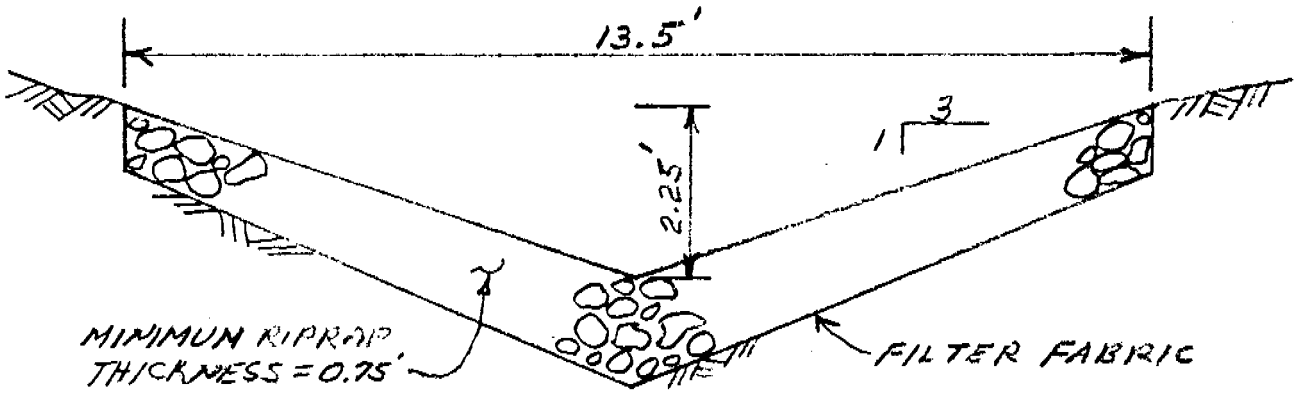
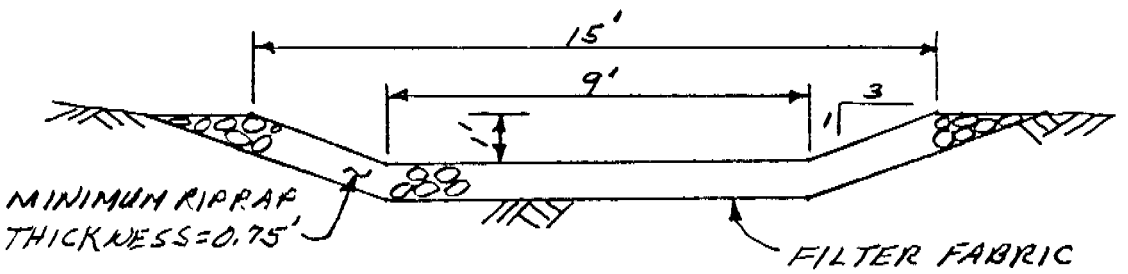
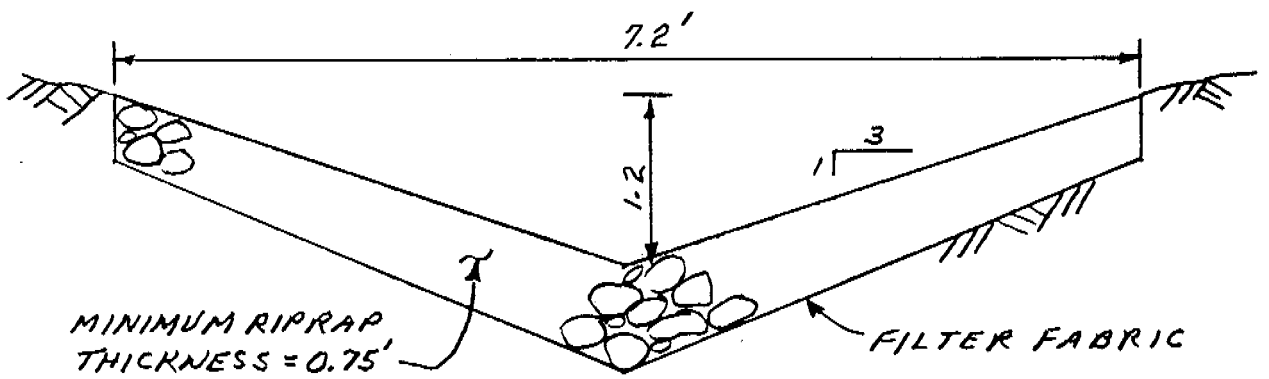
FIGURE 6
DIVERSION DITCHES



TYPICAL SECTION
DIVERSION DITCH NO. 1
N.T.S.



TYPICAL SECTION
DIVERSION DITCH NO. 2
N.T.S.



TYPICAL SECTION
DIVERSION DITCH NO. 3
N.T.S.

WASTE ROCK DISPOSAL SITE
SEVIER COUNTY, UTAH
S.H.B. JOB NO. E 83-2011

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TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment Truck-mounted CME-55 drill rigs powered with 4 or 6 cylinder Ford industrial engines are used in advancing test borings. The 4 cylinder and 6 cylinder engines are capable of delivering about 4,350 and 6,500 foot/pounds torque to the drill spindle, respectively. The spindle is advanced with twin hydraulic rams capable of exerting 12,000 pounds downward force. Drilling through soil or softer rock is performed with 6 1/2 O.D., 3 1/4 I.D. hollow stem auger or 4 1/2 inch continuous flight auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils which require blasting or very heavy equipment for excavation. Where refusal is experienced in auger drilling, the holes are sometimes advanced with tricone gear bits and NX rods using water or air as a drilling fluid. Where auger and tricone gear bits cannot be used to advance the hole due to cobbles or caving conditions, the ODEX (overburden drilling with the eccentric method) is used. A percussion down-the-hole hammer underreams the hole and 5 inch steel casing is introduced into the hole during drilling. The drill bit is eccentric and can be removed from the center of the casing to allow sampling of the material below the bit penetration depth.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the samplers in 6 inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3 inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587). Where samples of rock are required, they are obtained by NX diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

Continuous Penetration Tests Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1 5/8" O.D. drill rods to provide clearance to minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487) with appropriate group symbols being shown on the logs.

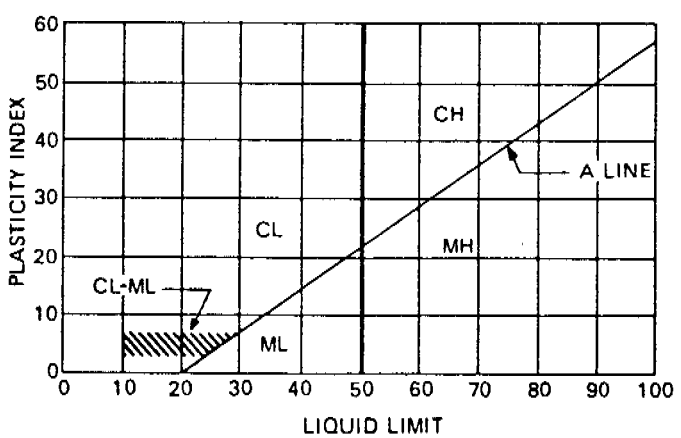
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (LIMITS PLOT BELOW "A" LINE & HATCHED ZONE ON PLASTICITY CHART)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (LIMITS PLOT ABOVE "A" LINE & HATCHED ZONE ON PLASTICITY CHART)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 9-13-83

LOG OF TEST BORING NO. 1

RIG TYPE CME-55

BORING TYPE 6¼" Dia. Hollow Stem Auger

SURFACE ELEV. 7909 ±

DATUM U.S.G.S.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	22			ML	dry	SANDY SILT, with organic material, dark brown TOPSOIL.
			X	S	24		9	CL	slightly moist firm	SILTY CLAY, some sand, medium plasticity, grey-brown.
5			X	S	45		13			
			X	S	31		15	CL	moist firm to very firm	SILTY CLAY, some sand, medium plasticity, black to dark brown with white streaks. (fine roots to depth of 7.0').
10			X	S	38					
			X	S	41		16			
15			X	S	26		14	CL	moist firm to very firm	SANDY CLAY, fine sand, medium plasticity, olive green.
20			X	S	30-50/4¼"		13		moist hard	CLAYSTONE, olive green with rust-brown staining.
25			X	S	50/4½" Seat					Auger stopped at 24'6". Sampler stopped at 24'10½".

GROUND WATER

DEPTH	HOUR	DATE
Dry	0.0	9-13-83

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier Co. Ut.

JOB NO. E83-2011 DATE 9-14-83

LOG OF TEST BORING NO. 2

RIG TYPE CME-55

BORING TYPE 6½" Dia. Hollow Stem Auger

SURFACE ELEV. 7897 ±

DATUM U.S.G.S.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	8				slightly moist to moist soft to firm	SANDY SILT, fine sand, low plasticity, light olive green, (fine roots to depth of 4.0').
			X	S	23			ML		
5			X	S	26		13		moist firm	SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
10			X	U	50	118	12	CL		
15			X	S	8			SC	moist soft to very firm	CLAYEY SAND, trace gravel (sandstone fragments), low to non plastic, brown.
20			X	S	40				moist hard	SANDSTONE, weathered, fine grained, tan.
25			X	S	51					
30			X	S	50/1½" Seat				moist hard	SANDSTONE, fine grained, reddish brown.
35				S	50/½" Seat					
				S	50/0" Seat					
40										Sampler refusal at 39'6". Auger refusal at 41'4".

GROUND WATER

DEPTH	HOUR	DATE
Dry	0.0	9-14-83

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

U – 3" O.D. 2.42" I.D. tube sample.

T – 3" O.D. thin-walled Shelby tube.

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A

PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 9-14-83

LOG OF TEST BORING NO. 3

RIG TYPE CME-55

BORING TYPE 6½" Dia. Hollow Stem Auger

SURFACE ELEV. 78~~88~~ ±

DATUM U.S.G.S.

Depth Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	13			ML	slightly moist moderately firm	CLAYEY SILT, some fine sand, low plasticity, dark brown, (roots to depth of 2').
			X	S	28				moist firm to hard	SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
5			X	S	31		15			
10			X	U	78	108	18	CL		
15			X	S	19			SC	very moist firm	CLAYEY SAND, with fine gravel, non plastic, tan grading to light grey.
20			X	S	47		21	CL	moist very firm	SILTY CLAY, medium plasticity, grey with rust colored streaks, (possibly CLAYSTONE).
25				S	50/0"				moist hard	SANDSTONE, fine grained, reddish brown.
30				S	50/0" Seat					Auger refusal at 29'6". Sampler refusal at 29'6"

*Observation well installed. See completion record for details.

GROUND WATER

DEPTH	HOUR	DATE
*		

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier, Co., Ut.

LOG OF TEST BORING NO. 4

JOB NO. E83-2011 DATE 9-13-83

RIG TYPE CME-55
BORING TYPE 6½" Dia. Hollow Stem Auger
SURFACE ELEV. 7923 ±
DATUM U.S.G.S.

Depth set	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	5		19	ML	slightly moist to moist soft to firm	SANDY SILT, low plasticity, dark brown, (fine roots to 1.5').
			X	S	11		12			
5			X	S	15		12			
10			X	S	12		16	CL	moist firm to moderately firm	SILTY CLAY, some fine sand, medium plasticity, dark brown with white streaks.
15			X	S	21		12	SC	moist firm	CLAYEY SAND, some gravel, low plasticity, greenish grey.
20			X	S	9		18	CL	moist moderately firm	SILTY CLAY, some fine sand, medium plasticity, dark brown with white streaks.
			X	S	11		12	ML	moist moderately firm	CLAYEY SILT, some fine sand, low to non plastic, light olive green.
25			X	S	9		14			Stopped auger at 24'6". Stopped sampler at 26'0".

GROUND WATER

DEPTH	HOUR	DATE
dry	0.0	9-13-83

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 9-15-83

LOG OF TEST BORING NO. 5

RIG TYPE CME-55

BORING TYPE 6½" Dia. Hollow Stem Auger

SURFACE ELEV. 7967 ±

DATUM U.S.G.S.

Depth in feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	13				slightly moist moderately firm to firm	SANDY SILT, low plasticity, dark brown, (fine roots to 8').
			X	S	21					
5			X	S	21			CL		
10			X	S	38			CL	slightly moist firm to hard	SILTY CLAY, some fine sand, medium plasticity, dark brown with white streaks.
15			X	S	21					
20			X	S	27					
25			X	S	38					
30			X	S	56				moist hard	SANDSTONE, weathered, fine grained, tan.
35			X	S	56					
40			X	S	74				moist hard	Claystone, ôlive green .
45				S	50/2" Seat				moist hard	CLAYSTONE, thinly layered, black.
				S	50/3" Seat					Auger refusal at 47'0". Sampler refusal at 47'3".
50										

*Observation well installed, see completion record for details.

GROUND WATER

DEPTH	HOUR	DATE
*		

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 9-14-83

LOG OF TEST BORING NO. 6

RIG TYPE CME-55

BORING TYPE 6½" Dia. Hollow Stem Auger

SURFACE ELEV. 7920±

DATUM USGS

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	26			CL	slightly moist to moist firm	SILTY CLAY, considerable sand, low plasticity, dark brown.
			X	S	24					
5			X	S	54				moist hard	CLAYSTONE, olive green to dark olive green.
10			X	S	45-50/4"					
15			X	S	50/2 1/2" Seat					
20				S	50/3"					
									moist hard	CLAYSTONE, black.
25			X	S	50/5" Seat					
30				S	50/1/2" Seat				moist hard	SANDSTONE, fine grained, grey.
35				S	50/0"					
40				S	50/1" Seat				moist hard	SANDSTONE, fine grained, reddish brown.
45				S	50/1" Seat					Sampler refusal at 44'7" Auger refusal at 46'0"
										*Observation well installed. See completion record for details.

GROUND WATER

DEPTH	HOUR	DATE
*		

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 9-15-83

LOG OF TEST BORING NO. 7

RIG TYPE CME-55

BORING TYPE 6½" Dia. Hollow Stem Auger

SURFACE ELEV. 7946±

DATUM U.S.G.S.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	18			CL	slightly moist firm	SANDY CLAY, medium plasticity, tan, (fill).
			X	S	11			CL	moist moderately firm	SANDY CLAY, some fine gravel, medium plasticity, dark grey to black, (fill).
5			X	U	27				moist firm	SANDY CLAY, considerable fine to coarse gravel and cobbles, medium plasticity, olive green, (fill).
10			X	U	25			CL		
15			X	U	35					
20			X	S	16					
25			X	S	10			CL	very moist moderately firm	SILTY CLAY, some fine sand, medium plasticity, black.
30			X	U	76			CL	moist very firm to hard	SANDY CLAY, fine sand, medium plasticity, olive green.
35			X	S	39					
40			X	U	36	110	17	CL	moist to very moist moderately firm to very firm	SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
45			X	S	14					
50										

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 9-15-83

LOG OF TEST BORING NO. 7

RIG TYPE CME-55

BORING TYPE 6½" Dia. Hollow Stem Auger

SURFACE ELEV. 7946±

DATUM U.S.G.S.

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	27			CL		SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
55										Stopped auger at 49'6". Stopped sampler at 51'0".
										*Observation well installed - see completion record for details.

GROUND WATER

DEPTH	HOUR	DATE
*		

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.
T – 3" O.D. thin-walled Shelby tube.

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PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 10-3-83

LOG OF TEST PIT NO. TP-1

Backhoe Type Case

Location –

Elevation 7871±

Datum U.S.G.S.

GROUND WATER

DEPTH	HOUR	DATE
none	0.0	10-3-83

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D	12	CL	slightly moist to moist	SILTY CLAY, some fine sand, medium plasticity, dark grey to black.
5		X	D	19	CL	moist	SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
10		X	D			moist	Weathered SANDSTONE, brown.
							Stopped backhoe at 11'.

10-3-83

LOG OF TEST PIT NO. TP-2

Backhoe Type Case

Location –

Elevation 7879±

Datum U.S.G.S.

GROUND WATER

DEPTH	HOUR	DATE
none	0.0	10-3-83

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	slightly moist	CLAYEY SILT, considerable fine sand, low plasticity, light brown.
		X	D			moist	SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
5					CL		
		X	D				
10		X	D		CL	moist	SANDY CLAY, fine sand, medium plasticity, olive green.
							Stopped backhoe at 12'.

SAMPLE TYPE
B – Undisturbed Block Sample
D – Disturbed Bulk Sample

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JOB NO. E83-2011 DATE 10-3-83

LOG OF TEST PIT NO. TP-3

Backhoe Type Case

Location -

Elevation 7911±

Datum U.S.G.S.

GROUND WATER

DEPTH	HOUR	DATE
Dry	0.0	10-3-83

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	moist	CLAYEY SILT, considerable fine sand, low plasticity, light brown.
5		X	D	17	CL	moist	SILTY CLAY, some fine sand, medium plasticity, dark grey with white streaks.
10		X	D		CL	moist	SANDY CLAY, fine sand, medium plasticity, olive green.
							Stopped backhoe at 12'.

10-3-83

LOG OF TEST PIT NO. TP-4

Backhoe Type Case

Location -

Elevation 7910±

Datum U.S.G.S.

GROUND WATER

DEPTH	HOUR	DATE
Dry	0.0	10-3-83

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	moist	SANDY SILT, low plasticity light brown.
					CL	moist	SILTY CLAY, some fine sand, medium plasticity, dark grey to black.
5		X	D	5		moist	SILTY SAND, fine to medium grained sand, low to non plastic, grey brown.
10		X	D		SM		
							Stopped backhoe at 12'.

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT Waste Rock Disposal Site, Sevier Co., Ut.

JOB NO. E83-2011 DATE 10-3-83

LOG OF TEST PIT NO. TP-5

Backhoe Type Case

Location -

Elevation 7945±

Datum U.S.G.S.

GROUND WATER

DEPTH	HOUR	DATE
Dry	0.0	10-3-83

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	moist	SANDY SILT, low plasticity, light brown.
5		X	D	5	ML	moist	SANDY SILT, fine grained sand, low plasticity, dark brown.
10		X	D	10			
							Stopped backhoe at 12'.

LOG OF TEST PIT NO.

Backhoe Type

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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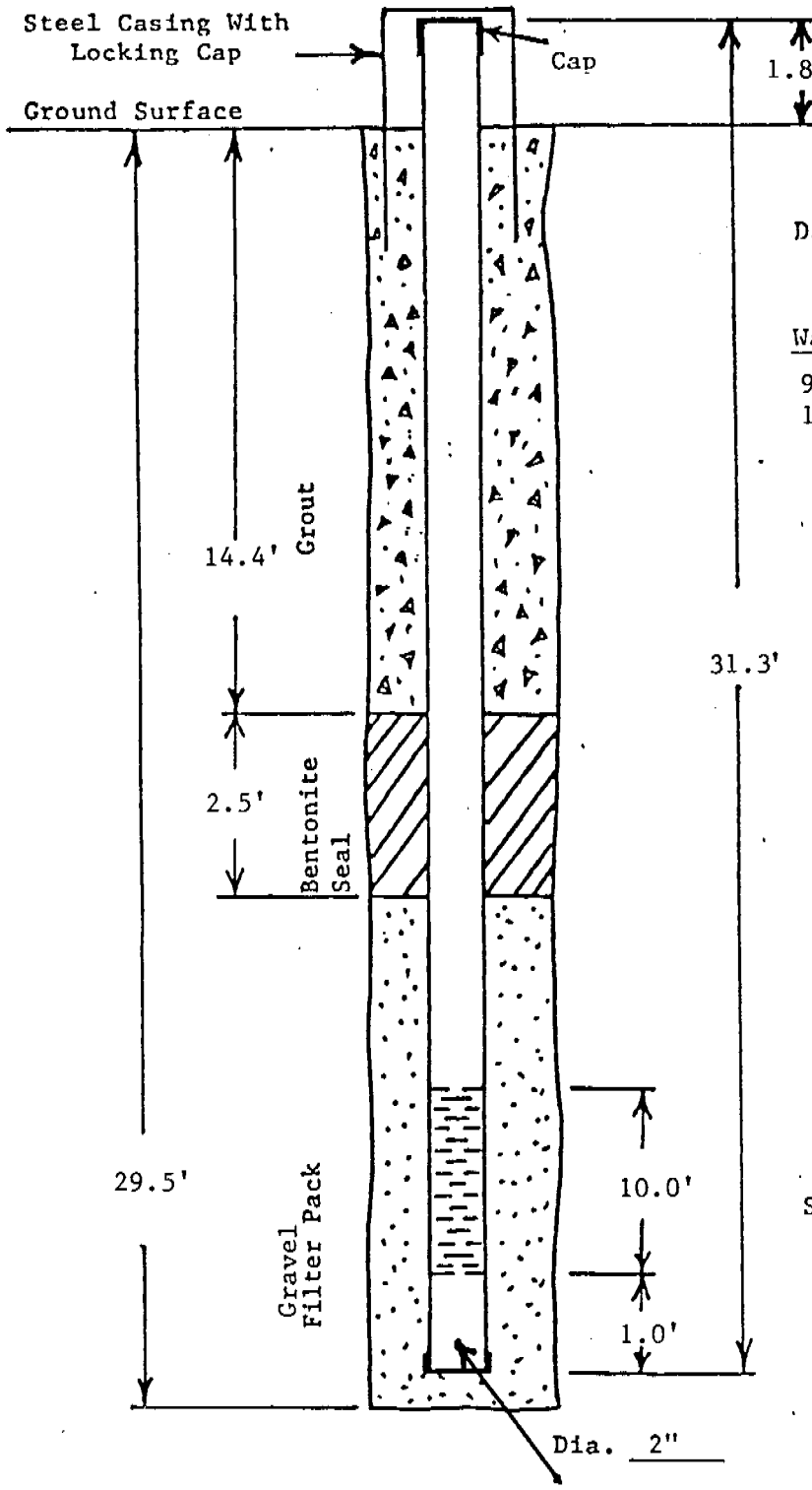
WELL COMPLETION RECORD

Well No. 3



Date Installed 9-14-83

Water Level Readings:

9-14-83	23.6
10-3-83	24.8

Screen Slot Size: 0.01"

SHB Job No. E83-2011

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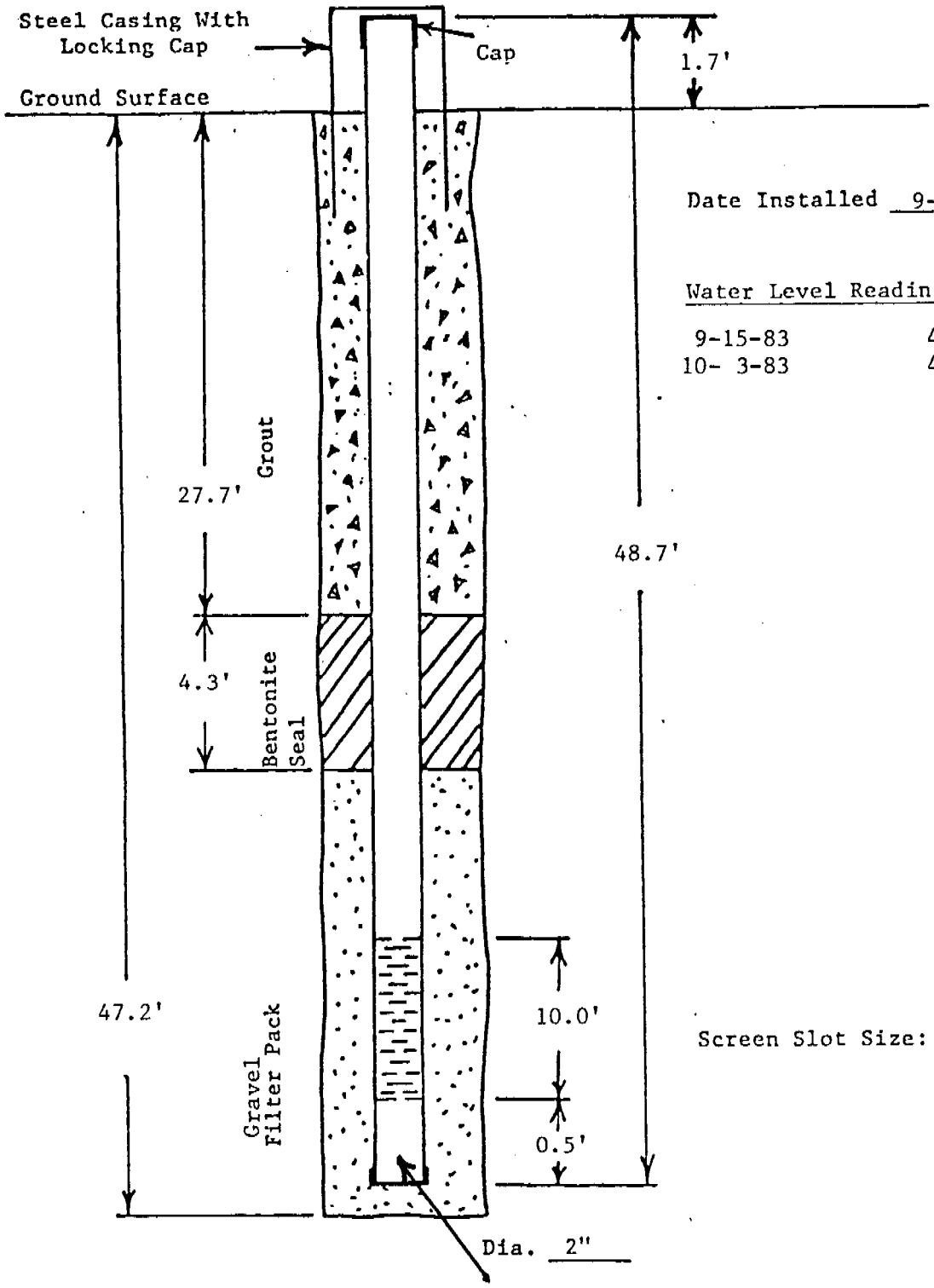
WELL COMPLETION RECORD

Well No. 5



Date Installed 9-15-83

Water Level Readings:

9-15-83	46.7'
10- 3-83	48.5'

Screen Slot Size: 0.01"

SHB Job No. E83-2011

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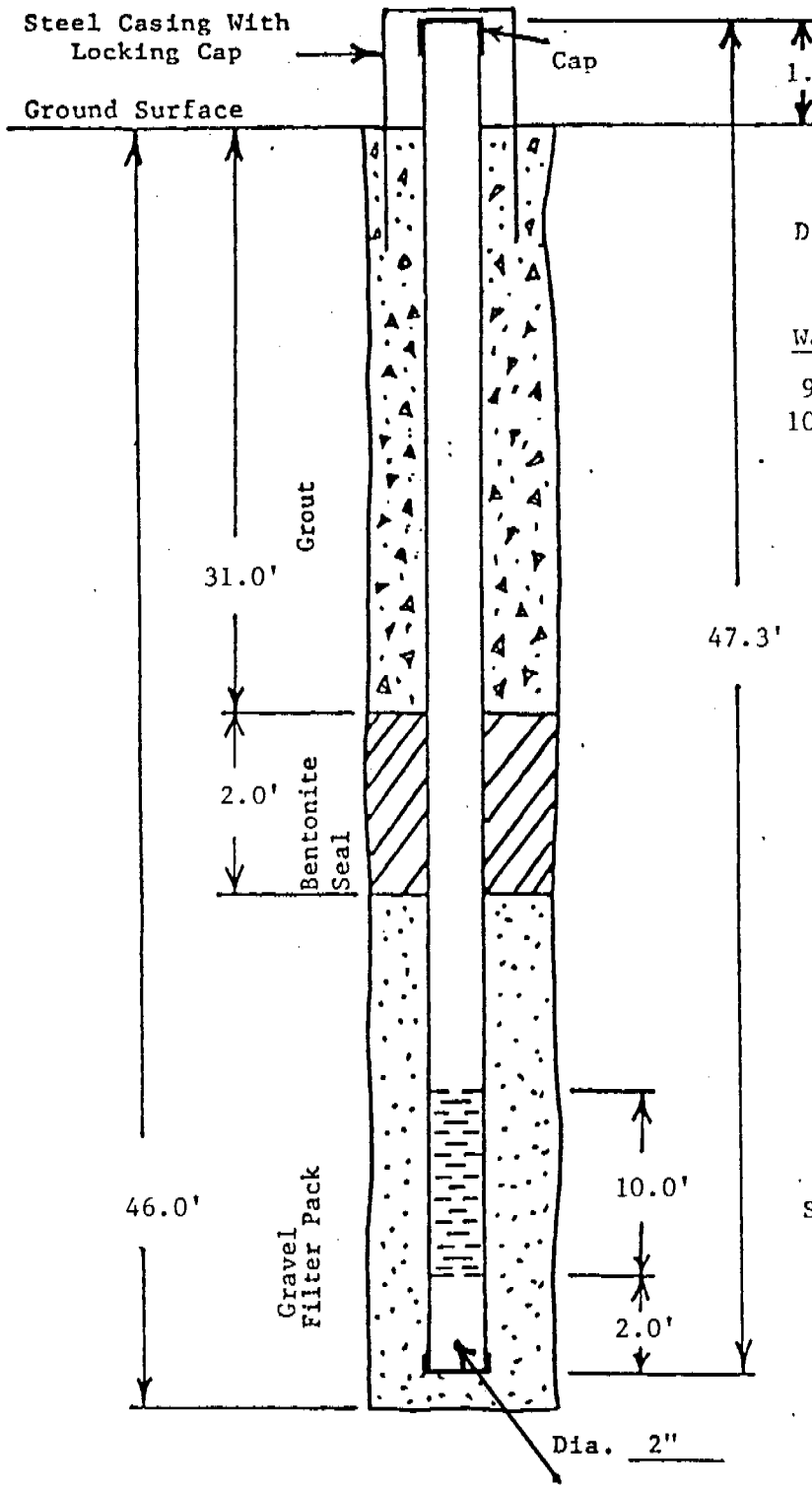
WELL COMPLETION RECORD

Well No. 6



Date Installed 9-14-83

Water Level Readings:

9-14-83	37.9'
10- 3-83	37.0'

Screen Slot Size: 0.01"

SHB Job No. E83-2011

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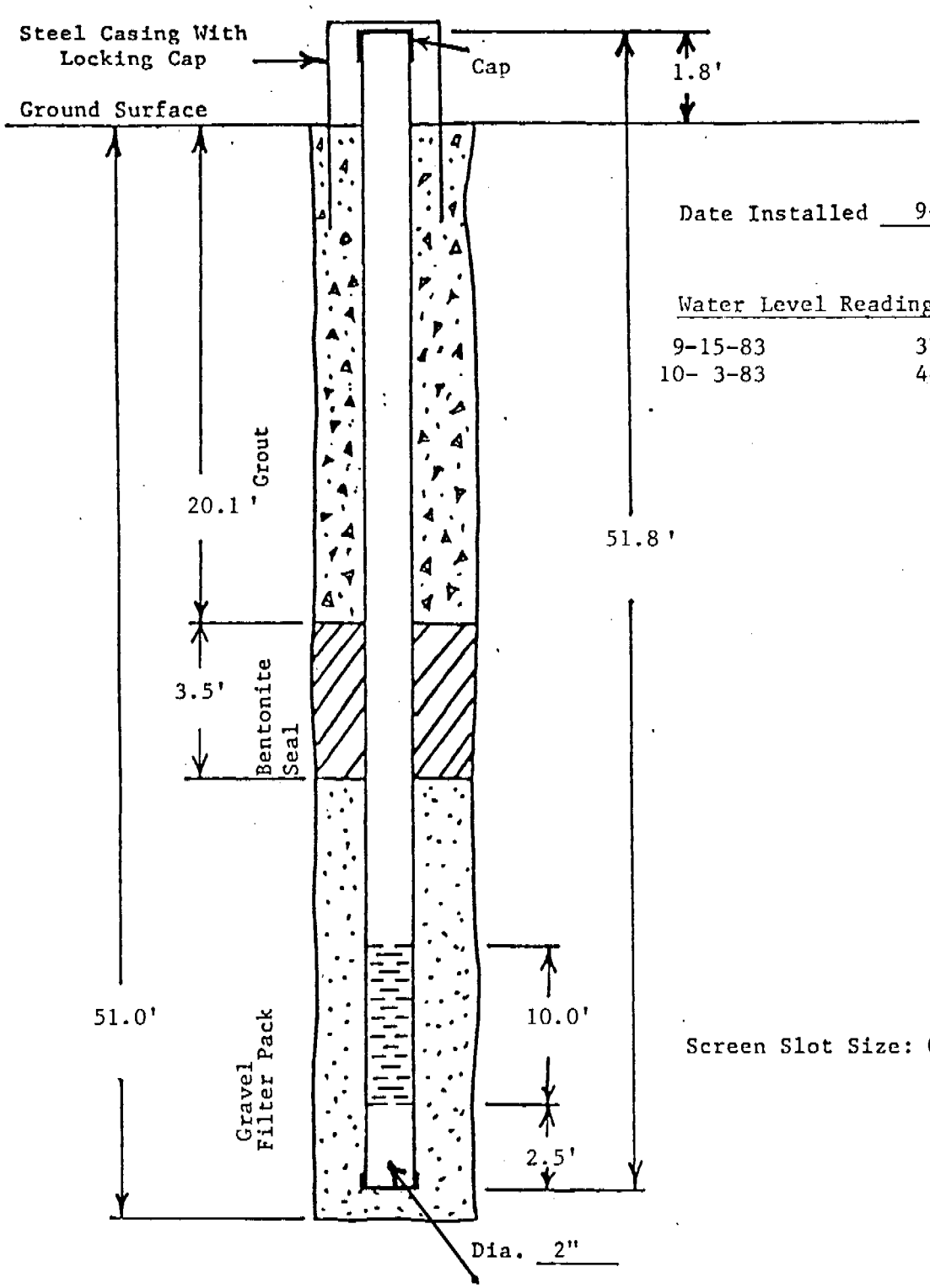
WELL COMPLETION RECORD

Well No. 7



Date Installed 9-15-83

Water Level Readings:

9-15-83	37.1'
10- 3-83	44.5'

Screen Slot Size: 0.01"

SHB Job No. E83-2011

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LABORATORY TESTING PROCEDURES

Consolidation Tests Soiltest or Clockhouse apparatus of the "floating-ring" type are employed for the one-dimensional consolidation tests. They are designed to receive one inch high 2.5 inch O.D. brass liner rings with soil specimens as secured in the field. Procedures for the tests generally are those outlined in ASTM D2435. Loads are applied in several increments to the upper surface of the test specimen and the resulting deformations are recorded at selected time intervals for each increment. For soils which are essentially saturated, each increment of load is maintained until the deformation versus log of time curve indicates completion of primary consolidation. For partially saturated soils, each increment of load is maintained until the rate of deformation is equal or less than 1/10,000 inch per hour. Applied loads are such that each new increment is equal to the total previously applied loading. Porous stones are placed in contact with the top and bottom of the specimens to permit free addition or expulsion of water. For partially saturated soils, the tests are normally performed at in situ moisture conditions until consolidation is complete under stresses approximately equal to those which will be imposed by the combined overburden and foundation loads. The samples are then submerged to show the effect of moisture increase and the tests continued under higher loadings. Generally, the tests are continued to about twice the anticipated curve due to overburden and structural loads with a rebound curve then being established by releasing loads.

Expansion Tests The same type of consolidometer apparatus described above is used in expansion testing. Undisturbed samples contained in brass liner rings are placed in the consolidometers, subjected to appropriate surcharge loads and submerged. The loads are maintained until the expansion versus log of time curve indicates the completion of "primary swell".

Direct Shear Tests Direct shear tests are run using a Clockhouse or Soiltest apparatus of the strain-control of approximately 0.05 inches per minute. The machine is designed to receive one of the one inch high 2.42 inch diameter specimens obtained by tube sampling. Generally, each sample is sheared under a normal load equivalent to the effective overburden pressure at the point of sampling. In some instances, samples are sheared at several normal loads to obtain the cohesion and angle of internal friction. When necessary, samples are saturated and/or consolidated before shearing in order to approximate the anticipated controlling field loading conditions.

TABULATION OF TEST RESULTS

Job No. E[illegible]-2011 Date Nov. 1983

Client: Southern Utah Fuel Company
P.O. Box P.
Salina, Utah 84654

Project Waste Rock Disposal Site
Sevier Co., Utah

Material –

Source –

HOLE NO.	LOCATION	DEPTH	UNIFIED CLASS.	LL	PI	SIEVE ANALYSIS – ACCUM. % PASSING												LAB. NO.
						200	100	40	16	10	4	¼	⅜	¾	1	1½	2	
B2	See Site Drawing	9.5'-10.5'	CL	29	15	71	82	97	99	100								
B3	"	9.5'-10.5'	CL	48	31	85	89	93	95	99	100							
B7	"	39.5'-40.5	CL	34	20	65	79	95	98	98	100							
TP1	"	2.0'-4.0'	CL	36	19	78	90	98	100									
TP1	"	6.0'-8.0'	CL	40	21	87	96	99	100									
TP2	"	2.0'-4.0'	CL	39	18	84	96	100										
TP2	"	10.0'-12.0'	CL	29	12	58	82	99	100									
TP3	"	0.0'-1.5'	ML	–	NP	71	92	99	100									
TP3	"	10.0'-12.0'	CL	27	10	55	76	97	100									
TP4	"	5.0'-7.0'	SM		*	47	69	89	94	96	98	99	100					
TP5	"	9.0'-11.0'	ML	–	*	57	77	94	98	99	100							
–	Waste Rock (Black)	–	–	–	NP													
–	Waste Rock (Grey)	–	–	–	5													
	*Assumed	PI of less	than 4															

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REPORT ON LABORATORY TESTS

DATE Oct. 1983

PROJECT Waste Rock Disposal Site JOB NO. E83-2011

LOCATION Sevier Co., Utah LAB NO. 3-2011-13

SAMPLE Boring #2 @ 9.5'-10.5'

DIRECT SHEAR TESTS
In Situ

In Situ - Point No. 1 (= ± 1.47 KSF)

Initial Moisture Content	13.6	%
Dry Density (PCF)	116.2	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(+)0.015	Inches
Shearing Stress, T Max.	3.07	KSF

In Situ - Point No. 2 (= ± 3.00 KSF)

Initial Moisture Content	11.9	%
Dry Density (PCF)	119.0	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(+)0.009	Inches
Shearing Stress, T Max.	4.03	KSF

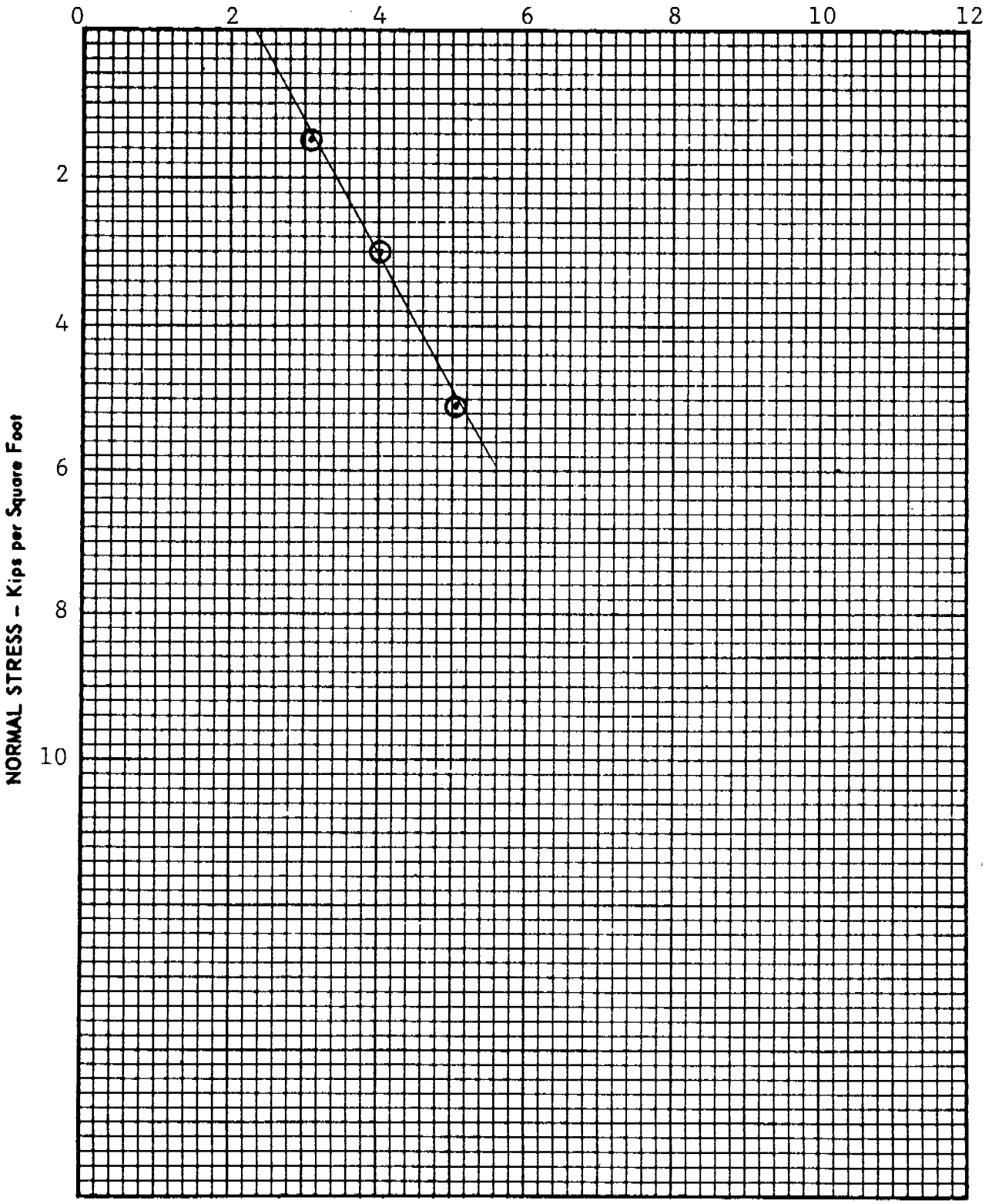
In Situ - Point No. 3 (= ± 5.08 KSF)

Initial Moisture Content	12.3	%
Dry Density (PCF)	117.7	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(+)0.009	Inches
Shearing Stress, T Max.	5.05	KSF

SUMMARY OF DIRECT SHEAR TESTS

PROJECT Waste Rock Disposal Site **JOB NO.** E83-2011

Boring #2 @ 9.5'-10.5' LAB NO. 3-2011-13



SOIL MOISTURE CONDITION

O – INSITU
● – SUBMERGED

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REPORT ON LABORATORY TESTS

DATE Oct. 1983

PROJECT Waste Rock Disposal Site JOB NO. E83-2011

LOCATION Sevier Co., Utah LAB NO. 3-2011-23

SAMPLE Boring #3 @ 9.5'-10.5'

DIRECT SHEAR TESTS
In Situ

In Situ - Point No. 1 (= ± 1.47 KSF)

Initial Moisture Content	18.4	%
Dry Density (PCF)	108.2	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(+)0.013	Inches
Shearing Stress, T Max.	2.97	KSF

In Situ - Point No. 2 (= ± 3.00 KSF)

Initial Moisture Content	18.3	%
Dry Density (PCF)	107.9	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(+)0.007	Inches
Shearing Stress, T Max.	3.88	KSF

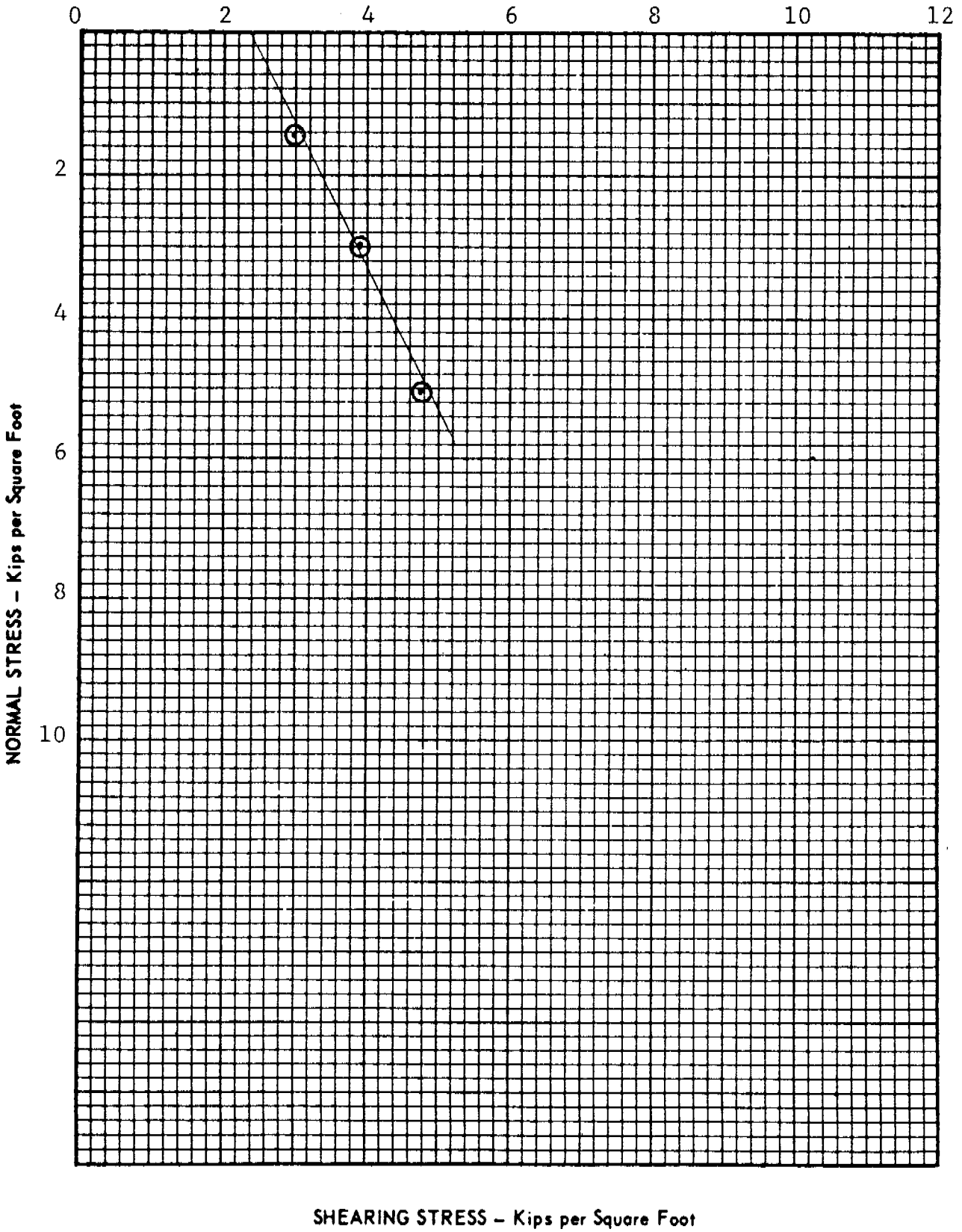
In Situ - Point No. 3 (= ± 5.08 KSF)

Initial Moisture Content	18.6	%
Dry Density (PCF)	106.4	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(+)0.005	Inches
Shearing Stress, T Max.	4.73	KSF

SUMMARY OF DIRECT SHEAR TESTS

PROJECT Waste Rock Disposal Site **JOB NO.** E83-2011

Boring #3 @ 9.5'-10.5' LAB NO. 3-2011-23



SOIL MOISTURE CONDITION

O – INSITU
● – SUBMERGED

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REPORT ON LABORATORY TESTS

DATE Oct. 1983

PROJECT Waste Rock Disposal Site JOB NO. E83-2011

LOCATION Sevier Co., Utah LAB NO. 3-2011-68

SAMPLE Boring #7 @ 39.5'-40.5'

DIRECT SHEAR TESTS
In Situ

In Situ - Point No. 1 (= ± 2.06 KSF)

Initial Moisture Content	19.1	%
Dry Density (PCF)	113.8	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(-)0.002	Inches
Shearing Stress, T Max.	1.48	KSF

In Situ - Point No. 2 (= ± 5.08 KSF)

Initial Moisture Content	19.2	%
Dry Density (PCF)	106.8	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(-)0.008	Inches
Shearing Stress, T Max.	2.41	KSF

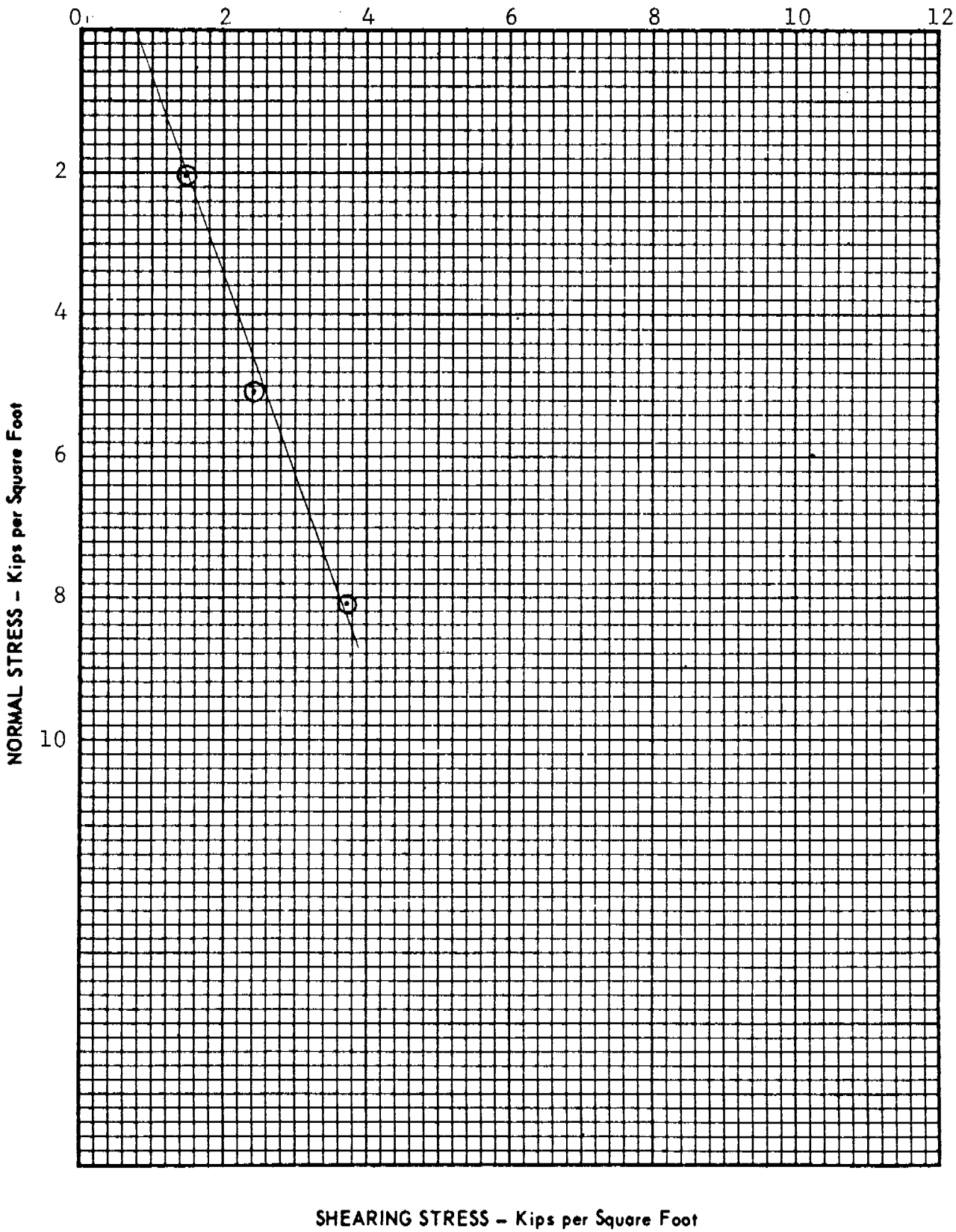
In Situ - Point No. 3 (= ± 8.19 KSF)

Initial Moisture Content	17.2	%
Dry Density (PCF)	109.9	
Submerged		
Final Moisture Content		%
Maximum Vertical Deformation @ T Max.	(-)0.014	Inches
Shearing Stress, T Max.	3.76	KSF

SUMMARY OF DIRECT SHEAR TESTS

PROJECT Waste Rock Disposal Site **JOB NO.** E83-2011

Boring #7 @ 39.5'-40.5' LAB NO. 3-2011-68



SOIL MOISTURE CONDITION

O – INSITU
● – SUBMERGED

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REPORT ON LABORATORY TESTS

DATE Nov. 1983

PROJECT Waste Rock Disposal Site JOB NO. E83-2011

LOCATION Sevier County, Utah LAB NO. 3-2011-69

CLIENT Southern Utah Fuel Co. ADDRESS P. O. Box P Salina, Utah 84654

SOURCE OF SAMPLE Rock Waste from Mine

MATERIAL Rock Waste(Black) SAMPLED BY

SUBMITTED BY SHB/DLC REQUESTED BY SHB/DLC

TESTED After: ISRM Doc. 2, Nov. 1972 DATE RECEIVED 11-8-83

TEST RESULTS

SLAKE DURABILITY INDEX

A = Initial O.D. Wt. + Drum	3170
B = O.D. Wt. After 1 Cycle + Drum	3156
C = O.D. Wt. After 2 Cycles + Drum	3140
D = Weight of Drum "A"	2656
Type of Fluid:	Tap Water
Temperature:	72.6°F

$I_{d1} = \frac{B - D}{A - D} \times 100 = \%$ Retained 97.3 (1 cycle)

$I_{d2} = \frac{C - D}{A - D} \times 100 = \%$ Retained 94.2 (2 cycles)

Remarks:

PHOENIX (602) 272-6848
ALBUQUERQUE (505) 344-9940
EL PASO (915) 591-8189

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REPORT ON LABORATORY TESTS

DATE Nov. 1983

PROJECT Waste Rock Disposal Site JOB NO. E83-2011

LOCATION Sevier County, Utah LAB NO. 3-2011-69A

CLIENT Southern Utah Fuel Co. ADDRESS P. O. Box P Salina, Utah 84654

SOURCE OF SAMPLE Rock Waste from Mine

MATERIAL Rock Waste(Grey) SAMPLED BY

SUBMITTED BY SHB/DLC REQUESTED BY SHB/DLC

TESTED After: ISRM Doc. 2, Nov. 1972 DATE RECEIVED 11-8-83

TEST RESULTS

SLAKE DURABILITY INDEX

A = Initial O.D. Wt. + Drum	3087
B = O.D. Wt. After 1 Cycle + Drum	3079
C = O.D. Wt. After 2 Cycles + Drum	3076
D = Weight of Drum "B"	2622
Type of Fluid:	Tap Water
Temperature:	72.6°F

$I_{d1} = \frac{B - D}{A - D} \times 100 = \%$ Retained 98.3 (1 cycle)

$I_{d2} = \frac{C - D}{A - D} \times 100 = \%$ Retained 97.6 (2 cycles)

Remarks:

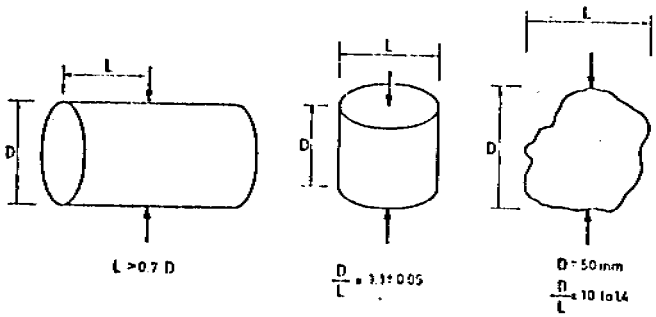
PHOENIX (602) 272-6848
ALBUQUERQUE (505) 344-9940
EL PASO (915) 591-8189

POINT LOAD INDEX TEST*

Type of Test Irregular Lump

Project Waste Rock Disposal Site — Job No. E83-2011

Location Sevier County, Utah — Lab No. 3-2011-69



Diametral test — Axial test — Irregular lump test

*After: International Society of Rock Mechanics, Doc. No. 1, October, 1972

**After: International Journal of Rock Mechanics & Mining Sciences, Vol. 17, No. 4, August, 1980

Lab No.	Boring No.	Depth	D / cm	L / cm	D / L	P / lbs	$^{**}T_{PSI} = 4.315 \frac{P}{(D^2)^{0.75}}$	$^{**}C_{PSI} = 12.5\ T_{PSI}$
3-2011-69	Rock Waste from Mine (Black Matl.)		2.840	-	(Note)	380	343	4282
			2.810	-	"	720	660	8245
			1.930	-	"	680	1094	13680

Note: Specimens submitted do not conform to size for irregular lump test $(\frac{D}{L})$

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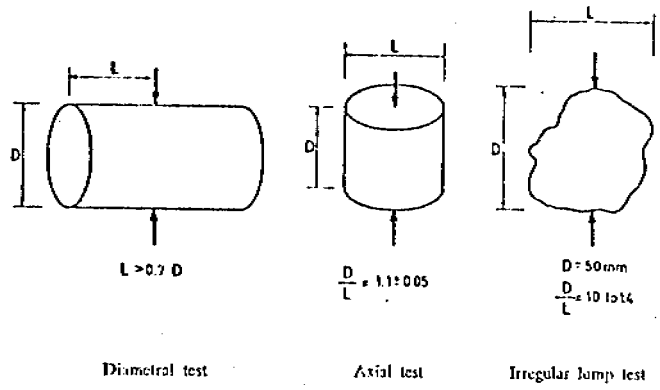
POINT LOAD INDEX TEST*

Type of Test Irregular Lump

Project Waste Rock Disposal Site — Job No. E83-2011

Location Sevier County, Utah — Lab No. 3-2011-69A



*After: International Society of Rock Mechanics, Doc. No. 1, October, 1972

**After: International Journal of Rock Mechanics & Mining Sciences, Vol. 17, No. 4, August, 1980

Lab No.	Boring No.	Depth	D / cm	L / cm	D / L	P / lbs	$^{**}T_{PSI} = 4.315 \frac{P}{(D^2)^{0.75}}$	$^{**}C_{PSI} = 12.5\ T_{PSI}$
3-2011-69A	Rock Waste from Mine (Grey Matl.)		5.00	5.00	1.0	1260	486	6079
			5.200	4.760	1.1	1900	691	8643
			5.400	5.305	1.0	1100	378	4728

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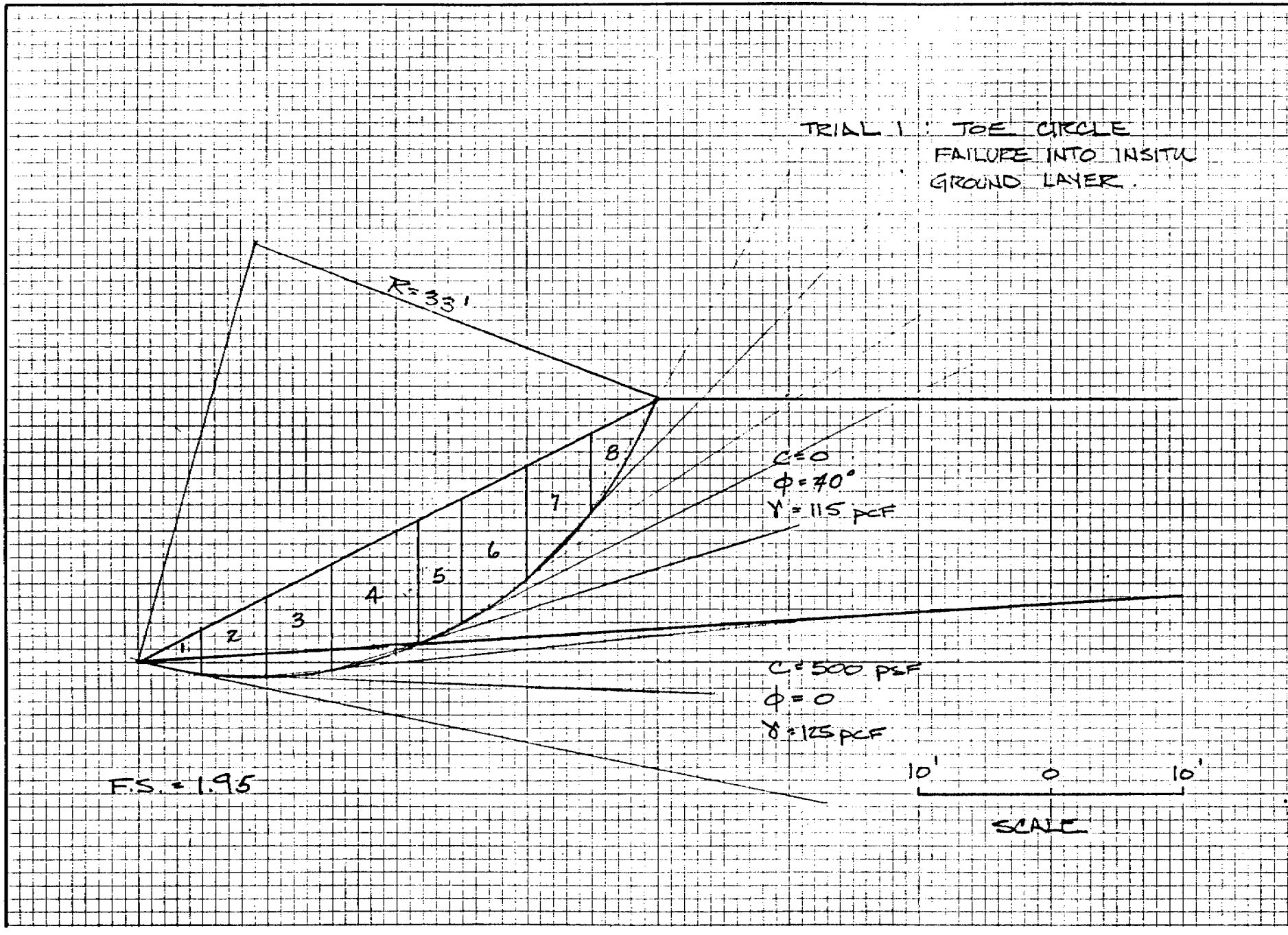

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Project WASTE ROCK DISPOSAL
Job No: E83-2011
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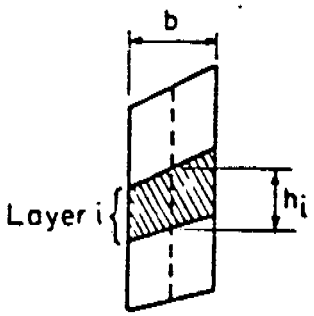
TRIAL 1



γ_i = unit weight of layer i

h_i = height of layer at center of slice

W_i = partial weight = $b\,h_i\,\gamma_i$

ΣW_i = total weight of slice

Slice No.	b	h_i	γ_i	W_i	ΣW_i
1					965
2	5	3.5	115	2012	
		1.5	125	937	2949
3	5	4.5	115	2587	
		1.75	125	1094	3681
4	6.75	8	115	6210	
		1	125	844	7054
5	3.25	9.5	115		3551
6	5	9.25	115		5462
7	5	7.5	115		4312
8	5	3.5	115		2012

TABULAR FORM FOR COMPUTING WEIGHTS OF SLICES.

Slice No.	W lb/FT	ℓ	α	C	ϕ	u	$u\ell$	$W\cos\alpha$	$W\cos\alpha - u\ell$	$(W\cos\alpha - u\ell)\tan\phi$	$C\ell$	$W\sin\alpha$
1	965	5	-11	500	0	0	0	947		0	2500	-184
2	2949	5	-2	500	0			2947		0	2500	-103
3	3681	5	5	500	0			3667		0	2500	321
4	7054	7	17	500	0			6746		0	3500	2062
5	3551	3.5	17	0	40			3396		2850		1038
6	5462	6	27	0	40			4867		4084		2480
7	4312	7	46	0	40			2995		2513		3102
8	2012	10	60	0	40			1006				1742
									Σ	9447	11 000	10458

C = cohesion intercept
ϕ = friction angle
u = pore pressure
} at base of slice

$$F = \frac{\Sigma (W\cos\alpha - u\ell)\tan\phi + \Sigma c\ell}{\Sigma W\sin\alpha}$$

$$F = \frac{20447}{10458} = 1.95$$

TABULAR FORM FOR CALCULATING FACTOR OF SAFETY BY ORDINARY METHOD OF SLICES.

TRIAL 1

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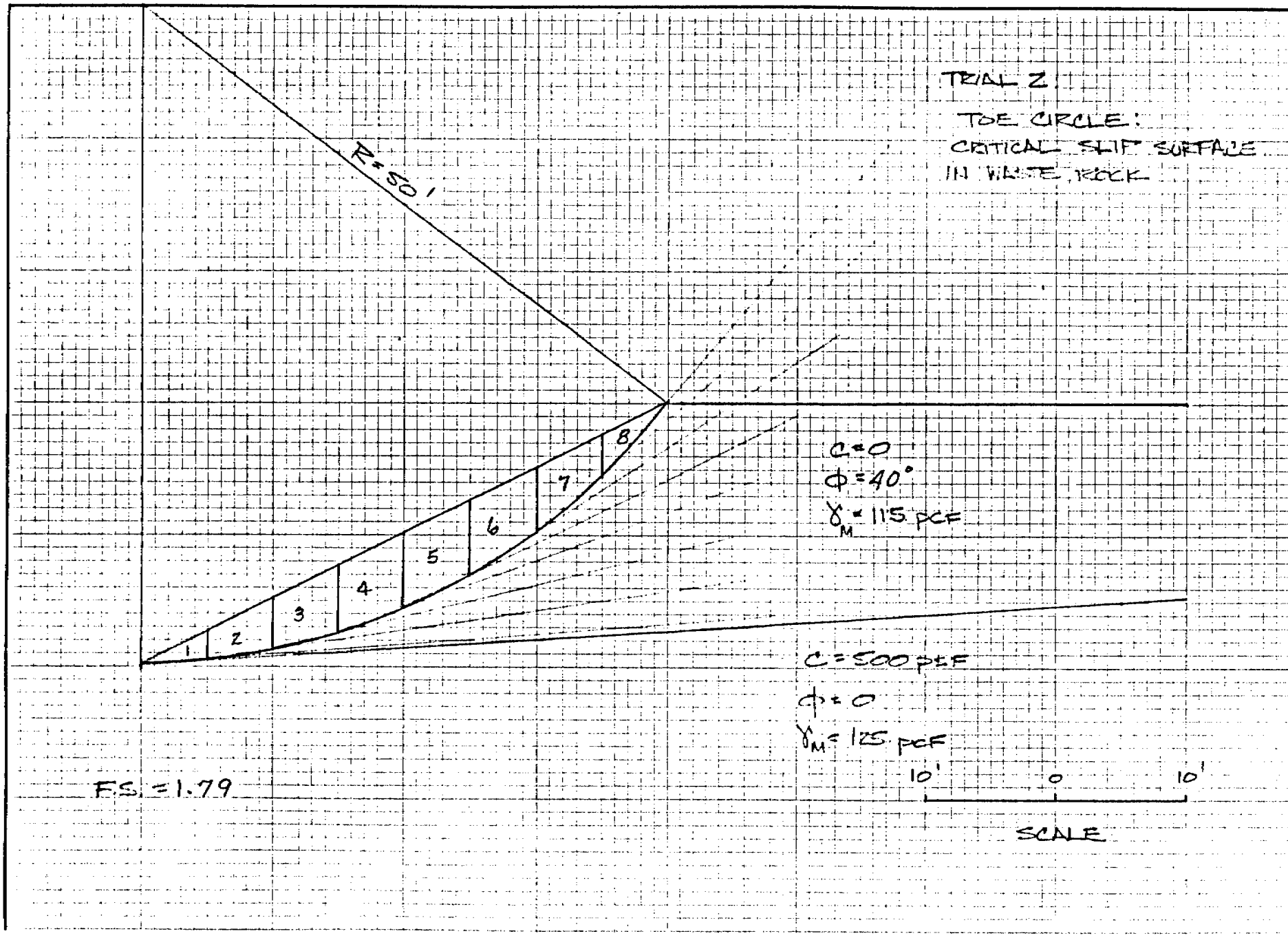

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Project [illegible]
Job No. [illegible]
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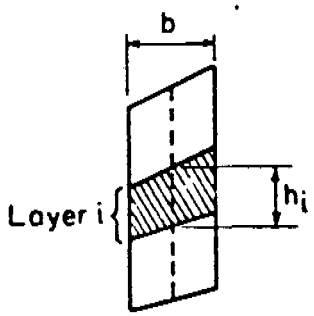
TRIAL 2



γ_i = unit weight of layer i

h_i = height of layer at center of slice

W_i = partial weight = $b\,h_i\,\gamma_i$

ΣW_i = total weight of slice

Slice No.	b	h_i	γ_i	W_i	ΣW_i
1	5	1	115		575
2	5	3.25	115		1869
3	5	4.5	115		2587
4	5	5.5	115		3162
5	5	6.0	115		3450
6	5	5.5	115		3162
7	5	4.0	115		2300
8	5	1.75	115		1006

TABULAR FORM FOR COMPUTING WEIGHTS OF SLICES.

Slice No.	W	ℓ	α	~~c~~	ϕ	~~u~~	~~$u\ell$~~	$W\cos\alpha$	~~$W\cos\alpha - u\ell$~~	~~$(W\cos\alpha - u\ell)\tan\phi$~~	~~$c\ell$~~	$W\sin\alpha$
1	575	5	5	0	40°	0	0	573	0	481	0	50
2	1869	5	9					1846		1549		292
3	2587	5	14					2510		2106		626
4	3162	5.25	20					2971		2493		1081
5	3450	5.5	26					3101		2602		1512
6	3162	6	33					2652		2225		1722
7	2300	6.5	40					1762		1478		1478
8	1006	7.5	49					660		554		759
									Σ	13488	0	7520

c = cohesion intercept
ϕ = friction angle
u = pore pressure
} at base of slice

$$F = \frac{\Sigma (W\cos\alpha - u\ell)\tan\phi + \Sigma c\ell}{\Sigma W\sin\alpha}$$

$$F = \frac{13488}{7520} = 1.79$$

TABULAR FORM FOR CALCULATING FACTOR OF SAFETY BY ORDINARY METHOD OF SLICES.

TRIAL 2

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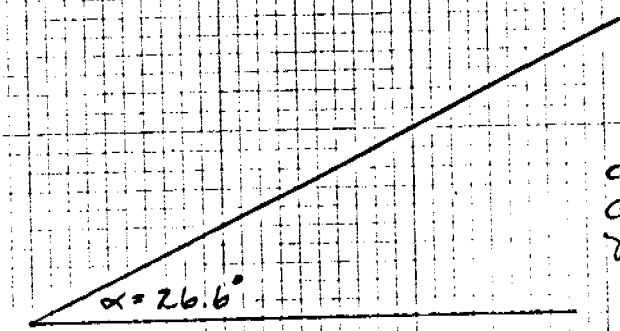
INFINITE SLOPE ANALYSIS:



$\phi = 40°$
$c = 0$
$\gamma_M = 115$ pcf

$$F.S. = \frac{\tan\phi}{\tan\alpha} = \frac{\tan 40°}{\tan 26.6°}$$

F.S = 1.7

THE INFINITE SLOPE CASE REPRESENTS THE MOST CRITICAL CONDITION FOR STATIC ANALYSES.

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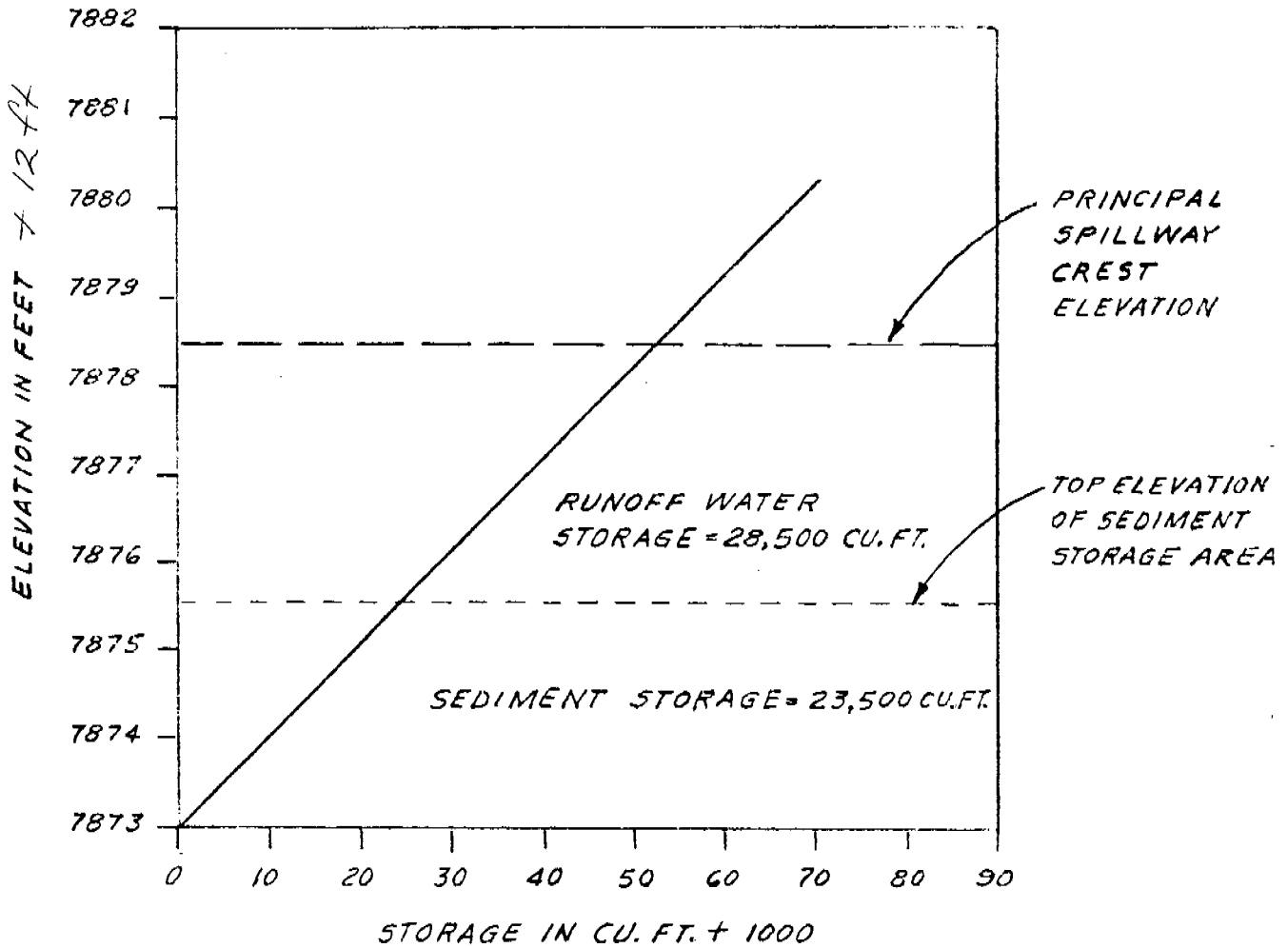
Project: WASTE [illegible] FILL, [illegible] Co, U.
Job No: [illegible]
Computed by: [illegible] Ckd. by: DLC
Date 12/1/83 Page — of —

FIGURE D-1



ELEVATION VS. STORAGE
VOLUME OF SEDIMENT POND

WASTE ROCK DISPOSAL SITE
SEVIER COUNTY, UTAH
S.H.B. JOB NO. E83-2011

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HYDROLOGIC DESIGN DATA SHEET

S C S METHOD: PART I

LOCATION DATA:

Highway - County Sevier

Location Waste Rock Disposal Site

Project No. E83-2011 Station -

Name of Stream Sedimentation Pond

DESIGN DATA:

Design Frequency	10	years
Drainage Area	12 ac.	~~square miles~~
Drainage Length	-	feet
Elevation		
Top of Drainage Area	-	feet
At Structure	-	feet
Drainage Area Slope	-	%
Drainage Width	-	feet
Width factor W_f	1.0	
Vegetative Cover Type	-	
Vegetative Cover Density	-	%
Soil Group	-	
Precipitation		
P = 6 hour =	1.3	inches
P = 24 hour =	2.1	inches

DESIGN COMPUTATION:

Precipitation	P = 1 hour =	0.90	inches
Curve Number		80	
Runoff	Q =	0.06	inches
Time of Concentration	Tc	0.4	hours
Time of Peak	$Tp = (Tc)(W_f)$	0.4	hours
Peak Discharge	$Qp = \frac{484\ AQ}{Tp} =$	1.25	cfs
By Rational Method	Qp=CIA = =	5.4	cfs

Computed by T. Engel Date 11/23/84

HYDROLOGIC DESIGN DATA SHEET

S C S METHOD: PART I

LOCATION DATA:

Highway - County Sevier
Location Waste Rock Disposal Site
Project No. ES3-2011 Station
Name of Stream Sedimentation Pond

DESIGN DATA:

Design Frequency	25	years
Drainage Area	12 ac.	~~square miles~~
Drainage Length	-	feet
Elevation		
Top of Drainage Area	-	feet
At Structure	-	feet
Drainage Area Slope	-	%
Drainage Width	-	feet
Width factor W_f	1	
Vegetative Cover Type	-	
Vegetative Cover Density	-	%
Soil Group	-	
Precipitation		
P = 6 hour =	1.6	inches
P = 24 hour =	2.6	inches

DESIGN COMPUTATION:

Precipitation	P = 1 hour =	1.10	inches
Curve Number		80	
Runoff	Q =	0.12	inches
Time of Concentration	Tc	0.40	hours
Time of Peak	$Tp = (Tc)(W_f)$	0.40	hours
Peak Discharge	$Qp = \frac{484\ AQ}{Tp} =$	2.63	cfs

By Rational Method Q=CIA = 6.6 cfs

Computed by A. Owen Date 4-4-84

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HYDROLOGIC DESIGN DATA SHEET

S C S METHOD: PART I

LOCATION DATA:

Highway - County Sevier
Location Waste Rock Disposal Site
Project No. E83-2011 Station -
Name of Stream Watershed No. 1 & 2

DESIGN DATA:

Design Frequency	100	years
Drainage Area	0.13	square miles
Drainage Length	2200	feet
Elevation		
Top of Drainage Area	8400	feet
At Structure	7930	feet
Drainage Area Slope	26	%
Drainage Width	1620	feet
Width factor W_f	1.00	
Vegetative Cover Type	-	
Vegetative Cover Density	-	%
Soil Group	-	
Precipitation		
P = 6 hour =	2.00	inches
P = 24 hour =	3.20	inches

DESIGN COMPUTATION:

Precipitation	P = 1 hour =	1.38	inches
Curve Number		75	
Runoff	Q =	0.13	inches
Time of Concentration	Tc	0.16	hours
Time of Peak	$Tp = (Tc)(W_f)$	0.16	hours
Peak Discharge	$Qp = \frac{484\,AQ}{Tp} =$	51 cfs	

Computed by T. Engel Date 11-21-83

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HYDRAULIC CAPACITY OF PRINCIPLE SPILLWAY *

Q = 5.4 CFS (10 YEAR FLOW PEAK)

DROP INLET 12" DIA. CMP CULVERT

$Q = CLH^{3/2}$

WHERE $C = 3.27$

$L = \pi d = 3.14$ FT

$H = 0.65$ FT

$Q = 3.27 \times 3.14 \times 0.65^{3/2} = 5.4$ CFS

* ACCORDING TO BARFIELD ETAL, 1981

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Project WASTE ROCK DISPOSAL
Job No: E83-2011
Computed by: ACO Ckd. by: DLC
Date — Page 1 of 1

HYDRAULIC CAPACITY OF EMERGENCY SPILLWAY

$Q = 6.6$ CFS (REQUIRED SPILLWAY CAPACITY, 25 YEAR FLOW)

ASSUME NO FLOW THROUGH PRINCIPAL SPILLWAY, NO HYDRAULIC ROUTING THROUGH POND, A "V" SHAPED DITCH WITH SIDE SLOPES OF 3H : 1V, A MANNINGS "n" OF 0.035 AND A GRADIENT OF 0.02. FLOW IN DITCH WILL BE SUPER CRITICAL; THEREFORE, ASSUME CRITICAL FLOW AT INTAKE OF SPILLWAY.

$Q_c = 2.295\, z\, h_c^{2.5} = 6.6$ CFS

$h_c = 0.8$ FT.

$v_c = 3.53$ FT/SEC

VELOCITY HEAD $= v_c^2/2g = 0.2$ FT.

TOTAL HEAD $= 0.8 + 0.2 = 1.0$ FT

MAKE DITCH 2 FT. DEEP TO ALLOW ONE FOOT OF FREEBOARD

CALCULATIONS FOR RIP RAP DESIGN

DITCH No. 1 FOR DRAINAGE AREA No. 1

REQUIRED DISCHARGE : $Q = 51$ CFS

MANNINGS COEFFICIENT : $n = 0.043$

SIDE SLOPE : $z = 3$

CHANNEL GRADIENT : $S = 0.033$ FT/FT

HYDRAULIC RADIUS : $R = \dfrac{zy}{2(1+z^2)^{1/2}}$

WETTED CHANNEL AREA : $A = zy^2$

USING MANNINGS EQUATION

$$Q = \frac{1.486\, A R^{2/3} S^{1/2}}{n}$$

THEN $y = 1.75$ FT. AND $R = 0.083$

USING RIP RAP DESIGN BY SIMONS ET. AL., 1977 AND SOLVING FOR SAFETY FACTOR.

$$\tau_{MAX} = 0.76\, \gamma R S$$

$$'' = (0.76)(62.4)(0.83)(0.033)$$

$$\tau_{MAX} = 1.30 \text{ LBS/FT}^2$$

$$n = \frac{21\, \tau_{MAX}}{\gamma (S.g. - 1) D_{50}}$$

ASSUME: $S.g. = 2.65$

$D_{50} = 4.5$ INCHES

THEN $n = 0.70$

$$\beta = \tan^{-1} \frac{n \tan \phi}{2 \sin \theta}$$

ASSUME : $\phi = 41°$ ANGLE OF REPOSE OF RIP RAP

$\theta = 18.4°$ ANGLE OF SIDE SLOPE

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THEN $\beta = 43.9°$

$$n' = n\left(\frac{1+\sin\beta}{2}\right)$$

THEN $n' = 0.59$

$$S.F. = \frac{\cos\theta \tan\phi}{n' \tan\phi + \sin\theta \cos\beta}$$

THEN $S.F. = 1.11$

DITCH NO. 2 FOR DRAINAGE AREA NO. 2

$Q = 51$ CFS

$n = 0.043$

$b = 9$ FT. (BASE WIDTH OF CHANNEL)

$z = 3$

$S = 0.040$

$y = 0.84$ FT.

$\tau_{max} = 1.28$ LBS/FT^2

$n = 0.69$

$\beta = 43.4°$

$n' = 0.58$

$S.F. = 1.12$

DITCH No 3. FOR ROAD AND DISPOSAL SITE

$Q = CIA = 0.5 \times 1.38 \times 7.7 = 5.4$ CFS

$n = 0.043$

$z = 3$

$S = 0.08$

$y = 0.64$ FT

$\tau_{MAX} = 1.15$ LB/FT^2

S.F. = 1.21

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CALCULATIONS FOR SIZING OF POND

AMOUNT OF RUNOFF FROM 10 YEAR, 24 HOUR STORM

PRECIPITATION = 2.10 INCHES

AREA = 12 ACRES

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$ (BARFIELD ETAL, 1981)

WHERE: $P = 2.10''$

$S = \frac{1000}{CN} - 10$

DETERMINATION OF CN

5 ACRES @ CN OF 65 (UNDISTURBED LAND)

3.5 ACRES @ CN OF 90 (DISTURBED LAND)

3.5 ACRES @ CN OF 80 (RESEEDED LAND)

THEREFORE CN = 77

$S = \frac{1000}{77} - 10 = 2.99$ ROUND TO 3

$$Q = \frac{(2.1 - 0.2 \times 3)^2}{2.1 + 0.8 \times 3} = 0.5 \text{ INCHES}$$

$$\text{TOTAL RUNOFF} = \frac{12 \text{ ACRES} \times 0.5 \text{ INCHES}}{12 \text{ INCH/FT.}} = 0.5 \text{ AC-FT}$$

" " $= 21{,}780 \text{ FT.}^3$

CALCULATIONS FOR SEDIMENT STORAGE

REQUIRED VOLUME FOR 3 YEARS OF SEDIMENT STORAGE.

ASSUME: 3.5 ACRES DISTURBED LAND FOR ANY GIVEN YEAR,
8.5 ACRES UNDISTURBED LAND FOR ANY GIVEN YEAR.

SEDIMENT FROM DISTURBED AREA

$$\text{VOL.} = 3.5 \text{ ACRES} \times 0.1 \frac{\text{AC-FT}}{\text{ACRE}} = 0.35 \text{ AC-FT}$$

$$\text{VOL.} = 15{,}246 \text{ FT}^3$$

SEDIMENT FROM UNDISTURBED AREA AFTER P.S.I.A.C. (1968)

FACTORS	RATING
A	7
B	7
C	8
D	8
E	15
F	5
G	0
H	8
I	10
TOTAL	68

SEDIMENT YIELD = 1.0 AC-FT / SQ.MI.-YR.

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Date — Page 1 of 2

$$VOL = \frac{8.5 \text{ ACRES}}{640 \text{ ACRES/SQ-MI}} \times \frac{1 \text{ AC-FT}}{\text{SQ MI-YR}} \times 3 \text{ YRS} = 0.04 \text{ AC-FT}$$

$$VOL = 1736 \text{ FT}^3$$

THEREFORE TOTAL SEDIMENT VOLUME EQUALS

$$\begin{array}{r} 15,246 \\ +\ 1,736 \\ \hline 16,980 \text{ FT}^3 \end{array}$$

Appendix III

A P P E N D I X I I I

ENGINEERING CALCULATIONS

Waste Rock Disposal

Working lift runoff:

UMC 645.746.212, 746.222 & 746.330 require that percipitation that falls on the refuse pile be diverted into channels and not allowed to impound. The design event is 100 yr. - 6 hr.

The working lift and associated slopes will have a maximum size of 150 ft wide x 300 ft long.

$A = 150 \times 300 / 43{,}560$

$A = 1.03$ Acres

100 year - 6 hour precipitation event = 2.2 inches

Assume pad has a curve number = 90

Using SCS method with $P = 2.2$, $CN = 90$, $A = 1.03$

gives $Q = 1.37$ in & $S = 1.11$

TOTAL RUNOFF VOLUME = 4,735 ft^3

Using SCS method

$$t_c = \frac{t_L}{0.6}$$

$$t_L = \frac{L^{0.8}(S+1)^{0.7}}{1900\,Y^{0.5}}$$

where L = hydraulic length
Y = average land slope in percent
S = SCS CN parameter
t_L = Lag time in hours

Pad working dimensions vary (Lift)

intially 150 x 300 pad @ 2% 3 ft high @ 1v:2h

final 90 x 340 pad @ 2% 30 ft high @ 1v:2h

Maximum hydraulic length

intially 150 + 300 + 6.7 = 457 ft

average slope = 2.7%

final 90 + 240 + 67 = 397 ft

average slope = 10%

$$t_{Li} = \frac{(457)^{0.8}(1.11+1)^{0.7}}{1900(2.7)^{0.5}}$$

$t_{Li} = 0.07$ hrs $\Rightarrow t_{c_i} = 0.12$ hrs

$$t_{Lf} = \frac{(397)^{0.8}(1.11+1)^{0.7}}{1900(10.0)^{0.5}}$$

$t_{Lf} = 0.034$ hrs $\Rightarrow t_{c_i} = 0.056$ hrs

Using SCS TR55 method

$q_p = q_p' A Q$

$q_{p_i} = 1000$ for $t_c \leq 0.1$ Fig 2.40 pg 115 Att 5 SFDA

$q_p' = 950$ for $t_c = 0.12$

For intial & final configurations:

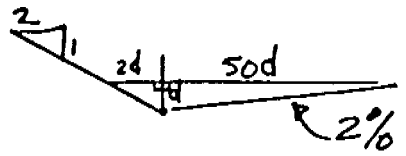
1.03 acres = 0.0016 mi²

$q_{p_i} = (1000)(0.0016)(1.37) = 2.19$ cfs USE 2.19 cfs

$q_{p_f} = (950)(0.0016)(1.37) = 2.08$ cfs

WKS 2/7/92
revised 3/4/92

Assume pad slopes 2% to ~~back~~ south and 2% to East with a 1v/2h triangular berm on south and existing 1v/2h slope on east. Then diversions on pad would have cross-section shown below:



$A = d^2 + 25d^2$
$A = 26d^2$
$P = 51.74d$

slope will be 2% on diversions.

For $n = 0.030$ and 2.19 cfs

depth = 0.226 ft and $v = 1.65$ fps
Less than 6 fps no riprap needed.

FOR SLOPE:

Using a trapezodial cross-section with a bottom width of 2 ft and 1v/2h side slopes $n = 0.030$. ⇒ depth = 0.123 ft and $v = 7.93$ fps.

greater than 6 fps ⇒ lining is needed.

Would require riprap with a $D_{50} = 10$ inches.

Recalculate ditch with $n = 0.040$ for riprap
⇒ depth = 0.145 and $v = 6.60$ fps $\boxed{\text{Use riprap } D_{50} = 6 \text{ inches}}$

Ditch needed on west of slope to collect runoff from slope. Assume ditch maximum of 20 ft from toe of slope. Area $= \frac{(20+60)(300)}{43560} = 0.55$ Acres

Maximum hydraulic length = 380 ft.
average slope = 5%

$$t_{cp} = \frac{(380)^{0.8}(1.11+1)^{0.7}}{1900(5)^{0.5}}$$

$t_{cp} = 0.046$ hrs $\Rightarrow t_{cp} = 0.077$

Using SCS TR55 Method

$q_p = q_p' A Q$

$q_p' = 1000$ for $t_c \leq 0.1$ Fig 2.40 pg 115 AH & SFDA

$A = 0.55$ acres $\equiv 0.00086$ mi^2

$q_p = (1000)(0.00086)(1.37) = 1.18$ cfs

Use triangular shaped ditch with 1w/2h side slopes.

depth = 0.41 ft velocity = 3.51 fps ∴ no rip rap needed

NOTE: Make all ditches to have minimum of depth + 0.5 ft freeboard.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

W.K. SORENSEN 04-Mar-92

OPEN CHANNEL FLOW
WASTE ROCK DISPOSAL SITE PAD
100 YR 6 HR

	PAD	SLOPE	FRONT
QUANITY	2.19	2.19	1.18
S	0.020	0.500	0.050
AREA	1.33	0.33	0.34
V	1.65	6.60	3.51
DEPTH	0.226	0.145	0.410
n	0.030	0.040	0.030

FOR	SPECIAL	TRAPEZOID	TRIANGULAR
B (BOTTOM WIDTH)	0.00	2.00	0.00
Z (SIDE SLOPE)	2.00	2.00	2.00
A (AREA)	1.33	0.33	0.34
R	0.11	0.13	0.18

NOTE: A=26D^2 & P=51.742D FOR SPECIAL CASE

RGT HAND SIDE	2.19	2.19	1.21

WASTE ROCK DISPOSAL 7/23/87

SLOPE STABILITY

FILL WILL BE UP TO 30 Ft deep as shown on section F-F' pg 2.

BECAUSE OF COARSE NATURE OF MATERIAL ASSUME SLOPE IS FULLY DRAINED.

ASSUME $c = 0$
$\phi = 40^\circ$ $\alpha = 15^\circ$
$\gamma = 185$ pcf
$H = 30$ ft

Using Taylor's circular failure method.

$$\frac{c}{\gamma H \tan\phi} = \frac{0}{\gamma H \tan\phi} = 0$$

FROM CHART 1 ATTACHED

$$\frac{\tan\phi}{F} = 0.25 \quad \text{For slope of } 15^\circ$$

$$F = \frac{\tan\phi}{0.25}$$

$$\underline{F = 3.36}$$

For $\alpha = 18.5^\circ$

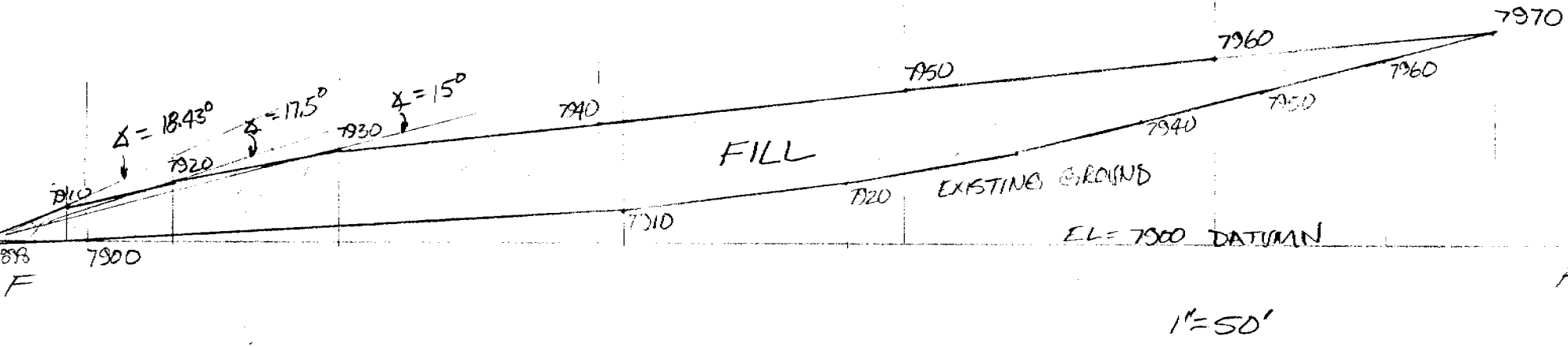
$$\frac{\tan\phi}{F} = 0.32$$

$$F = \frac{\tan\phi}{0.32}$$

$$\underline{F = 2.62}$$

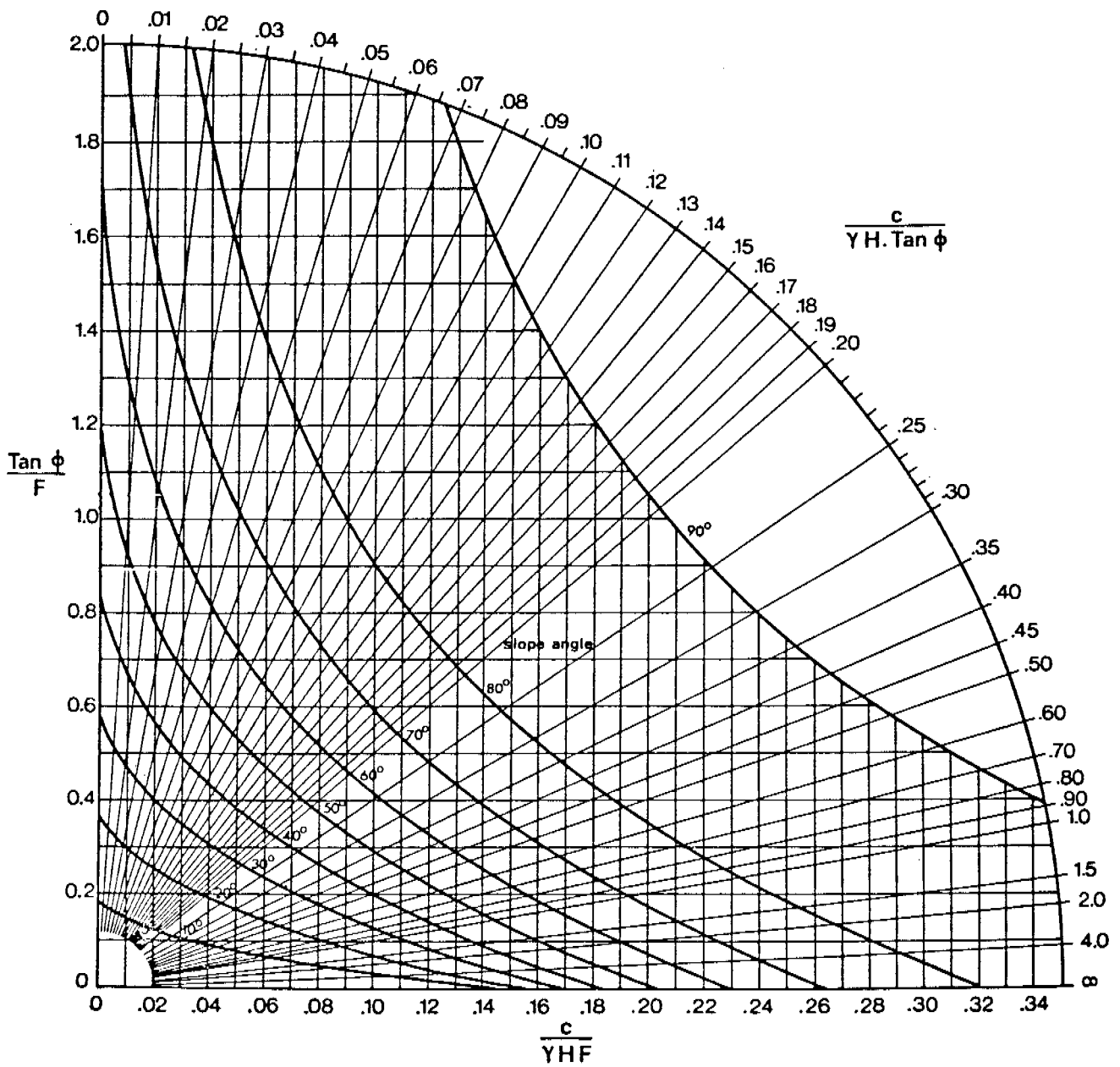
FROM ABOVE SLOPE SHOULD BE VERY STABLE

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS



1" = 50'

CIRCULAR FAILURE CHART NUMBER 1



WKS
7/17/87
REVISED 9/8

WASTE ROCK DISPOSAL RECLAMATION COSTS

The waste rock disposal will have the operating cross-section shown on page 1A. This cross-section shows a 95 ft down slope @ 3h:1v, a 100 ft pad area, a 65 ft up slope @ 3h:1v and a 80 ft 8h:1v area ready for reclamation. This configuration can be reclaimed at any point by ripping, topsoil distribution, seeding and mulching.

ACREAGE TO RECLAIM

$$\frac{(95 + 100 + 65 + 80) \times 360}{43,560} = 2.73 \text{ ACRES}$$

RIPPING

D8L tractor w/ 7 ft implement
Estimate speed @ 2 mi/hr.

$$\frac{7 \text{ ft} \times 5280 \text{ ft/mi} \times 2 \text{ mi/hr}}{43,560 \text{ ft}^2/\text{acre}} = 1.68 \text{ ACRE/hr}$$

REDUCE BY 20%: $1.68 \times 0.8 = 1.34$ ACRE/hr

$2.73 / 1.34 = \underline{2.0 \text{ hrs}}$

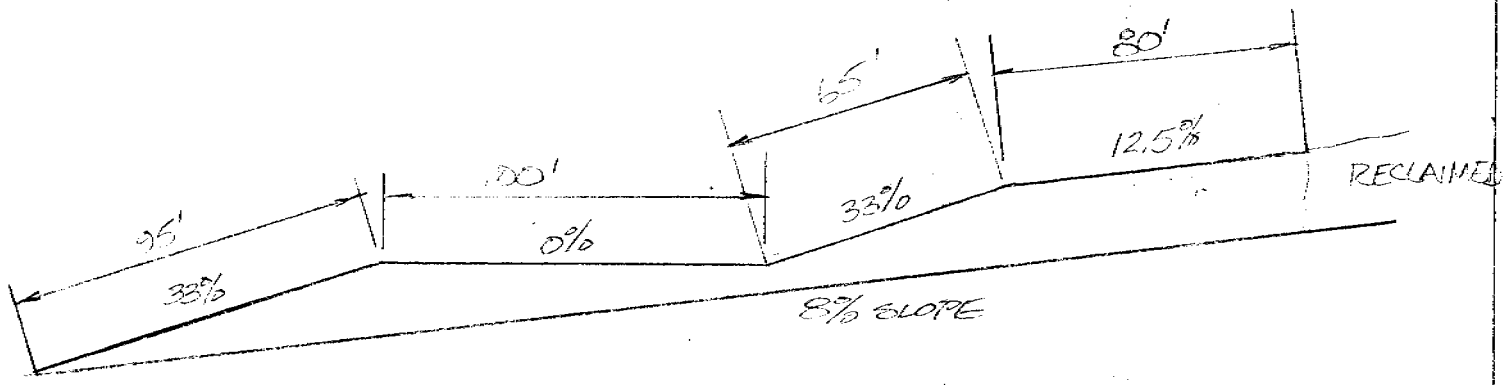
TOPSOIL

$2.73 \text{ ACRES} \times 43,560 \text{ ft}^2/\text{ACRE} \times 2.5 \text{ ft} = 297,297 \text{ ft}^3$

$118,919 \text{ ft}^3 / 27 \text{ ft}^3/\text{yd}^3 = 11,011 \text{ yd}^3$

$4404 \text{ yd}^3 \times 2300 \text{ lb/yd}^3 = 25,325,300 \text{ lbs}$

AMPAD 22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS



OPERATING X-SECTION LOOKING NORTH

NOTE: AVG. FILL WIDTH IS ≐ 350 ft

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USE D8L to spread topsoil

MATERIAL = 2300 lb/yd^3 in bank
= 1600 lb/yd^3 loose

LOAD FACTOR = 0.70
TRACTION FACTOR = 0.90

DOZING DISTANCE = 340' (ON FILL)

100' NO GRADE
95' −33%
65' +33%
80' +12.5%

AVG DOZING DISTANCE ≅ 200'

FROM CAT BOOK D8L-S = 750 LCY/hr UNCORRECTED
MATERIAL LOOSE ⇒ FACTOR (1.20)
AVG GRADE = 18.5% ⇒ FACTOR (0.65)
SIDE BY SIDE DOZING ⇒ FACTOR (1.20)
JOB EFFICENCY 40min/hr ⇒ FACTOR (0.67)

PRODUCTION = (750 LCY/hr)(1.20)(0.65)(1.20)(0.67)

PRODUTION = 470 LCY/hr

$$\frac{4404\ yd^3}{0.70} = 15{,}730\ yd^3\ loose$$

$$\frac{(6291\ LCY)}{470\ LCY/hr} = \underline{33.5\ hrs}$$

DISC TOPSOIL

USE 60 hp tractor with 10 foot implement

ESTIMATE SPEED AT 2 mi/hr

$$\frac{10\ ft \times 5280\ ft/mi \times 2\ mi/hr}{43{,}560\ ft^2/acre} = 2.42\ ACRE/hr$$

2.73 ACRES/2.42 = 1.1 hrs x 1.5 = 1.7 hrs

ASSUME SEEDING CAN BE DONE AT SAME RATE 1.7 hrs

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TOPSOIL FROM PILE TO PAD

LOADER

USE 988-B Loader

NEED TO MOVE 11,011 BCY or 15,730 LCY

NEED TO MOVE ≈ 500 LCY/hr

AVERAGE CYCLE TIME = 0.60 min

$$\text{Cycles/hr} = \frac{60}{0.6} = 100$$

Payload per cycle = 500/100 = 5 LCY

988B with ROCK BUCKET = 7 yd³

$$\frac{5}{7} = 71\% \text{ fill factor}$$

Fill factor should be about 100% for soil; hence bucket is okay.

$$\frac{15{,}730 \text{ LCY}}{500 \text{ LCY/hr}} = \underline{31.5 \text{ hrs}}$$

TRUCKS

USE 12 yd³ dump trucks

HAUL & RETURN:

$$\frac{1200 \text{ ft} \times 60 \text{ min/hr}}{(5280 \text{ ft/mi})(5 \text{ mi/hr})} = 2.7 \text{ min}$$

LOAD TIME	= (0.6) × 3 =	1.8 min
MANEUVER TIME	= (0.8) × 2 =	1.6 min
DUMP TIME	=	1.2 min
HAUL & RETURN	=	2.7 min
		7.3 min

$$\text{cycles/hr} = \frac{60}{7.3} = 8.2$$

12 yd^3 x 8.2 = 98.4 LCY/hr

500 LCY/98.4 = 5 TRUCKS

MULCHING

2.73 ACRES hydromulch @ 2000 lb/ACRE

$225/TON MATERIAL

PRODUCTION 1/2 ACRE/HR

2.73 ACRES/0.5 ACRE/HR = 5.5 hrs

SEEDING

Bluebunch wheatgrass	3 lb	@	6.04	18.12
Kentucky bluegrass	1 lb	@	2.88	2.88
Western wheatgrass	4 lb	@	3.91	15.64
Smooth brome	3 lb	@	2.88	8.64
Blue penstemon (Rx Mix)	1/4 lb	@	30.00	7.50
Blue flax	1/4 lb	@	7.48	1.87
Cicer milkvetch	1/4 lb	@	2.88	0.72
Alfalfa	1 lb	@	1.67	1.67
Yellow sweetclover	1 lb	@	0.69	0.69
Yarrow	1/4 lb	@	37.95	9.49
Rubber rabbitbrush	2 lb	@	86.25	172.50
Big sagebrush	2 lb	@	34.50	69.00
	18 lbs			308.72

COST SCHEDULE

D8L'S	$11,225/mo $3,825/wk $1,185/DY $177.50/HR	O.C. $30.95/hr	= $1433/DY = 208.45/hr
988B	$1,155/DY $172.50/HR	O.C. $43.65/hr	$1504/DY $216.15/hr
12yd³ Truck (10 wheeler) (6x4)	$300/DY $45.25/hr	O.C. $16.00/hr	$428/DY $61.25/hr
60 hp Tractor w/implements	$185/DY $27.50/hr	O.C. $5.55/hr	$229/DY $33.05/hr
PICKUP	$35.75/DAY $5.40/hr	O.C. $8.80/hr	$106/DY $14.20/hr

Laborer $23.65/hr

FOREMAN $33.65/hr

OPERATOR $30.35/hr

DRIVER $29.60/hr

HYDROSEEDER $105.65/hr INCLUDES LABOR

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

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WASTE ROCK COSTS:

RIPPING

D8L	2 hrs	x(208.45+30.35)=	478

TOPSOIL

D8L	33.5 hrs	x(208.45+30.35) =	8000
988 B	31.5 hrs	x(216.15+30.35) =	7765
12 yd³ Trucks	31.5 hrs	x5x(61.25+24.60) =	13,521
60 hp Tractor	1.7 hrs	x(33.05+24.60) =	98
Laborer	4 hrs	x(23.65) =	95

SEEDING

60 hp Tractor	1.7 hrs	x(33.05+24.60) =	98
Laborer	4 hrs	x(23.65) =	95

SUPERVISION

PICKUP	(8+8+8)x106	+4x14.20 =	2601
FOREMAN	(4+8+8+8)x33.65	=	942

MULCHING

(2.73 ACRES @ 2000 lb/ACRE) $225/TON	=	614
5.5 hrs @ 105.65/hr	=	581

SUB TOTAL = 34,888

SEED 2.73 ACRES @ $308.72 = 843

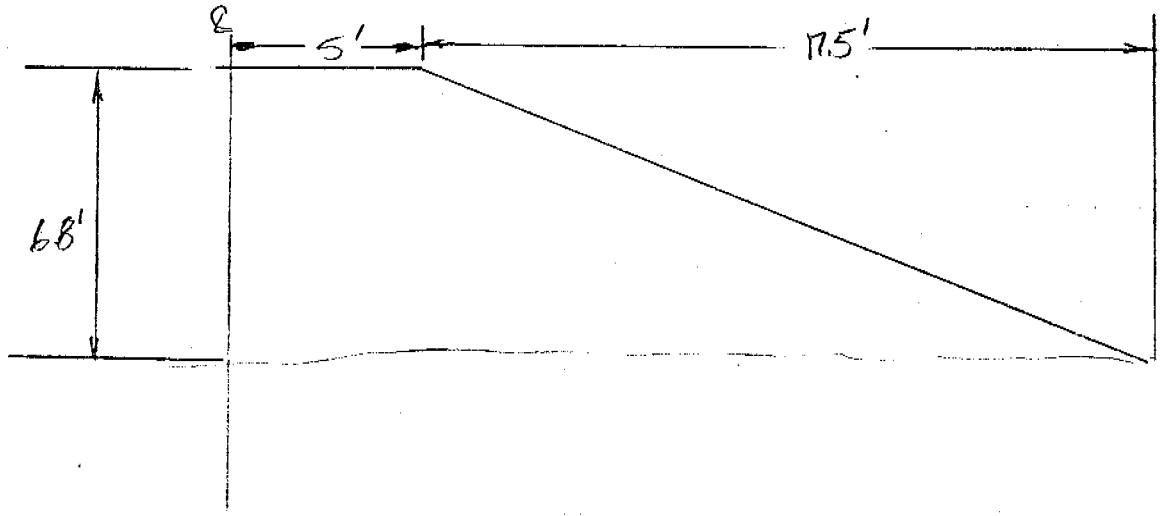
TOTAL = $ 35,731

SEDIMENT POND RECLAMATION

POND WILL BE FLATENED - DAM PUSHED OVER SEDIMENT

POND COVERS AN AREA OF ±1 ACRE

MAXIMUM DEPTH = 4.73 FEET



VOLUME DAM = {(5 ft × 6.8 ft × 2) + (17.5 ft × 6.8 ft)} × WIDTH + SIDE VOLUME

= (68 + 17.5 × 6.8)(50 + 18 + 18 + 10) + [½(6.8)(100) + (12.5)(6.8/2)] 2

= 17952 + 737

= 18,689

TOTAL = 18,689/27 = 692 BCY

ASSUME 3200 lb/BCY & 2550 lb/LCY

USE D8L to spread

Assume spread 70% of volume over 1.0 acre area

AVERAGE DOZING DISTANCE ≐ 100'

FROM CAT BOOK D8L-S ⇒ 900 LCY/hr uncorrected

MATERIAL IN BANK FACTOR = 0.8

SIDE BY SIDE DOZING FACTOR = 1.20

JOB EFFICIENCY (40 min/hr) FACTOR = 0.67

% GRADE +5% FACTOR = 0.90

PRODUCTION = (900)(0.8)(1.20)(0.67)(0.90)
= 520 LCY/hr

$$\frac{(692\ BCY)(1.25)}{520\ LCY/hr} = \underline{1.33\ hrs}$$

TOPSOIL

(1.0 ACRE)(43560 ft²/ACRE)(1.0 ft) = 43560 ft³
= 1613 yd³

LOADER

USE 988 B loader 100 cycles/hr ⇒ 500 LCY/hr

(1613 BCY)(1.438) = 2319 LCY

$$\frac{2319\ LCY}{500\ LCY/hr} = \underline{4.6\ hrs}$$

TRUCKS

HAUL & RETURN $\frac{800\ ft \times 60\ min/hr}{(5280\ ft/mi)(5\ mi/hr)} = 1.8\ min$

HAUL & RETURN	1.8 min
MANEUVER	1.6 min
DUMP	1.2 min
LOAD	1.8 min
	6.4 min

$$\text{cycles/hr} = \frac{60}{6.4} = 9.4$$

$12 yd^3 \times 9.4 = 113$ LCY/hr

$$\frac{500 \text{ LCY/hr}}{113 \text{ LCY/hr}} = 4.4 \text{ TRUCKS}$$

USE 4 TRUCKS

PRODUCTION = 113 x 4 x 1 = 450 LCY/hr

$$\frac{2319 \text{ LCY}}{450} = 5.2 \text{ hrs}$$

NOTE: WILL ALSO TAKE 5.2 hrs w/ LOADER

DOZER

SPREAD TOPSOIL WITH D8L

AVERAGE DOZING DISTANCE = 175'

FROM CAT BOOK D8L-S ⇒ 950 LCY/hr uncorrected

MATERIAL LOOSE	FACTOR = 1.20
SIDE BY SIDE	FACTOR = 1.20
JOB EFFICENCY 40/60	FACTOR = 0.67
% GRADE +5%	FACTOR = 0.90

PRODUCTION = (950)(1.20)(1.20)(0.67)(0.90)

= 825 LCY/hr

$$\frac{2319 \text{ LCY}}{825 \text{ LCY/hr}} = 2.8 \text{ hrs}$$

DISC

60 hp tractor with 10 foot implement

Estimate speed = 3 mi/hr

$$\frac{10 \text{ ft} \times 5280 \text{ ft/mi} \times 3 \text{ mi/hr}}{43{,}560 \text{ ft}^2/\text{acre}} = 3.63 \text{ ACRE/HR}$$

1.0 ACRE/3.63 = 0.3 hr x 1.5 = 0.5 hr

Assume seed at same rate as disc.

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POND COSTS:

PUSH IN:

D8L	1.33 hrs x (208.45 + 30.35)	= 318

TOPSOIL:

D8L	2.8 hrs x (208.45 + 30.35)	= 669
988B	5.2 hrs x (216.15 + 30.35)	= 1282
12 yd³ trucks	5.2 hrs x 4 x (61.25 + 24.60)	= 1786
60 hp tractor	0.5 hrs x (33.05 + 24.60)	= 29
Laborer	5 hrs x (23.65)	= 118

Seeding:

60 h.p. tractor	0.6 hrs x (33.05 + 24.60)	= 35
Laborer	2 hrs x (23.65)	= 47

Supervision

Pickup	(8+8) x 106	= 1696
Foreman	(8+8) x 33.65	= 538

Mulching

	(1.0 ACRES @ 1 ton/acre) 225/ton	= 225
	3 hrs @ 105.65/hr	= 317

Total = 7060

TOTAL RECLAMATION COSTS

WASTE ROCK	35,731
POND	7060
	42,791

WKS
1/7/88
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Top Soil Estimate.

AREA WITH TOPSOIL = 218,760 ft^2

TEST PITS SHOW 24" AVERAGE OF SOILS THAT ARE COLLECTABLE

$$218,760 \times \frac{45}{12} = 820,350 \text{ ft}^3$$

EXISTING TOPSOIL PILE HAS ESTIMATED

2,250 yd^3 or 60,750 ft^3

TOTAL = 881,100 ft^3
32,633 yd^3

SEDIMENT POND TOPSOIL

1 ACRE AT 2 ft = 87,120 ft^3

TO BE STORED SEPARATE

THERE IS 7.32 ACRES OF DISTURBED AREA EXCLUDING SEDIMENT POND.

AT 12" DEPTH (7.32)(43,560)(1) = 797,148 ft^3 of top soil is required.

EXCESS:

$$\frac{(881,100 - 797,148)}{797,148} \quad \underline{11\%}$$

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

UNDISTURBED AREA DRAINAGE

AREA #1 contains 120.8 acres $= 0.19\ mi^2$

AREA #2 contains 77.9 acres $= 0.12\ mi^2$

10yr 24 hr event = 2.1 in

100yr 24 hr event = 3.2 in

CN = 55 No grazing brush covered

$$S = \frac{1000}{CN} - 10$$

$$S = 8.18$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

DIVERSION #1, #2, #3

For 10yr P = 2.1

Q = 0.02

For 100yr P = 3.2

Q = 0.25

Using SCS method

$$t_c = \frac{t_L}{0.6}$$

$$t_L = \frac{L^{0.8}(S+1)^{0.7}}{1900\,Y^{0.5}}$$

where L = length in feet (hydraulic)

Y = average land slope in percent

S = as given above.

t_L = Lag time in hours

FOR AREA #1

$L = 4300$ ft

$$\% \text{ slope} = 100 \times \left\{ \frac{\Sigma \text{ contour lengths (ft)} \times \text{contour interval (ft)}}{\text{Area (ft}^2)} \right\}$$

$$\% \text{ slope} = 100 \left(\frac{34{,}589 \times 40}{120.8 \times 43560} \right) = 26.3$$

$$t_L = \frac{4300^{0.8} (8.18+1)^{0.7}}{1900 (26.3)^{0.5}}$$

$t_L = .391$ hrs

$t_L = 0.65$ hrs

$q_p = q_p' A Q$ Using SCS TR55 method

For a $t_c = 0.65$ hrs

$q_p' = 430$ csm/in Fig 2.40 pg 115 AH & SFDA

FOR 10 YR

$q_p = 430(0.19)(0.02)$

$q_{p_{10}} = 1.6$ cfs

FOR 100 YR

$q_p = 430(0.19)(.25)$

$q_{p_{100}} = 20.4$ cfs

DIVERSION #1

DIVERSION #1 CONSISTS OF A DIVERSION DIKE LOCATED AT THE EXISTING CHANNEL DELTA TO SPREAD THE FLOW ONTO AN EXISTING VEGETATED FLOOD PLAIN. DESIGN CALLS FOR DIKE & CHECK ON EXISTING FLOOD PLAIN. SINCE DIVERSION IS TO BE LEFT IN PLACE DESIGN FOR 100 YR EVENT. NOTE: CHECK EXISTING CMP DESIGN THROUGH COUNTY ROAD.

CMP DESIGN CHECK EXISTING 36" ϕ

$D = 36''$

$L = 75\ ft$

Elev Diff $= 7997.87 - 7994.12$

$= 3.75$

$S_o = 3.75/75$

$S_o = 0.05$

Inlet will control since culvert is cantilevered on outlet.

$H_w = H + h_o - LS_o$

where H = head
L = length
S_o = slope
$h \approx 2$

$H_w = 3.75 + 2 - 75(0.05)$

$H_w = 2$

Using inlet control Fig 4.18 Handbook of Steel Drainage & Highway Construction Products

$H_w/D = 1.5$

$Q = 45\ cfs$

Which is more than adequate for 100 yr event.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

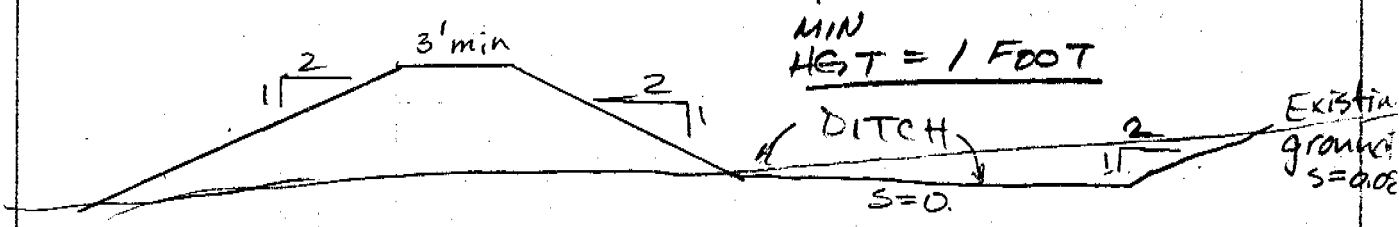
DIVERSION DIKE DESIGN

10yr event $q_{P_{10}} = 1.6$ cfs

100yr event $q_{P_{100}} = 20.4$ cfs

USE an interceptor Dike to transfer flow from existing ditch to existing vegetated flood plain.

Put dike ditch on 2% slope



Flow will be wide an shallow

Approximate with trapezodial channel

$S = 0.02$
$n = 0.030$
$b = 12$ feet
$z = 2$

FOR 10 YR EVENT $q_{10} = 1.6$ cfs

$R = 0.09$
$d = 0.09$ ft
$v = 1.41$ fps

FOR 100 yr Event $q_{100} = 20.4$ cfs

$R = 0.39$
$d = 0.42$ ft
$v = 3.75$ fps

NOTE:
DESIGN DITCH TO HAVE

depth = 0.75 ft
bottom width = 12 feet
SIDE SLOPES = 2:1

MAKE DIKE MINIMUM 1 FT HIGH

~~DITCH~~ DIVERSION DESIGN AREA #1

AREA IS VEGETATED WITH GRASS & BRUSH

$v \leq 3.5$ fps to prevent erosion

$S = 0.074$

Retardance class C

Assume a prabolic channel profile since this approximates existing flood plain

From Fig 3.11c p173 AH&SFDA

@ velocity of 3fps $R = 0.41$ ft

2fps $R = 0.35$ ft

1fps $R = 0.32$ ft

FOR $Q_{100} = 20.4$ cfs

FINAL DESIGN:

$v = 2.3$ fps
$R = 0.36$ ft

$d = 0.55$
$T = 24.29$
$A = 8.87$

From Fig 3.11c for $v = 2.3$ $R = 0.36$

FOR $Q_{10} = 1.6$ cfs using same profile

$v = 0.3$ fps
$R = 0.26$ ft

$d = 0.39$
$T = 20.51$
$A = 5.33$

BOTH OF THE ABOVE CONDITIONS ARE APPROXIMATED IN THE EXISTING FLOOD PLAIN PROFILE

FOR 10yR event flow will be 0.4ft deep $v = 0.3$ fps

FOR 100yR event flow will be 0.6ft deep $v = 2.3$ fps

Diversion #3 - County Road Right of Way Runoff

AREA = 0.61 ACRES or 0.001 mi^2

CURVE = 90

$$Q = \frac{(P-0.2S)^2}{P+0.8S}$$

$$S = \frac{1000}{CN} - 10$$

$S = 1.11$

FOR 10 yr 24 hr event $P = 2.1$ in

FOR 100 yr 24 hr event $P = 3.2$ in

FOR 10 YR $P = 2.1$ FOR 100 YR $P = 3.2$

$Q_{10} = 1.18$ cfs $Q_{100} = 2.17$ cfs

Hydraulic length = 1020 ft

% slope = 10

$$t_L = \frac{1020^{0.8}(1.11+1)^{0.7}}{1900(10)^{1/2}}$$

$t_L = 0.07$ hrs

$t_c = 0.12$ hrs

$q_p = q_p' A Q$ using SCS TR55 method

FOR a $t_c = 0.12$ hrs $q_p' = 950$ csm/in

$q_{P_{10}} = (950)(0.001)(1.18)$ $q_{P_{100}} = (950)(0.001)(3.2)$

$q_{P10} = 1.12$ cfs $q_{P100} = 3.04$ cfs

DESIGN TRAPEZODIAL CHANNEL (Ditch #3)

$b = 2'$
$z = 2$

KNOW: $Q_{10} = 1.12$ cfs

$Q_{100} = 3.04$ cfs

$S = 0.05$ to 0.08 along road side $n = 0.030$
$S = 0.24$ off embankment $n = 0.030$

Slope (%)	Q_{10} Depth (ft)	Q_{10} Velocity (fps)	Q_{100} Depth (ft)	Q_{100} Velocity (fps)
5	0.16	2.97	0.29	4.06
6	0.15	3.15	0.27	4.37
7	0.15	3.32	0.26	4.60
8	0.14	3.48	0.25	4.84
24	0.10	4.93	0.18	6.98

Use channel

$d = 0.6$ ft
$b = 2$ ft
$z = 2$

Riprap 24% portion with $D_{50} = 6''$ riprap. Dump into armored stilling basin at begining of Diversion #2.

LINE REST OF DITCH WITH SEWER ROCK RIPRAP $D_{50} \doteq 3''$. USE ROAD BASE FILTER BLANKET DEPTH OF D_{50} on both portions. FILTER MATERIAL MAY BE USED IF DESIRED. YES

FOR AREA #2

$L = 2700$ ft

$$\% \text{ slope} = 100 \times \left\{ \frac{\Sigma \text{ contour lengths (ft)} \times \text{contour interval (ft)}}{\text{AREA (ft}^2)} \right\}$$

$$\% \text{ slope} = 100 \left(\frac{24{,}566 \times 40}{(77.9)(43560)} \right)$$

$\% \text{ slope} = 29\%$

$$t_L = \frac{2700^{0.8}(8.18+1)^{0.7}}{1900(29)^{0.5}}$$

$t_L = 0.256$ hrs

$t_c = 0.43$ hrs

$q_p = q_p' AQ$ using SCS TR55 method

For a $t_c = 0.43$ hrs $q_p' = 550$ csm/in

For 10 yr

$q_{p_{10}} = 550(0.12)(0.02)$

$q_{p_{10}} = 1.32$ cfs

For 100 yr

$q_{p_{100}} = 550(0.12)(0.25)$

$q_{p_{100}} = 16.5$ cfs

RUNOFF FROM DIVERSION #3

$Q_{10} = 1.12$ cfs $\quad Q_{100} = 3.04$ cfs

DESIGN #2 DIVERSION

$Q_{10} = 1.32 + 1.12 =$

$\underline{Q_{10} = 2.44 \text{ cfs}}$

$Q_{100} = 16.5 + 3.04$

$\underline{Q_{100} = 19.54 \text{ cfs}}$

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

call wks

DESIGN #2 DIVERSION TO PACK Q_{10} without lining; i.e $v \leq 3.5$ fps.

Vegetative lining will be established within two growing seasons. Q_{100} to be packed in vegetative lined channel.

For vegetation covered channel use parabolic channel. Vegetation quick covering grasses.

Slope = 6% $v \leq 4$ fps

Erosion class D fig 3.11d pg 174 AH & SFDA

$v = 1$ fps $R = 0.21$

$v = 2$ fps $R = 0.29$

$v = 3$ fps $R = 0.36$

$v = 3.5$ fps $R = 0.39$

$v = 4.0$ fps $R = 0.42$

10 YR	100 YR
$Q_{10} = 2.44$ cfs	$Q_{100} = 15.26$
$R = 0.21$	$R = 0.38$
$V = 1.00$ fps	$V = 3.3$
$D = 0.32$ ft	$D = 0.57$ ft
$T = 11.44$ ft	$T = 15.26$ ft
$A = 2.44$ ft^2	$A = 5.92$ ft^2

Use parabolic channel $T = 19.18'$, $D = 0.9'$
$A = 11.51$ ft^2

check errosion velocity unlined with 10yr event.

$$V_P = \frac{1.49}{n} R^{2/3} S^{1/2}$$

$S = 0.06$

Assume $n = 0.030$

NOTE: APPLICANT IS NOT CLEAR ON WHICH DESIGN WILL BE USED.

2 stipulation: → if veg. not in 2 yrs then rip rap modific →

Using same shape

$$t = T\left(\frac{d}{D}\right)^{1/2}$$

$T = 15.26$

$D = 0.57$

$$R = \frac{t^2 d}{1.5t^2 + 4d}$$

Try flow depth of 0.2 ft

$$t = 15.26\left(\frac{0.2}{0.57}\right)^{1/2} = 9.04$$

$$R = \frac{(9.04)^2\, 0.2}{1.5(9.04)^2 + 4(0.2)} = 0.13$$

$$V = \frac{1.49}{0.030}(0.13)^{2/3}(0.06)^{1/2}$$

$V = 3.12$ fps

$A = 2/3\,(9.04)(0.2) = 1.2\ ft^2$

$Q = (3.12)(1.2) = 3.74$ cfs

$\Rightarrow$ d is to big

TRY $d = 0.16$

$T = 8.08$

$R = 0.106$

$V = 2.72$ fps

$A = 0.862$

$Q = (0.862)(2.72) = 2.34$ cfs

Try $d = 0.17$

$T = 8.33$

$R = 0.11$

$V = 2.83$ fps

$A = 0.944$

$Q = 2.67$ cfs

Thus flow for 10 yr event in unlined channel will have a velocity of about 2.75 fps which will not be erosionable. Use channel designed on page 9.

Apron design at bottom of 36" CMP and where diversion #3 drops into diversion #2.

Use a 6 ft diameter basin 1 foot deep armored with $D_{50} = 6"$ riprap. Basin to be underlined with 1 foot thick filter blanket of road base.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

DISTURBED AREA DRAINAGE

The runoff from the disturbed area will be captured by two ditches and conveyed to the sediment pond:

Ditch #1 West

Ditch #2 South side

Since portions of area going to each ditch will vary depending on placement of waste rock, each ditch will be sized to handle flow.

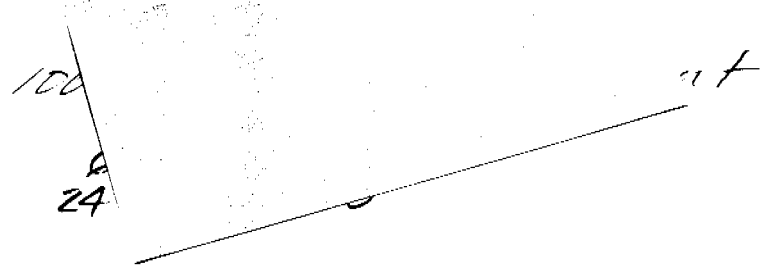
Disturbed area = 7.93 ACRES

of which 0.61 ACRES is asphalt road.

from SHE Ditches #1, #2 event:

Design

event:



CN = 81 for disturbed area (weighted)

CN = 98 for ROAD

DIVERSION #3 WILL BE USED TO CATCH RUN OFF FROM ROAD.

$$Q = \frac{(P-0.2S)^2}{P+0.8S} \quad \text{when } P > 0.2S$$

$$S = \frac{1000}{CN} - 10$$

Q = inches of runoff

10 yr 24 hr storm
P = 2.1" Type II

Time (hr)	P_t/P_{24}	Depth (in)	Inc Depth (in)	Intensity iph
0				
0.25	0.005	0.011		
0.50	0.007	0.015	0.004	0.02
0.75	0.010	0.021	0.006	0.02
1.00	0.012	0.025	0.004	0.02
1.25	0.014	0.029	0.004	0.02
1.50	0.016	0.034	0.004	0.02
1.75	0.018	0.038	0.004	0.02
2.00	0.020	0.042	0.004	0.02
3.00	0.035	0.074	0.032	0.03
4.00	0.05	0.105	0.032	0.03
5.00	0.06	0.126	0.021	0.02
6.00	0.08	0.168	0.042	0.04
7.00	0.10	0.210	0.042	0.04
8.00	0.12	0.252	0.042	0.04
9.00	0.15	0.315	0.063	0.06
10.00	0.19	0.399	0.084	0.08
11.00	0.24	0.504	0.105	0.11
12.00	0.66	1.386	0.882	0.88
13.00	0.77	1.617	0.231	0.23
14.00	0.82	1.722	0.105	0.11
15.00	0.85	1.785	0.063	0.06
16.00	0.88	1.848	0.063	0.06
17.00	0.90	1.890	0.042	0.04
18.00	0.92	1.932	0.042	0.04
19.00	0.94	1.974	0.042	0.04
20.00	0.95	1.995	0.021	0.02
21.00	0.97	2.037	0.042	0.04
22.00	0.98	2.058	0.021	0.02
23.00	0.99	2.079	0.021	0.02
24.00	1.00	2.100	0.021	0.02

Assume infiltration loss = 0.3 iph

max effective intensity = 0.88 − 0.3 = 0.58

For most hydrologic remote location

Flow = 200'@ 10% slope
320'@ 2% terrace
620'@ 2% [illegible]

L = 1140' S_h = 0.07

$t_c = 0.928 (nL)^{0.6} / (i_e^{0.4} S^{0.3})$

where n = mannings n ASSUME 0.04

$t_c = 0.928 \{(0.04)(1142)\}^{0.6} / (0.58^{0.4})(0.07)^{0.3}$

$t_c = 9.182 / 0.362$

$t_c = 25.35$ minutes

$t_c = 0.42$ hrs

Using SCS TR 55 method

$q_p = q_p' A Q$

for $P = 2.1$ in
$CN = 81$
$S = 2.35$
$Q = 0.67$ in

q_p' for 0.42 hrs $= 550$
$A = 0.012 \, mi^2$ (7.68 Acres)

$q_p = (550)(0.012)(0.67)$

$q_p = 4.42$ cfs

DESIGN DITCH #1 & DITCH #2

for earth limiting velocity = 3.5 fps

Max slope = 20%

min slope = 2%

$V = \frac{1.49}{n} R^{2/3} S^{1/2}$ Mannings Equation

$Q = VA$

WKS
10/15/[illegible]

FOR A TRAPEZOIDAL CHANNEL

$$A = bd + zd^2$$

$$R = \frac{bd + zd^2}{b + 2d\sqrt{z^2+1}}$$

KNOW: QUANITY = 4.42 cfs
MAX SLOPE = 20%
MIN SLOPE = 2%
n = 0.045 TABLE 3.1 A.H.S.F.D.A. by Barnett, [illegible]

FIND:
FLOW DEPTH & VELOCITY
FOR VARIOUS GRADIENTS

ASSUME: b = 2'
z = 1

THE FOLLOWING TABLE WAS GENERATED BY SOLVING

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

USING TRIAL & ERROR FOR VARIOUS DEPTHS

SLOPE (%)	d (ft)	V (fps)	A (ft²)	R (ft)	Q
2	0.62	2.67	1.66	0.44	4.48
5	0.48	3.71	1.19	0.35	4.41
6	0.46	3.91	1.13	0.34	4.50
7	0.44	4.12	1.07	0.33	4.50
8	0.42	4.35	1.02	0.32	4.44
10	0.39	4.74	0.93	0.30	4.38
11	0.38	4.89	0.90	0.29	4.39
13	0.36	5.20	0.85	0.28	4.36
14	0.36	5.20	0.85	0.28	4.52
18	0.33	5.75	0.77	0.26	4.42
20	0.32	5.95	0.74	0.26	4.43

[illegible] b = 2 ft, z = 1 trapezoidal ditch

depth = 0.62 + 0.3 = 0.93

SAY 1.1 ft

Riprap is need for slopes above 4% in ditches #1 & #2

Using limiting velocity approach for riprap.
$V_{max} \doteq 6$ fps

From curve stone diameter = 5"

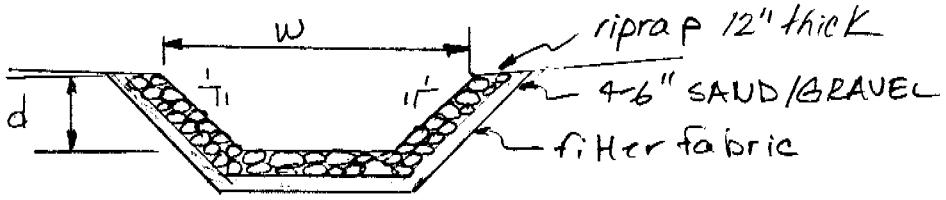
Use Riprap with following size distribution.

Size, Inches	Percent Passing
12"	100
5"	45-35
3"	15-0

Rip rap shall be hard, durable and free from rocks having a maximum dimension twice or more times greater than the minimum dimension of the particle.

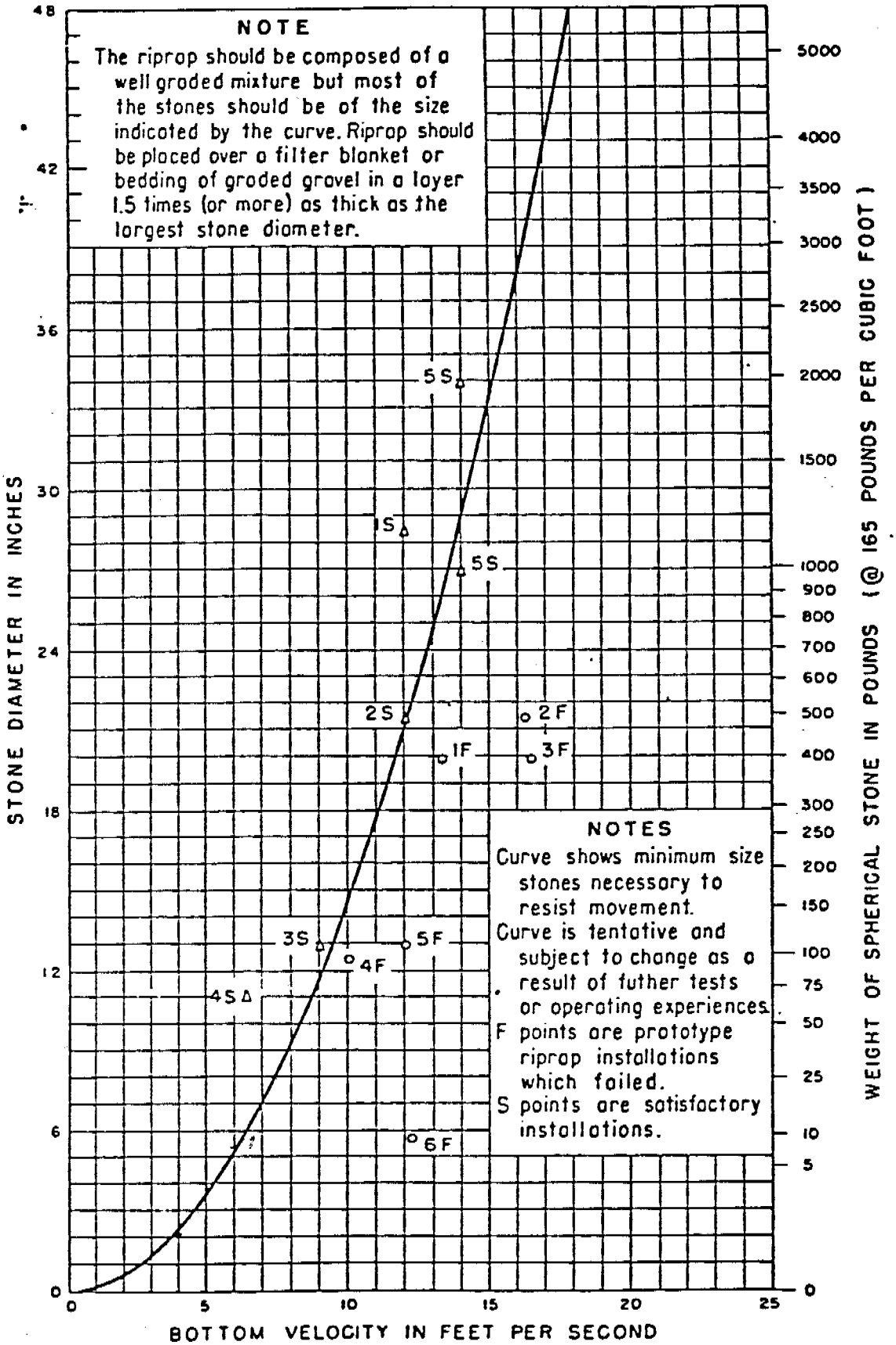
A filter fabric such as DuPont Typar 3401 or equivalent may be placed on the prepared soil surface prior to rip rap placement. A sand blanket or gravel blanket should be placed over the filter fabric. Depth of the blanket should be 4-6".

DITCHES #1 & #2 will have the cross-section shown below on slopes above 4%.



final design

$d = 1'$ $w = 4'$ for $S \leq 5\%$
$d = 0.8'$ $w = 3.6'$ $5\% < S \leq 8\%$
$d = 0.7'$ $w = 3.4'$ $8 < S \leq 20\%$



Curve to determine maximum stone size in riprap mixture

WASTE ROCK DISPOSAL WKS 1/2
26 OCT 8[illegible]

FILL TERRACES

From MAP 2 MAXIMUM DRAINAGE AREA $= 91{,}920\,ft^2$

Install @ 2% slope $= 2.11$ ACRES

$= 0.003\,mi^2$

FOR 10 yr 24 hr event

$P = 2.1$ in
$CN = 80$ average
$S = 2.5$
$Q = 0.62$

For most hydraulic remote location

$L = 110'$ @ 9% + 85' @ 12% + 400' @ 2% [illegible]

from previous disturbed area drainage calculations

$i_e = 0.58''$

$$S_A = \frac{(110)(.09) + (85)(.12) + 400(.02)}{110 + 85 + 400}$$

$S_A = 4.7\%$

$L = 595$

$$t_c = 0.928(nL)^{0.6} / i_e^{0.4} S^{0.3}$$

where n = mannings n Assume $n = 0.04$

$$t_c = \frac{0.928[(0.04)595]^{0.6}}{(0.58)^{0.4}(.047)^{0.3}}$$

$t_c = 19.34$ min or 0.32 hrs

Using SCS TR55 method

$q_p = q_p' AQ$ for $t_c = 0.32$ $q_p' = 650$

$q_p = (650)(0.003)(0.62) = 1.21$ cfs

USE A TRIANGULAR SHAPED X-SECTION

$z = 1.50$ color shown

$n = 0.40$

$Q = 1.21$ cfs

SOLVE BY TRIAL & ERROR

DEPTH = 0.616 ft

$R = 0.26$ ft

$A = 0.57$ ft^2

$V = 2.13$ fps okay

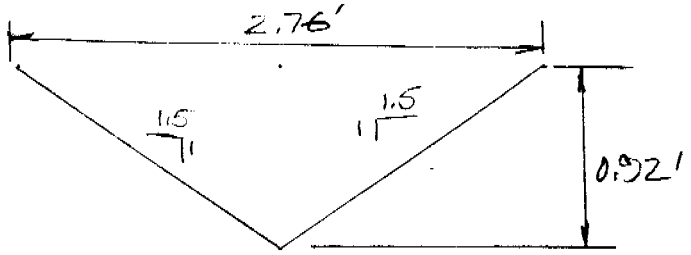
$t = 1.848'$

USE 0.3 ft free board

DESIGN $z = 1.5$

depth = 0.92 ft

width = 2.76 ft



MAKE TERRACE 10-15 FT WIDE BENCH WITH DITCH NEAR CENTER

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Sedimentation Pond Sizing

Disturbed area = 7.93 acres

X-SECTION A-A' FROM TOP

120' @ 12%
110' @ 9%
85' @ 17%
115' @ 24%
72' @ 2%

505' @ 13.5%

[illegible]

X-SECTION B-B' FROM TOP

75' @ 1%
60' @ 17%
75' @ 13%
70' @ [illegible]
[illegible] @ 20%

280' @ 5.3%

[illegible]
[illegible] @ [illegible]
[illegible] @ 7%
90' @ 8%

USING USLE modified after Neibling & Foster

$A = RKLSCP$

FOR WASATCH PLATEAU MEAN ANN. R = 25 ANNUAL
FROM FIG. 5.2 p 514 AH&SFDA

SOILS CONTAIN: ≈ 60% SAND,
≈ 20% SILT
≈ 18% CLAY
≈ 2% Organic Matter

$K = 0.15$

FROM Fig 5.3 p 529 AH&SFDA

$$LS = \left(\frac{\lambda}{72.6}\right)^m \left(\frac{430x^2 + 30x + 0.43}{6.61}\right)$$

$x = \sin\theta$ θ = slope %

λ = slope length

$m = 0.5$

USE AVG SLOPE OF 443' @ 13.4%

$$LS = \left(\frac{443}{72.6}\right)^{0.5} \left(\frac{(420)(\sin 13.4)^2 + 30(\sin 13.4) + 3.45}{6.613} \right)$$

$LS = 11.38$

for $C_{10} = 0.5$ 1 T/A mulch Table 5.9 AHS, SFDA

Contouring use multiplier of 0.6

Use $C_{10} = 0.5 \times 0.6 = \underline{0.3}$

$A = (35)(0.15)(11.38)(0.3)$

$A = 17.92$ TONS/ACRE

Using 7.93 ACRES

$(7.93)(17.92) = 142.11$ TONS/YR

convert to sediment volume assume b.d = 1.5

$$Y = \frac{(142.11 \text{ tons})(2000 \text{ lbs/ton})(1 \text{ acre})}{(1.5)(62.4 \text{ lbs/ft}^3)(43{,}560 \text{ ft}^2)}$$

$Y = 0.0697$ acre-ft/yr

For 3 years

Storage volume $= (0.0697)(3) = 0.21$ ac ft

storage volume = 9,148 ft³

10,114

OK

RUNOFF TO SEDIMENT POND

DISTURBED AREA = 7.93 ACRES
SEDIMENT POND = 1.00 ACRE
8.93 ACRES

FOR 10 yr 24 hr event

Q = 0.67 in (from CN = 81)

TOTAL RUNOFF = $\frac{(8.93 \text{ ACRES})(0.67 \text{ in})}{12 \text{ in/ft}}$ = 0.50 ACFT

TOTAL RUNOFF = 21,792 ft^3 OK my value is 15,289

SED. STORAGE VOL = 9,148 ft^3

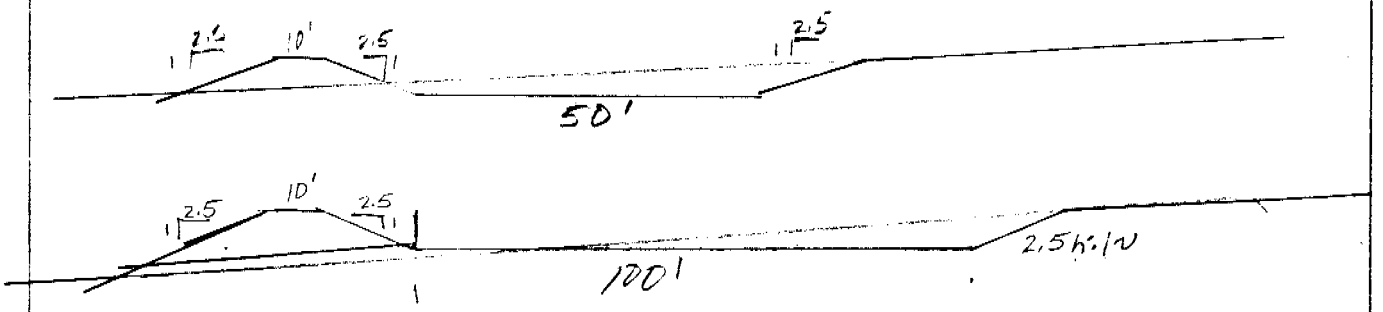
30,940 ft^3 OK my value is 25,403

SEDIMENT POND CAPACITY ≥ 30,940 ft^3

POND SIZE IS 100' LONG x 50' WIDE

NATURAL GRADE IS ≈ 5%

CROSS-SECTION



NOTE: BOTTOM TO BE FLAT

DISTURBED AREA DRAINAGE

The runoff from the disturbed area will be captured by two ditches and conveyed to the sediment pond:

Ditch #1 West

Ditch #2 South side

Since portions of area going to each ditch will vary depending on placement of waste rock, each ditch will be sized to handle flow.

Disturbed area = 7.93 ACRES

of which 0.61 ACRES is asphalt road.

from SHE 10 yr Precipitation event:
1 hr = 0.9 in
6 hr = 1.3 in
24 hr = 2.1 in

25 yr Precipitation event:
1 hr = 1.1 in
6 hr = 1.6 in
24 hr = 2.6 in

100 yr Precipitation event
1 hr = 1.38 in
6 hr = 2.00 in
24 hr = 3.20

CN = 81 for disturbed area (weighted)

CN = 98 for ROAD

DIVERSION #3 WILL BE USED TO CATCH RUN OFF FROM ROAD.

$$Q = \frac{(P-0.2S)^2}{P+0.8S} \quad \text{when } P > 0.2S$$

$$S = \frac{1000}{CN} - 10$$

Q = inches of runoff

WKS 2/5
10/15/87

10 yr 24 hr storm
P = 2.1" Type II

Time (hr)	P_t/P_{24}	Depth (in)	Inc Depth (in)	Intensity (iph)
0				
0.25	0.005	0.011		
0.50	0.007	0.015	0.004	0.02
0.75	0.010	0.021	0.006	0.02
1.00	0.012	0.025	0.004	0.02
1.25	0.014	0.029	0.004	0.02
1.50	0.016	0.034	0.004	0.02
1.75	0.018	0.038	0.004	0.02
2.00	0.020	0.042	0.004	0.02
3.00	0.035	0.074	0.032	0.03
4.00	0.05	0.105	0.032	0.03
5.00	0.06	0.126	0.021	0.02
6.00	0.08	0.168	0.042	0.04
7.00	0.10	0.210	0.042	0.04
8.00	0.12	0.252	0.042	0.04
9.00	0.15	0.315	0.063	0.06
10.00	0.19	0.399	0.084	0.08
11.00	0.24	0.504	0.105	0.11
12.00	0.66	1.386	0.882	0.88
13.00	0.77	1.617	0.231	0.23
14.00	0.82	1.722	0.105	0.11
15.00	0.85	1.785	0.063	0.06
16.00	0.88	1.848	0.063	0.06
17.00	0.90	1.890	0.042	0.04
18.00	0.92	1.932	0.042	0.04
19.00	0.94	1.974	0.042	0.04
20.00	0.95	1.995	0.021	0.02
21.00	0.97	2.037	0.042	0.04
22.00	0.98	2.058	0.021	0.02
23.00	0.99	2.079	0.021	0.02
24.00	1.00	2.100	0.021	0.02

Assume infiltration loss = 0.3 iph

max effective intensity = 0.88 − 0.3 = 0.58

For most hydrologic remote location

Flow = 200'@ 10% slope
320'@ 2% terrace
620'@ 8% ditch

L = 1140' S_h = 0.07

$t_c = 0.928(nL)^{0.6} / (i_e^{0.4} S^{0.3})$

where n = mannings n Assume 0.04

$t_c = 0.928\{(0.04)(1142)\}^{0.6} / (0.58^{0.4})(0.07)^{0.3}$

$t_c = 9.182 / 0.362$

$t_c = 25.35$ minutes

$t_c = 0.42$ hrs

Using SCS TR 55 method

$q_p = q_p' A Q$

for $P = 2.1$ in
$CN = 81$
$S = 2.35$
$Q = 0.67$ in

q_p' for 0.42 hrs = 550
$A = 0.012\ mi^2$ (7.68 Acres)

$q_p = (550)(0.012)(0.67)$

$q_p = 4.42$ cfs

DESIGN DITCH #1 & DITCH #2

for earth limiting velocity = 3.5 fps

Max slope = 20%

min slope = 2%

$V = \frac{1.49}{n} R^{2/3} S^{1/2}$ Mannings Equation

$Q = VA$

WKS
10/15/87

FOR A TRAPEZODIAL CHANNEL

$$A = bd + zd^2$$

$$R = \frac{bd + zd^2}{b + 2d\sqrt{z^2+1}}$$

KNOW: QUANITY = 4.42 cfs
MAX SLOPE = 20%
MIN SLOPE = 2%
n = 0.045 TABLE 3.1 A.H.S.F.D.A. by Barfield, et al

FIND:
FLOW DEPTH & VELOCITY
FOR VARIOUS GRADIENTS

ASSUME: b = 2'
z = 1

THE FOLLOWING TABLE WAS GENERATED BY SOLVING

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

USING trial & ERROR FOR VARIOUS DEPTHS

SLOPE (%)	d (ft)	V (fps)	A (ft²)	R (ft)	Q
2	0.63	2.67	1.66	0.44	4.48
5	0.48	3.71	1.19	0.35	4.41
6	0.46	3.91	1.13	0.34	4.50
7	0.44	4.12	1.07	0.33	4.50
8	0.42	4.35	1.02	0.32	4.44
10	0.39	4.74	0.93	0.30	4.38
11	0.38	4.89	0.90	0.29	4.39
13	0.36	5.20	0.85	0.28	4.36
14	0.36	5.20	0.85	0.28	4.52
18	0.33	5.75	0.77	0.26	4.42
20	0.32	5.95	0.74	0.26	4.43

DESIGN USING b = 2 ft, z = 1 trapezodial ditch

depth = 0.63 + 0.3 = 0.93

say 1 ft

Riprap is need for slopes above 4% in ditchs #1 & #2

Using limiting velocity approach for riprap.
$V_{max} \approx 6$ fps

From curve stone diameter = 5"

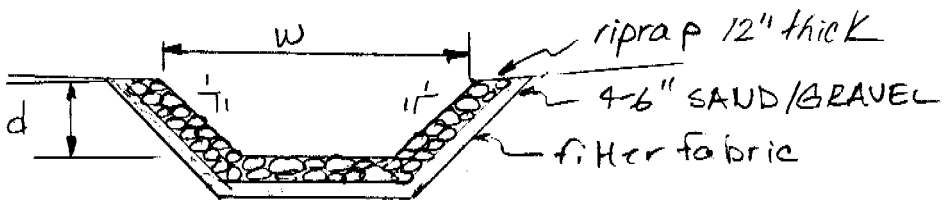
USE Riprap with following size distribution

Size, Inches	Percent Passing
12"	100
5"	45-35
3"	15-0

Riprap shall be hard, durable and free from seams having a maximum dimension twice or more times greater than the minimum dimension of the particle.

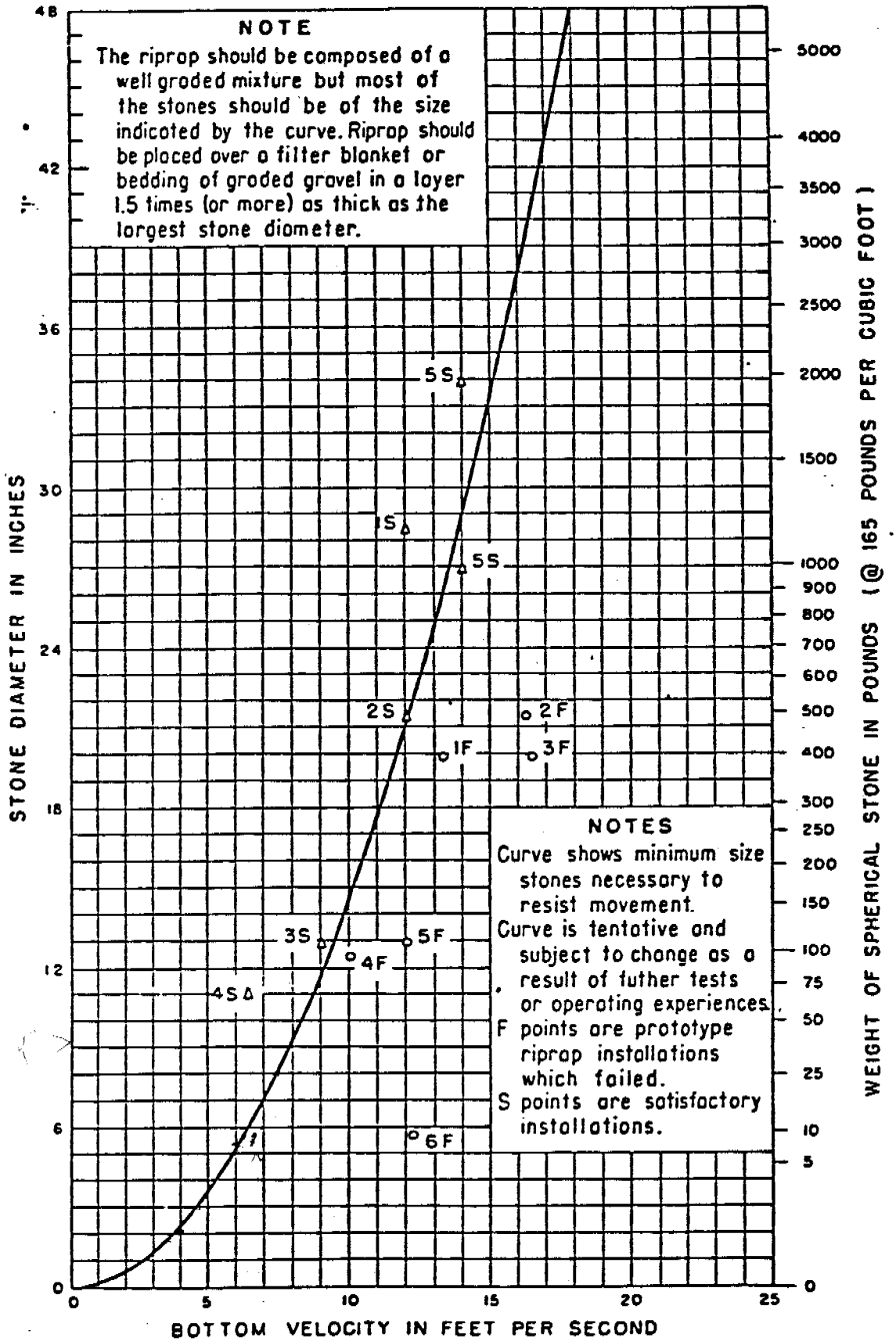
A filter fabric such as Dupont Typar 3401 or equivalent may be placed on the prepared soil surface prior to riprap placement. A sand blanket or gravel blanket should be placed over the filter fabric. Depth of blanket should be 4-6".

DITCHES #1 & #2 will have the cross-section shown below on slopes above 4%.



final design

$d = 1'$ $w = 4'$ for $S \leq 5\%$
$d = 0.8'$ $w = 3.6'$ $5\% < S \leq 8\%$
$d = 0.7'$ $w = 3.4'$ $8 < S \leq 20\%$



Curve to determine maximum stone size in riprap mixture

FILL TERRACES

From MAP 2 MAXIMUM DRAINAGE AREA = 91,920 ft^2
Install @ 2% slope = 2.11 ACRES
= 0.003 mi^2

For 10 yr 24 hr event

P = 2.1 in
CN = 80 average
S = 2.5
Q = 0.62

For most hydraulic remote location

L = 110' @ 9% + 85' @ 12% + 400' @ 2%

from previous disturbed area drainage calculations
i_c = 0.58"

$$S_A = \frac{(110)(.09) + (85)(.12) + 400(.02)}{110 + 85 + 400}$$

S_A = 4.7%

L = 595

$$t_c = 0.928 (nL)^{0.6} / i_c^{0.4} S^{0.3}$$

where n = mannings n Assume n = 0.04

$$t_c = \frac{0.928[(0.04)595]^{0.6}}{(0.58)^{0.4}(.047)^{0.3}}$$

t_c = 19.34 min or 0.32 hrs

Using SCS TR55 method

$q_p = q_p' A Q$ for t_c = 0.32 q_p' = 650

$q_p = (650)(0.003)(0.62) = 1.21$ cfs

USE A TRIANGULAR SHAPED X-SECTION

$z = 1.50$

$n = 0.40$ / error should be 0.04

$Q = 1.21$ cfs

SOLVE BY TRIAL & ERROR

DEPTH = 0.616 ft

$R = 0.26$ ft

$A = 0.57$ ft^2

$V = 2.13$ fps okay

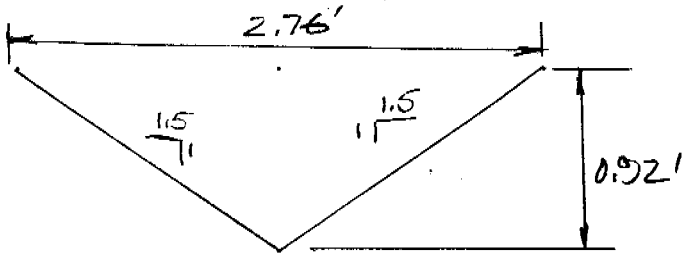
$t = 1.848'$

USE 0.3 ft free board

Design $z = 1.5$

depth = 0.92 ft

width = 2.76 ft



MAKE TERRACE 10-15 FT WIDE BENCH WITH DITCH NEAR CENTER

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

WKS
10/22/87

Sedimentation Pond Sizing

Disturbed area = 7.93 acres

X-SECTION A-A' FROM TOP

120' @ 12%
110' @ 9%
85' @ 12%
115' @ 26%
75' @ 3%

505' @ 13.5%

SED POND

X-SECTION B-B' FROM TOP

75' @ 1%
60' @ 17%
75' @ 13%
70' @ 14%
100' @ 20%

380' @ 13.3%

DITCH
90' @ 10%
200' @ 7%
90' @ 8%

USING USLE modifed after Neibling & Foster

A = RKLSCP

FOR WASATCH PLATEAU NEAR MINE R = 35 ANNUAL
FROM FIG. 5.3 p 314 AH&SFDA

SOILS CONTAIN: ± 60% SAND,
± 20% SILT
± 18% CLAY
± 2% Organic Matter

K = 0.15

FROM Fig 5.3
p 329 AH&SFDA

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

$x = \sin\theta$ θ = slope ∡ $m = 0.5$
λ = slope length

USE AVG SLOPE OF 443' @ 13.4%

error should be in degrees

error

$$LS = \left(\frac{443}{72.6}\right)^{0.5}\left(\frac{430(\sin 13.4)^2 + 30\sin 13.4 + 0.43}{6.613}\right)$$

$LS = 11.38$

Use $C_{10} = 0.5$ 1 T/A mulch Table 5.9 p 345 AH & SFDA

Contouring use multiplier of 0.6

Use $C_{10} = 0.5 \times 0.6 = \underline{0.3}$

$A = (35)(0.15)(11.38)(0.3)$

$A = 17.92$ TONS/ACRE

Using 7.93 ACRES

$(7.93)(17.92) = 142.11$ TONS/YR

convert to sediment volume assume b.d = 1.5

$$Y = \frac{(142.11\ \text{tons})(2000\ \text{lbs/ton})(1\ \text{acre})}{(1.5)(62.4\ \text{lbs/ft}^3)(43{,}560\ \text{ft}^2)}$$

$Y = 0.0697$ acre-ft/yr

For 3 years

storage volume = (0.0697)(3) = 0.21 acft

storage volume = [redacted] OK

10,114

RUNOFF TO SEDIMENT POND

DISTURBED AREA = 7.93 ACRES
SEDIMENT POND = 1.00 ACRES
8.93 ACRES

FOR 10 yr 24 hr event

Q = 0.67 in (from CN = 81)

TOTAL RUNOFF = (8.93 ACRES)(0.67 in) / 12 in/ft = 0.50 ACFT

TOTAL RUNOFF = 21,792 ft³ OK my value is 15,289

SED. STORAGE VOL = 9,148 ft³

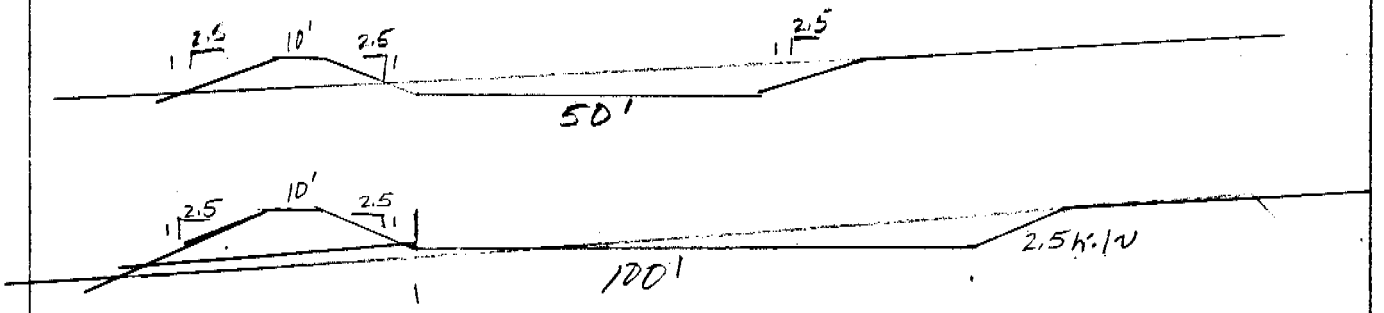
30,940 ft³ OK my value is 25,403

SEDIMENT POND CAPACITY ≥ 30,940 ft³

POND IS 100' LONG X 50' WIDE

NATURAL GRADE IS ≈ 5%

CROSS-SECTION



NOTE: BOTTOM TO BE FLAT

VOLUME OF POND FOR EACH FOOT OF DEPTH USING END AREA METHOD

$$\text{VOLUME} = \tfrac{1}{2}d(5000 + (50+5d)(100+5d))$$

$$= \tfrac{1}{2}d(10{,}000 + 750d + 25d^2)$$

$$=$$

$$\text{VOLUME} = 5000d + 375d^2 + 12.5d^3$$

DEPTH	VOLUME (ft^3)
0	0
1'	5,388
2'	11,600
3'	18,713
4'	26,800
5'	35,938

MAX. SED. STORAGE = 9,148 ft^3 ⇒ 1.63' DEPTH

10 yr 24 hr storm is 21,792 ft^3

To totally contain storm with sediment volume need 30,940 ft^3 or a depth of 4.47 ft

USE 4.50 ft

SIZE PRINCIPAL SPILLWAY

$$Q = C' \times \frac{\pi D^2}{4} \times \gamma\sqrt{2gH}$$

ASSUME POND CAN BE DECANTED TO 7887.00

ASSUME POND IS FULL TO DECANT WHEN 10 yr 24 hr. storm OCCURS.

11,600 + 21,792 = 33,392

DEPTH would be 4.73 ft

THUS $H = 4.73 - 2 = 2.73'$

what is this

$C' = 0.6$ for sharp edged inlet i.e. CMP pipe

$q = 3.782\, D^2 H^{1/2}$

$D = \left[\frac{q}{H^{1/2}(3.782)}\right]^{1/2}$

error in head this is from top of 1°

$D = \left[\frac{4.42}{(2.73)^{1/2}(3.782)}\right]^{1/2}$

$D = 0.71$ ft

$D = 8.50''$

USE 8" pipe

actual is 12"

CHANGED
SEE PAGE 13

Emergency Spill way - locate at minimum elevation of 4.73' from pond bottom

NOTE: Regs require 1 ft above principal as a minimum

25 yr 24 hr event

$t_c = 0.42$ hrs

for $P = 2.6$ in
$CN = 81$
$S = 2.35$
$Q = 1.01$ inches

USING SCS TR55

q_p' for 0.42 hrs $= 550$

$A = 0.012\ mi^2$

$q_p = q_p' A Q$

$q_p = 550(0.012)(1.01)$

$q_p = 6.69$ cfs

Emergency Spillway

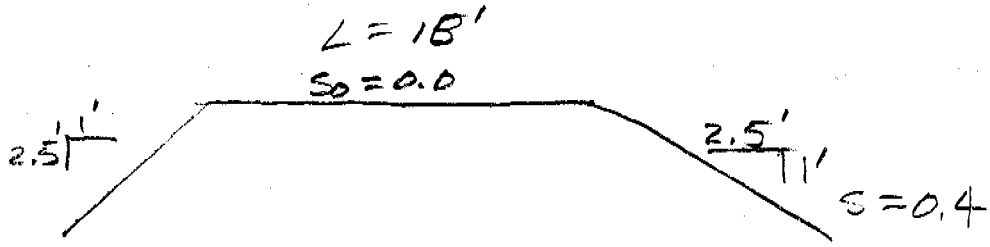
downstream spillway slope = 5% max dictated by site

SIDE SLOPES ARE 2.5:1 on dam

$z = 2$ for spillway

USE 8 ft/sec as velocity limit $n = 0.04$

Assume cross section is as shown



$H_{ec} = 0.65$ ft Fig 4B.14 pg 303 AH&SFDA

$H_p = 0.75$ ft Fig 4B.1 $L = 18$ ft

Determine bottom width

$Q = 0.544 g^{1/2} H_{ec}^{3/2} b$

$Q = 0.544 (32.2)^{1/2} (0.65)^{3/2} b = 1.618 b$

$Q = 6.69$ cfs $= 1.618 b$

$\Rightarrow b = 4.14$ ft

NOTE: PGS 7a & 7b give stage discharge

USE RIPRAP

FROM RIPRAP stone diameter = 9"

USE riprap with following size distribution

size Inches	Percent Passing
18"	100
9"	45-35
4"	15-0

Underlie with filter fabric and 4-6" of sand or gravel.

Emergency spillway will handle 25yr 24hr event independent of principal spillway.

size channel on spillway.

$Q = 6.69$ cfs

DOGM using $n = 0.045$ + SUFCO Q

$D = 0.21$

$V = 6.91$ fps

Use trapezodial channel

$S = 0.40$

$n = 0.4$ ← ? should be 0.045

Assume $b = 3$

$z = 2'$

DOGM using

$n = 0.045$

$Q = 7.54$ (DOGM)

$D = 0.23$

$A = 1.05$

$w_p = 5.18$

$V = 7.21$ fps

By solving $Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$

using trial & error method

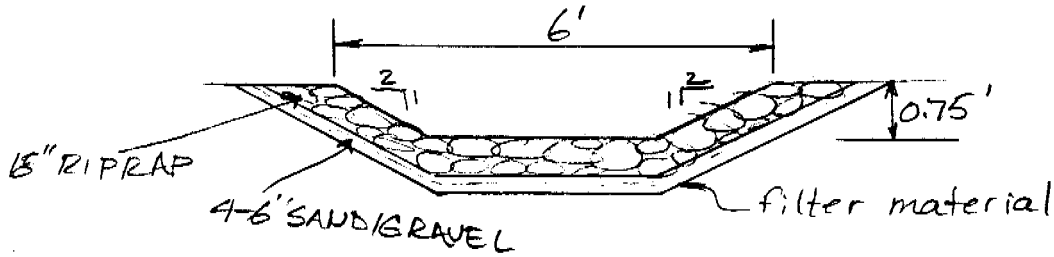
$d = 0.237$ $V = 8.13$ fps

use 0.5' free board.

$d \doteq 0.75'$

USE SAME RIPRAP AS IN CREST

Profile:

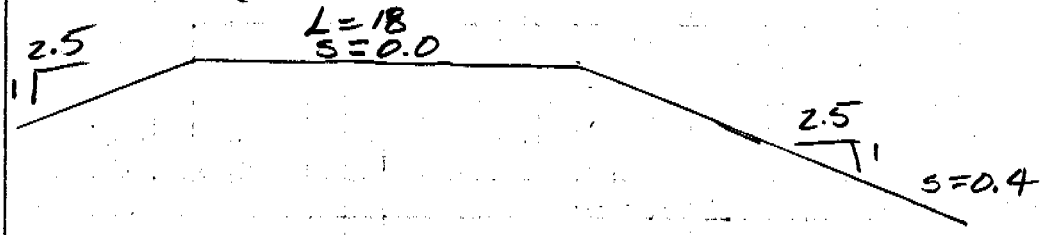


Emergency Spillway

Elevation 5.5 ft above bottom of pond. EL=7890.5

downstream spillway slope = 40%

Spillway is as follows:



z = 2 for side slope of spillway

bottom width = 4'-2" = 4.17'

Principal spillway 4.5 ft above bottom of pond

12" pipe

Elevation of inlet = 7889.5

Elevation of outlet = 7885.0

Develop stage discharge curve.

Use Fig 4B.1 AH&SFDA pg 289 for H_{ec}

Use $Q_r = 0.544\, g^{1/2} H_{ec,r}^{3/2} b$ for discharge from 100' rectangular spillway

$Q_r = 3087 H_{ec}^{3/2}$

Use $Q = Q_r \left(\frac{1.5b + z H_{ec,z}}{150} \right)$ for discharge in Trapezoidal spillway

Note: check % error using Fig 4.26 AH&SFDA

Use following for principal spillway flow

WEIR $Q = 3.0 L H^{3/2}$ where L = circumference in ft

$Q = 18.85 H^{3/2}$

or ORFICE $Q = C' a \sqrt{2gH}$ where $C' = 0.65$ a = area ft^2

$= 4.09 H^{1/2}$

or PIPE $Q = \frac{a (2gH')^{1/2}}{(1 + K_e + K_b + K_c L)} = 2.331 H^{1/2}$ see pg 12

which ever is less

AMPAD 22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

FOR 10 YEAR 24 HR EVENT TOTAL Q = 4.42 cfs
FOR 25 YEAR 24 HR EVENT TOTAL Q = 6.69 cfs see page 5

Head Above Crest of Emergency Spillway Hp (ft)	Hec (ft)	Discharge 100 ft rectangular Spillway Qr (cfs)	Discharge in trapezoidal Spillway Q (cfs)	Head Above principal spillway (ft)	Discharge in Principal Spillway (cfs)	Total Discharg (cfs)
0	0	0	0	0.5	2.89*	2.89
0	0	0	0	1	4.09*	4.09
0	0	0	0	1.1	4.28*	4.28
0	0	0	0	1.2	4.48*	4.48
0.1	0.1	97.6	4.20	1.3	4.66*	8.86

* ORFICE CONTROLLED

DESIGN DEPTH EMERGENCY SPILLWAY IS 0.1 FT

THIS IMPLIES MINIMUM POND HEIGHT = 1.2 + .1 + 4.5 = 5.8

ADD 5% for settlement = 6.1 ft

7885 + 6.09 = 7891.1 ft

NOTE: DAM MUST BE 1 FT HIGHER THAN WATER SURFACE AT 25yr

THIS IMPLIES MINIMUM DEPTH = 5.8 + 1 = 6.8
ADD 5% 0.34
7.14

7885 + 7.14 = 7892.14

4/15/88

CUTOFF TRENCH

$w_{ct} = h_{es} - d_{ct}$

where h_{es} = head on dam when water going over emergency spillway

d_{ct} = depth cut off trench

USE $d_{ct} = 2'$

$h_{es} = 4.73' + 0.75'$

$h_{es} = 5.48'$

$w_{ct} = 5.48' - 2' = 3.48'$

MAKE CUT OFF TRENCH AT LEAST 4' wide.

ANTISEEP COLLARS

DAM HEIGHT = 5.48 + 1. = 6.48' + 5% = 6.80'

WIDTH AT BASE:

$(2.5)(7)(2) + 10 = 45'$

FLOW LENGTH = 45'

INCREASE FLOW LENGTH BY 10%

or 4.5 feet

USE 3' x 3' ANTISEEP COLLARS

PIPE ϕ = 8" or 0.67'

$2\left(\frac{3-0.67}{2}\right) = 2.33'$ for each collar

<u>USE 2 collars</u>

SUMMARY OF POND

		EL	STORAGE
BOTTOM OF POND ELEVATION	=	7885.00	0
60% SEDIMENT POOL	=	7886.00'	5490 ft³
TOP SEDIMENT POOL	=	7886.63'	9200 ft³
TOP OF DETENTION POOL	=	7890.70'	43,000 ft³
INLET OF PRINCIPAL SPILLWAY	=	7889.50	
CREST OF EMERGENCY SPILLWAY	=	7890.70	

MAX ELEV FOR 25yr 24hr storm = 7890.80 ?1'

+ Free board (1 ft) = SETTLED DAM HGT = 7891.80 error should be 7891.

+ 5% Allowance for settling = 0.34

MAX Unsettled dam height = 7892.14

OUT & INSLOPES TO HAVE 2.5h:1v

TOP OF DAM WIDTH = 10 ft

DESIGN ROCK RIPRAP FOR POND INLETS

Q = 4.42 cfs

S = 0.4 ON SIDE OF POND

VELOCITY ENTERING

DITCH #1 V = 3.91 fps @ 6% S

DITCH #2 V = 4.35 fps @ 8% S

ASSUME b = 2
z = 1

SOLVING $Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$

with n = 0.045

Yields v = 7.52 fps
d = 0.26 ft

USE DITCH 0.6 ft deep & 3.2 ft wide
same riprap as emergency spillway.

Principal spillway apron

$Q = 4.42$ cfs
$D = 8''$ pipe

Flow will be spread into existing vegetated ditch ditch is parabolic in cross-section

$w \doteq 6$ ft slope $= 0.045$
$d \doteq 1$ ft

Retardance class C vegetation

using Fig 3.11c AH & SDA

$n \approx 0.10$

For $v = 1.70$ fps

$R = 0.43$ Fig 3.11c

$A = 4.42/1.7 = 2.60 \text{ ft}^2$

For a parabolic channel

$$R = \frac{t^2 d}{1.5t^2 + 4d^2}$$

$$A = \tfrac{2}{3} t d$$

Assume $d = 0.67$ ft

$$t = 3A/2d$$

$$t = \frac{3(2.6)}{2(0.67)}$$

$$t = 5.82'$$

$$R = \frac{(5.82)^2(0.67)}{1.5(5.82)^2 + 4(0.67)^2}$$

$R = 0.43$ <u>checks</u>

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Tailwater depth = 0.67'

$T_w = 0.67'$ ∴ $T_w > 0.5D$

$T_w/D = \frac{0.67}{0.67} = 1$

Using Fig 7:26 & extrapolating for 8" pipe

$D_{50} = 0.33'$ or 4"

$L_a = 20'$

Make a riprap pad 20' long x 8" WIDE @ INLET & 8.67' WIDE @ OUTLET

DEPTH OF RIPRAP TO BE MINIMUM 8".

USE WIRE BASKET WITH MAX SIZE OF 8".

CHANGED SEE PG 13

CHECK DISCHARGE CAPACITY OF 8" TRICKLE TUBE

L = 45 ft

$\frac{L}{D} = \frac{45}{0.667} = 67.5$

outlet not submerged pipe is hydraulically long.

n = 0.024

$Q = \frac{a(2gH')^{1/2}}{(1 + K_c + K_b + K_c L}$

$K_c = 0.183$ Table 4.1 AH & SFDA p 233

$K_b = 0.5$

$K_E = 1.0$

$a = 0.349\ ft^2$

$Q = \frac{0.349(2(32.2H'))^{1/2}}{(1+1+0.5+(.183)(45))^{1/2}}$

$Q = 0.107(64.4H')^{1/2}$

$Q = 0.859(H')^{1/2}$

$H' = HEAD$

$H' = 7889.50 - 7885$ ... using bottom of outlet as reference

$H' = 4.5'$

FOR $H' = 4.5'$

$Q = 1.82$ cfs

MAX HEAD $= 4.73' + 0.75 = 5.48$

$Q = 0.859(5.48)^{1/2}$

$Q = 2.01$ cfs before flow goes over emergency spillway.

For inlet control

$Q = 3.782\, D^2 H^{1/2}$

$Q = 1.68\, H^{1/2}$

H (ft)	Q cfs
4.5	3.56
5.48	3.93

Pipe flow will control

8" pipe will not carry 10 yr 24 hr event of 4 ft cfs

Increase pipe to 12 inch

$Q = 0.785$

$$Q = \frac{0.785\,(64.4\,H')^{1/2}}{\{(2.5 + (106.7)(45))\}^{1/2}}$$

$Q = 0.291\,(64.4\,H')^{1/2}$ $H' = H + 1$ using top of outlet as reference

$Q = 2.331\,(H')^{1/2}$

For:

H (ft)	Q (cfs)
4.5	4.94 cfs
5.48	5.46 cfs w/ Flow of 25yr event over emergency spillway

IF no discharge were to occur during 10yr 24 hr event max depth in pond = 4.47 ft
(including full sediment volume)

4.47 + 7885 = 7889.47 EL

EL TOP OF OUTLET = 7889.50

⇒ NO DISCHARGE DURING 10yr 24 hr event

USE 12" ϕ pipe.

Change discharge apron width

ASSUME $T_w = 0.67'$

$$\frac{T_w}{D} = \frac{0.67}{1} = 0.67$$

FROM FIG 7.26 A.H.&SFDA p 540

$L_a = 10'$

$D_{50} = 0.2'$ or $2.5''$

MAKE APRON 10' LONG
5' WIDE AT OUTLET
1' WIDE AT INLET

$D_{50} = 2.5''$

$D_{max} = 7''$

Depth of riprap 7"

Filter blanket = 4" gravel/sand

Decanting Impoundment sizing

area draining to pond = 1.503 acres

X-section I-I' from top

130' @ 7%
33' @ 6%
53' @ 8%
56' @ 4%
26' @ 8%

298' @ 6.6%

X-section J-J' from top

90' @ 6%
38' @ 5%
33' @ 6%
80 @ 5%

241' @ 5.5%

X-section K-K' from top

10' @ 0%
18' @ 33%
65' @ 3%
20' @ 1%
13' @ 15%

126' @ 9.4%

ave slope 222' @ 6.7%

Using USLE modified after Neibling + Foster

$A = RKLSCP$

R = 35 annual from Fig 5.3 p314 AH+SFDA

Soils contain ≈ 60% SAND
≈ 20% SILT
≈ 18% CLAY
≈ 2% ORGANIC MATTER

K = 0.15 from Fig 5.13 p 329 AH+SFDA

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

$X = \sin\theta$
θ = slope ∡
λ = slope length
$m = 0.5$ p333 AH+SFDA

Use avg slope of 222' @ 6.7%

$$LS = \left(\frac{222}{72.6}\right)^{0.5} \left(\frac{430(\sin 6.7)^2 + 30\sin 6.7 + 0.43}{6.613}\right)$$

$LS = 2.59$

Use $C_{TO} = 0.5$ 1 T/A MULCH TABLE 5.9 p345 AH+SFDA

$A = RKLSCP$

$= (35)(0.15)(2.59)(0.5) = 6.80$ TONS/ACRE

Using 1.503 ACRES

$(1.503)(6.80) = 10.22$ TONS/YR

Convert to sediment volume assume bd = 1.5

$$Y = \frac{(10.22 \text{ TONS})(2000 \text{ lbs/TON})(1 \text{ acre})}{(1.5)(62.4 \text{ \#/FT}^3)(43{,}560 \text{ FT}^2)} = 0.005 \text{ ACRE-FT/YR}$$

For 3 years Storage volume $= (0.005)(3) = 0.015$ ACRE-FT

Storage volume = 654 FT^3

For 10yr 24hr event $Q = 0.67$ in

$$\text{total runoff} = \frac{(1.503 \text{ acres})(0.67 \text{ in})}{12 \text{ in/FT}} = 0.0839 \text{ ACFT}$$

total runoff = 3655 FT^3

Decanting impoundment capacity ≥ 4309 FT^3

A P P E N D I X I V

VEGETATION REPORT OF THE PROPOSED WASTE ROCK DISPOSAL SITE CONVULSION CANYON MINE

Appendix IV

VEGETATION AND SOILS OF THE PROPOSED WASTE ROCK DISPOSAL SITE, CONVULSION CANYON MINE SOUTHERN UTAH FUEL COMPANY

Prepared for
COASTAL STATES ENERGY COMPANY
175 East 400 South, Suite 800
Salt Lake City, UT 84111

Attention: Keith Welch

Prepared by
Stanley L. Welsh and Joseph R. Murdock
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129 North 1000 East
Orem, Utah 84057

October 1983

Note: This report has been amended with the consultants' approval to reflect the Division concerns expressed in the Completeness Review dated October 6, 1987 under UMC 783.19 and in the Tecnhical Deficiency Review dated March 30, 1988 under UMC 817.21-25, UMC 817.111, UMC 817.113 and UMC 817.114. Portions of this report have been superseded by the December 1987 Soils Report.

Page Revised 4/88

INTRODUCTION

The area proposed for a waste rock disposal site lies approximately 2 miles west of Accord Lakes and south of a large bend in the Convulsion Canyon Mine road (T22S, R4E, NW/NE Sec. 18). The proposed site lies on forty acres of land privately owned by the Southern Utah Fuel Company. However, only a portion of that area will be utilized for the disposal of waste rock from the Convulsion Canyon Mine. Six vegetative communities occur on the land owned by SUFCo. They are: sagebrush, disturbed, sagebrush--mountain brush, mountain brush, aspen--oak--mountain brush, and oak (see vegetation map, Appendix B). The sagebrush community is, by far, the largest type and accounts for approximately 54 percent of the forty acres. Disturbed areas, mostly associated with the roadside, account for approximately 19 percent. Waste rock disposal will only affect these two community types, and reclamation plans will be based on measurements of the sagebrush community. (For a percentage breakdown of each community type, see Table 1. Species lists for the sagebrush and disturbed communities, along with the closely adjacent mountain brush community, are included in tables 9, 10, and 11.)

On the 8th, 9th, and 10th of September, data was gathered from the sagebrush community within the proposed waste rock disposal site (see vegetation map, Appendix B). Information on cover, productivity, shrub density, and soil characteristics was obtained. The purpose of this report is to submit and discuss the findings of these measurements and to recommend a reclamation plan for the area.

VEGETATION

Cover measurements in the validation area were completed by the ocular estimation method. The size of plot used was 2 X 5 decimeters. Plots were randomly placed in the communities and the cover of each species estimated to the nearest one percent. Total cover, including bare ground and litter, does not exceed 100 percent. Sample adequacy was calculated, by use of the formula provided in DOGM guidelines, after several plots had been measured.

Measurements in the proposed waste rock disposal site indicate a cover percentage of 75.3, with 8.6 percent bare ground and 16.1 percent litter. Big sagebrush was the dominant species, with 39.3 percent cover. Agropyron spicatum accounted for 6.5 percent cover with Penstemon watsonii, a species of Poa, little rabbitbrush, and snowberry each accounting for between 4 and 5 percent cover. The number of plots measured was 20. Sample adequacy for this community type was 18. (See Table 2 for a detailed list of data.)

Productivity measurements in the validation area were also taken. A 9.6 sq. ft. hoop was randomly placed throughout each community and the current years growth was clipped and separated according to life form (ie., shrubs, grasses, and forbs). Productivity measurements are not critical until the time of comparison with the revegetated areas and do not need to meet statistical adequacy until that time. Therefore, only ten plots were sampled in each community, which was sufficient to indicate trends. However, it should be noted that the 1983 season has been an exceptionally wet one. After the plots were clipped, the samples were oven-dried in the lab and measured for dry weight.

Productivity for the proposed waste rock disposal site was 1,008 pounds per acre. Approximately 79 percent of that figure is attributable to shrubs, 6 percent to forbs, and 15 to grasses (see Table 4).

Shrub density measurements were also taken in the validation site. A 9.6 sq, ft. hoop was randomly placed in each community and then the number of shrubs in each plot, by species, was counted. Forty-five plots were counted, so that the conversion to shrubs per acre might be simplified. Sample adequacy was calculated using the recommended formula by DOGM.

Shrub density in the proposed waste rock disposal site indicated a total of 25,000 shrubs per acre. Artemisia tridentata accounted for 12,700 of that number, snowberry for 1,800, little rabbitbrush for 8,600, Opuntia fragilis for 1,500, and Utah serviceberry for 400. Sample adequacy indicated 30 plots were statistically sufficient.

SOILS

See December 1987 Report.

RECLAMATION PLAN

The mining company plans to utilize the waste rock disposal site a portion at a time. A narrow strip immediately to the south of the road will be used first. Waste rock will be deposited and periodically compacted. When a certain level has been reached, the deposits will be covered with topsoil and reseeded. Then the same process will be repeated out into the sagebrush flat. Only as much of the area as is necessary will be disturbed. Initial plans estimate approximately 7 acres will be used.

It is recommended that topsoil be removed and stored from that part of the sagebrush community adjacent to the road which will be immediately utilized for disposal. As waste rock fills

the site, appropriate areas should be covered with at least 12 inches of topsoil. The topsoil should be scarified to prepare it for seeding. The following seed mix should then be broadcast over the area.

See Table 4.6.1-1 of the January 1988
application revision for the latest seed mix

Since the area to be reseeded is flat, the proposed seeding rate of 21.4 lbs per acre seems adequate. Previous experience with reseeding attempts show that similar rates provide good revegetation success.

REVEGETATION SUCCESS

Revegetation success and stabilization should be evaluated periodically during the height of growing seasons following initial seeding. Statistically acceptable techniques should be used in determination of percent cover, shrub density, and productivity.

It was originally intended that a reference area, located immediately north of the county road across from the disposal site, be used to measure revegetation success. However, a potential for lack of control of activity at this site has suggested a preference for using the baseline data method of evaluating revegetation success. This change has been coordinated with Division personnel.

Revised 4/88

A P P E N D I X A

TABLE 1

SUFCO WASTEROCK DISPOSAL SITE

PLANT COMMUNITIES

VEGETATION TYPE	PERCENT COMPOSITION	ACREAGE
Sagebrush	54.3	21.7
Disturbed	18.6	7.4
Sagebrush--Mountain brush	12.2	4.9
Mountain brush	7.2	2.9
Aspen--Oak--Mountain brush	7.3	2.9
Oak	0.4	0.2
TOTAL	100.0	40.0

TABLE 2

SUFCO WASTEROCK DISPOSAL SITE

Cover Measurements

Quadrat Size: 2 X 5 dm

Sample Mean: 75.3

Sample Size: 20

Vegetation: Sagebrush

Site: Validation

Standard Deviation: 19.5

Sample Size Min. (80%): 18

SPECIES	PERCENT COVER	PERCENT COMPOSITION
Artemisia tridentata	39.3	52.2
Penstemon watsonii	4.8	6.4
Poa sp.	4.3	5.7
Agropyron spicatum	6.5	8.6
Agropyron cristatum	0.8	1.0
Phlox longifolia	0.4	0.5
Chenopodium leptophylla	0.3	0.4
Elymus cinereus	2.1	2.8
Chrysothamnus viscidiflorus	4.3	5.7
Stipa comata	0.6	0.8
Agropyron trachycaulum	0.3	0.4
Opuntia fragilis	0.2	0.3
Elymus salina	0.3	0.4
Taraxacum officinale	0.7	0.9
Oryzopsis hymenoides	0.9	1.2
Stellaria jamesiana	1.0	1.3
Stipa lettermanii	0.8	1.1
Symphoricarpos oreophila	4.5	6.0
Poa fendleriana	1.7	2.3
Salsola iberica	0.1	0.1
Machaeranthera canescens	0.2	0.3
Castilleja sp.	0.9	1.2
Agropyron smithii	0.3	0.4
TOTAL	75.3	100.0
BARE GROUND	8.6	
LITTER	16.1	

TABLE 2

SUFCO WASTEROCK DISPOSAL SITE

Cover Measurements

Quadrat Size: 2 X 5 dm

Sample Mean: 75.3

Sample Size: 20

Vegetation: Sagebrush

Site: Validation

Standard Deviation: 19.5

Sample Size Min. (80%): 18

SPECIES	PERCENT COVER	PERCENT COMPOSITION
Artemisia tridentata	39.3	52.2
Penstemon watsonii	4.8	6.4
Poa sp.	4.3	5.7
Agropyron spicatum	6.5	8.6
Agropyron cristatum	0.8	1.0
Phlox longifolia	0.4	0.5
Chenopodium leptophylla	0.3	0.4
Elymus cinereus	2.1	2.8
Chrysothamnus viscidiflorus	4.3	5.7
Stipa comata	0.6	0.8
Agropyron trachycaulum	0.3	0.4
Opuntia fragilis	0.2	0.3
Elymus salina	0.3	0.4
Taraxacum officinale	0.7	0.9
Oryzopsis hymenoides	0.9	1.2
Stellaria jamesiana	1.0	1.3
Stipa lettermanii	0.8	1.1
Symphoricarpos oreophila	4.5	6.0
Poa fendleriana	1.7	2.3
Salsola iberica	0.1	0.1
Machaeranthera canescens	0.2	0.3
Castilleja sp.	0.9	1.2
Agropyron smithii	0.3	0.4
TOTAL	75.3	100.0
BARE GROUND	8.6	
LITTER	16.1	

TABLE 3

SUFCO WASTEROCK DISPOSAL SITE

DELETED

TABLE 4

SUFCO WASTEROCK DISPOSAL SITE

Productivity Measurements

Quadrat size: 9.6 sq. ft.

Sample size: 10

Vegetation: Sagebrush

Site: Validation

Standard deviation: 29.87

LIFE FORM	AVERAGE DRY WEIGHT
GRASSES	14.81
FORBS	6.15
SHRUBS	79.83
TOTAL	100.79

PRODUCTIVITY: 1008 lbs per acre

TABLE 5

SUFCO WASTEROCK DISPOSAL SITE

DELETED

TABLE 6

SUFCO WASTEROCK DISPOSAL SITE

Shrub Density Measurements

Quadrat Size: 9.6 sq. ft.

Sample Mean: 5.56

Sample Size: 45

Vegetation: Sagebrush

Site: Validation

Standard Deviation: 2.4

Sample Size Min (80%): 30

Species	Shrubs Sampled	Shrubs per Acre
Artemisia tridentata	127	12,700
Symphoricarpos oreophilus	18	1,800
Chrysothamnus viscidiflorus	86	8,600
Opuntia fragilis	15	1,500
Amelanchier utahensis	4	400
TOTAL	250	25,000

TABLE 7

SUFCO WASTEROCK DISPOSAL SITE

DELETED

TABLE 8

SUFCO WASTEROCK DISPOSAL SITE

AMENDED IN APPENDIX V

TABLE 9

SUFCO WASTEROCK DISPOSAL SITE

SAGEBRUSH COMMUNITY SPECIES LIST

Artemisia tridentata
Chrysothamnus viscidiflorus
Symphoricarpos oreophilus
Machaeranthera canescens
Elymus cinereus
Agropyron cristatum
Artemisia ludoviciana
Sisymbrium altissimum
Penstemon watsonii
Penstemon comarrhena
Poa sp.
Poa fendleriana
Elymus salinus
Castilleja linariifolia
Salsola iberica
Taraxacum officinale
Stellaria jamesiana
Juniperus scopulorum
Amelanchier utahensis
Heliomeris multiflora
Opuntia fragilis
Chenopodium leptophyllum
Eriogonum racemosum
Androsace septentrionalis
Oryzopsis hymenoides
Stipa comata
Stipa lettermanii
Agropyron spicatum
Allium acuminatum
Descurainia californica
Arabis holboellii
Cirsium sp.
Sphaeralcea coccinea
Chaenactis douglasii
Achillea millefolium
Aster chilensis
Gilia aggregata
Sambucus coerulea
Sitanion hystrix
Lupinus sericeus
Astragalus drummondii
Quercus gambelii
Cercocarpus ledifolius
Populus tremuloides
Orthocarpus tolmiei
Astragalus convallarius
Gutierrezia sarothrae
Vicia americana
Tragopogon sp.
Lappula occidentalis
Astragalus argophyllus

TABLE 10

SUFCO WASTEROCK DISPOSAL SITE

MOUNTAIN BRUSH COMMUNITY SPECIES LIST

Agropyron spicatum
Astragalus drummondii
Symphoricarpos oreophilus
Amelanchier utahensis
Castilleja linariifolia
Vicia americana
Eriogonum racemosum
Artemisia tridentata
Bromus ciliatus
Cercocarpus montaum
Quercus gambelii
Machaeranthera canescens
Sitanion hystrix
Purshia tridentata
Cirsium wheeleri
Cercocarpus ledifolius
Poa secunda
Balsamorhiza sp.
Antennaria sp.
Chrysothanmus nauseousus
Taraxacum officinale
Pachystima sp.
Ozmorhiza sp.
Cowania mexicana
Astragalus argophyllus
Juniperus osteosperma

TABLE 11

SUFCO WASTEROCK DISPOSAL SITE

MOUNTAIN BRUSH COMMUNITY SPECIES LIST

Salsola iberica
Sysimbrium altissimum
Atriplex rosea
Melilotus officinalis
Hordeum jubatum
Dactylis glomerata
Agropyron tricopherum
Heliomeris multiflora
Bromus inermis
Agropyron cristatum
Machaeranthera canescens
Medicago sativa
Lactuca scariola
Cirsium sp.
Penstemon sp.
Physaria acutifolia

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APPENDIX IV

Vegetation and Soils of the Proposed Waste Rock Disposal Site, Convulsion Canyon Mine

VEGETATION AND SOILS OF THE PROPOSED WASTE ROCK DISPOSAL SITE, CONVULSION CANYON MINE, SOUTHERN UTAH FUEL COMPANY

Prepared for
COASTAL STATES ENERGY COMPANY
411 West 7200 South
Midvale, Utah 84047

Attn.: Mr. Keith Welch

Prepared by
Stanley L. Welsh and Joseph R. Murdock
ENDANGERED PLANT STUDIES, INC.
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October 1983

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INTRODUCTION

The area proposed for a waste rock disposal site lies approximately 2 miles west of Acord Lakes and south of a large bend in the Convulsion Canyon Mine road (T22S, R4E, NW/NE Sec. 18). The proposed site lies on forty acres of land privately owned by the Southern Utah Fuel Company. However, only a portion of that area will be utilized for the disposal of waste rock from the Convulsion Canyon Mine. Six vegetative communities occur on the land owned by SUFCo. They are: sagebrush, disturbed, sagebrush--mountain brush, mountain brush, aspen--oak--mountain brush, and oak (see vegetation map, Appendix B). The sagebrush community is, by far, the largest type and accounts for approximately 54 percent of the forty acres. Disturbed areas, mostly associated with the roadside, account for approximately 19 percent. Waste rock disposal will only affect these two community types, and reclamation plans will be based on measurements of the sagebrush community. (For a percentage breakdown of each community type, see Table 1. Species lists for the sagebrush and disturbed communities, along with the closely adjacent mountain brush community, are included in tables 9, 10, and 11.)

On the 8th, 9th, and 10th of September, data was gathered from the sagebrush community within the proposed waste rock disposal site and from an adjacent sagebrush community designated as a reference area (see vegetation map, Appendix B). Information on cover, productivity, shrub density, and soil characteristics was obtained. The purpose of this report is to submit and discuss the findings of these measurements and to recommend a reclamation plan for the area.

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VEGETATION

Cover measurements in both the validation and reference areas were completed by the ocular estimation method. The size of plot used was 2 X 5 decimeters. Plots were randomly placed in the communities and the cover of each species estimated to the nearest one percent. Total cover, including bare ground and litter, does not exceed 100 percent. Sample adequacy was calculated, by use of the formula provided in DOGM guidelines, after several plots had been measured.

Measurements in the proposed waste rock disposal site indicate a cover percentage of 75.3, with 8.6 percent bare ground and 16.1 percent litter. Big sagebrush was the dominant species, with 39.3 percent cover. Agropyron spicatum accounted for 6.5 percent cover with Penstemon watsonii, a species of Poa, litle rabbitbrush, and snowberry each accounting for between 4 and 5 percent cover. The number of plots measured was 20. Sample adequacy for this community type was 18. (See Table 2 for a detailed list of data.)

Measurements in the sagebrush reference area indicated a cover percentage of 84.3, with 1.1 percent bare ground and 14.6 percent litter. The percentage of big sagebrush present in the reference area was almost identical to the validation site. Sagebrush accounted for 39.8 percent of the total cover. However, a significant increase in the percentage of little rabbitbrush comprises the essential difference between the two sites. In the reference area the percentage of little rabbitbrush is 26.1. Penstemon watsonii, Agropyron spicatum, Elymus cinereus, and snowberry each accounted for between 2 and 3 percent cover. The number of plots measured in the reference area was 20. Sample adequacy for this community type was 13. (See Table 3 for a

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detailed list of data.)

Productivity measurements in both validation and reference areas were also taken. A 9.6 sq. ft. hoop was randomly placed throughout each community and the current years growth was clipped and separated according to life form (ie., shrubs, grasses, and forbs). Productivity measurements are not critical until the time of comparison with the revegetated areas and do not need to meet statistical adequacy until that time. Therefore, only ten plots were sampled in each community, which was sufficient to indicate trends. However, it should be noted that the 1983 season has been an exceptionally wet one. After the plots were clipped the samples were oven-dried in the lab and measured for dry weight.

Productivity for the proposed waste rock disposal site was 1,008 pounds per acre. Approximately 79 percent of that figure is attributable to shrubs, 6 percent to forbs, and 15 to grasses (see Table 4).

Productivity for the reference site was 1,738 pounds per acre. Approximately 76 percent of that figure is attributable to shrubs, 1 percent to forbs, and 23 percent to grasses (see Table 5).

Shrub density measurements were also taken in the validation and reference sites. A 9.6 sq. ft. hoop was randomly placed in each community and then the number of shrubs in each plot, by species, was counted. Forty-five plots were counted, so that the conversion to shrubs per acre might be simplified. Sample adequacy was calculated using the recommended formula by DOGM.

Shrub density in the proposed waste rock disposal site indicated a total of 25,000 shrubs per acre. Artemisia tridentata accounted for 12,700 of that number, snowberry for 1,800, little rabbitbrush for

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8,600, Opuntia fragilis for 1,500, and Utah serviceberry for 400. Sample adequacy indicated 30 plots were statistically sufficient.

Shrub density in the reference area indicated a total of 27,600 shubs per acre. Big sagebrush accounted for 11,400 of that number, little rabbitbrush for 13,200, Opuntia fragilis for 1,300, snowberry for 1,300, Utah serviceberry for 300, and big rabbitbrush for 100. Sample adequacy indicated 29 plots were statistically sufficient.

SOILS

The soil found in the proposed waste rock disposal site is similar to that found in map unit D of the general lease area, which was taxonomically classified as fine, mixed, frigid Typic Argixerolls. The associated vegetation in both areas is a sagebrush community type. The elevation for this type is higher in the general lease area, ranging from 8200 to 8600 feet. Whereas the elevation of the proposed waste rock disposal site is approximately 7900 feet.

Range of characteristics includes a surface layer 3 to 8 inches thick with an organic content of from 2 to 4 percent. The subsoil extends to a depth of 38 inches with 0 percent rock fragment in all layers until a depth of 34 inches is reached. From 34 to 38 inches there is a 15 percent rock fragment content. The soil classes range from sandy loam in the surface layer to clay loam in the substratum. For complete laboratory analysis data see Table 8 in Appendix A.

AVAILABILITY OF TOPSOIL

Soil pits were excavated in several places throughout the validation site to determine depths and availability of topsoil. The sagebrush community occupying the proposed site consists of

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approximately 21 acres of land, much of which is available for the removal of topsoil. However, observations indicated that nearly 1/3 of the area is comprised of a stony and rocky surface material that will be unusable. The remaining 14 acres have an average of 30 inches of available topsoil, indicating 4,033 cubic yards available per acre, or a total of 56,467 cubic yards in the area. Only a portion of topsoil will be removed and used at a time.

RECLAMATION PLAN

The mining company plans to utilize the waste rock disposal site a portion at a time. A narrow strip immediately to the south of the road will be used first. Waste rock will be deposited and periodically compacted. When a certain level has been reached, the deposits will be covered with topsoil and reseeded. Then the same process will be repeated out into the sagebrush flat. Only as much of the area as is necessary will be disturbed. Initial plans estimate approximately 7 acres will be used.

It is recommended that topsoil be removed and stored from that part of the sagebrush community adjacent to the road which will be immediately utilized for disposal. As waste rock fills the site, appropriate areas should be covered with 6 inches of topsoil. The topsoil should be scarified to prepare it for seeding. The following seed mix should then be broadcast over the area.

Bluebunch wheatgrass	3 lbs
Kentucky bluegrass	1 lb
Western wheatgrass	4 lbs
Smooth brome	3 lbs
Blue penstemon	1/4 lb
Blue flax	1/4 lb
Cicer milkvetch	1/4 lb

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Alfalfa	1 lb
Yellow sweetclover	1 lb
Yarrow	1/4 lb
Rubber rabbitbrush	2 lbs
Big sagebrush	2 lbs
TOTAL	18 lbs per acre

Since the area to be reseeded is flat, the proposed seeding rate of 18 lbs per acre seems adequate. Previous experience with reseeding attempts show that similar rates provide good revegetation success. Cyclone-type seed spreaders will be used in all reseeding attempts.

It is recommended that a wet fiber mulch be applied at the rate of 1000 lbs per acre. No method of anchoring the mulch will be needed because of the flatness of the area.

Revegetation success and stabilization should be evaluated during the height of each growing season following initial seeding. Statistically acceptable techniques should be used in determination of percent cover, shrub density, and productivity. Reference areas should be utilized by comparing these parameters with those of the disturbed area.

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APPENDIX A

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TABLE 1
SUFCO WASTEROCK DISPOSAL SITE
PLANT COMMUNITIES

VEGETATION TYPE	PERCENT COMPOSITION	ACREAGE
Sagebrush	54.3	21.7
Disturbed	18.6	7.4
Sagebrush--Mountain brush	12.2	4.9
Mountain brush	7.2	2.9
Aspen--Oak--Mountain brush	7.3	2.9
Oak	0.4	0.2
TOTAL	100.0	40.0

TABLE 2
SUFCO WASTEROCK DISPOSAL SITE

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Cover Measurements

Vegetation: Sagebrush

Quadrat Size: 2 X 5 dm

Site: Validation

Sample Mean: 75.3

Standard Deviation: 19.5

Sample Size: 20

Sample Size Min. (80%): 18

Species	Percent Cover	Percent Composition
Artemisia tridentata	39.3	52.2
Penstemon watsonii	4.8	6.4
Poa sp.	4.3	5.7
Agropyron spicatum	6.5	8.6
Agropyron cristatum	0.8	1.0
Phlox longifolia	0.4	0.5
Chenopodium leptophylla	0.3	0.4
Elymus cinereus	2.1	2.8
Chrysothamnus viscidiflorus	4.3	5.7
Stipa comata	0.6	0.8
Agropyron trachycaulum	0.3	0.4
Opuntia fragilis	0.2	0.3
Elymus salina	0.3	0.4
Taraxacum officinale	0.7	0.9
Oryzopsis hymenoides	0.9	1.2
Stellaria jamesiana	1.0	1.3
Stipa lettermanii	0.8	1.1
Symphoricarpos oreophila	4.5	6.0
Poa fendleriana	1.7	2.3
Salsola iberica	0.1	0.1
Machaeranthera canescens	0.2	0.3
Castilleja sp.	0.9	1.2
Agropyron smithii	0.3	0.4
TOTAL	75.3	100.0
BARE GROUND	8.6	
LITTER	16.1	

TABLE 3
SUFCO WASTEROCK DISPOSAL SITE

OLD

Cover Measurements

Quadrat Size: 2 X 5 dm

Sample Mean: 84.3

Sample Size: 20

Vegetation: Sagebrush

Site: Reference

Standard Deviation: 18.6

Sample Size Min. (80%): 13

Species	Percent Cover	Percent Composition
Amelanchier utahensis	0.8	0.9
Chrysothamnus viscidiflorus	26.1	31.0
Artemisia tridentata	39.8	47.2
Penstemon watsonii	2.8	3.3
Agropyron spicatum	2.2	2.6
Tragopogon sp.	0.4	0.5
Agropyron smithii	2.0	2.4
Opuntia fragilis	1.3	1.5
Phlox longifolia	0.4	0.5
Erigeron sp.	0.3	0.4
Schoencrambe linifolia	0.3	0.4
Oryzopsis hymenoides	0.5	0.6
Symphoricarpos oreophilus	2.9	3.4
Taraxacum officinale	0.4	0.5
Senecio multilobatus	0.5	0.6
Chenopodium leptophyllum	0.1	0.1
Elymus cinereus	2.8	2.4
Bromus ciliatus	0.2	0.2
Sphaeralcea coccinea	0.7	0.9
Machaeranthera canescens	0.2	0.2
TOTAL	84.3	100.0
BARE GROUND	1.1	
LITTER	14.6	

TABLE 4
SUFCO WASTEROCK DISPOSAL SITE

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Productivity Measurements

Vegetation: Sagebrush

Quadrat size: 9.6 sq. ft.

Site: Validation

LIFE FORM	AVERAGE DRY WEIGHT
GRASSES	14.81
FORBS	6.15
SHRUBS	79.83
TOTAL	100.79

PRODUCTIVITY: 1008 lbs per acre

TABLE 5
SUFCO WASTEROCK DISPOSAL SITE

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Productivity Measurements

Vegetation: Sagebrush

Quadrat size: 9.6 sq. ft.

Site: Reference

LIFE FORM	AVERAGE DRY WEIGHT
GRASSES	40.22
FORBS	2.34
SHRUBS	131.27
TOTAL	173.83

PRODUCTIVITY: 1738 lbs per acre

TABLE 6
SUFCO WASTEROCK DISPOSAL SITE

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Shrub density Measurements

Vegetation: Sagebrush

Quadrat Size: 9.6 sq. ft.

Site: Validation

Sample Mean: 5.56

Standard Deviation: 2.4

Sample Size: 45

Sample Size Min (80%): 30

Species	Shrubs sampled	Shrubs per Acre
Artemisia tridentata	127	12,700
Symphoricarpos oreophilus	18	1,800
Chrysothamnus viscidiflorus	86	8,600
Opuntia fragilis	15	1,500
Amelanchier utahensis	4	400
TOTAL	250	25,000

TABLE 7
SUFCO WASTEROCK DISPOSAL SITE

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Shrub density Measurements

Vegetation: Sagebrush

Quadrat size: 9.6 sq. ft.

Site: Reference

Sample Mean: 6.1

Standard Deviation: 2.56

Sample Size: 45

Sample Size Min. (80%): 29

Species	Shrubs Sampled	Shrubs per Acre
Artemisia tridentata	114	11,400
Chrysothamnus viscidiflorus	132	13,200
Opuntia fragilis	13	1,300
Symphoricarpos oreophilus	13	1,300
Amelanchier utahensis	3	300
Chrysothamnus nauseosus	1	100
TOTAL	276	27,600

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TABLE 8
SUFCO WASTEROCK DISPOSAL SITE
SAGEBRUSH COMMUNITY SOIL ANALYSIS

Horizon	Depth	Dry Color	Moist Color	Texture Sand	Silt	Clay
A11	0-3"	10yr 4/2	10yr 3/1	61.4	21.4	17.1
A12	3-8"	10yr 4/4	10yr 3/2	63.4	18.2	18.3
B21	8-18"	10yr 6/2	10yr 4/2	53.8	25.0	21.1
B22	18-34"	10yr 5/2	10yr 3/2	54.3	22.5	23.1
B3ca	34-38"	10yr 6/2	10yr 4/2	56.3	20.5	23.1
C	38"+	10yr 6/2	10yr 4/2	55.8	23.0	21.1

Horizon	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A11	Sandy loam	fine grained, not sticky	0	3.69
A12	Clay loam	weak platey, flaky slightly sticky	0	2.00
B21	Clay loam	columnar prismatic, firm, sticky	0	1.59
B22	Clay loam	columnar, silty, weak prisms, mottled with flakes	0	1.38
B3ca	Clay loam	weak blocky, granular, slightly sticky, stones	15	1.15
C	Clay loam	weak, sandy granular, non-sticky	0	.95

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Horizon	pH	EC X 10_3	Solubility ppm Ca	Mg	Na	K
A11	7.69	.611	3987	183	8.75	338
A12	7.74	.712	4187	209	12.70	333
B21	7.90	.622	8000	212	10.20	345
B22	8.10	.444	9075	210	7.50	288
B3ca	8.10	.468	8737	223	10.00	175
C	8.20	.372	9125	266	10.00	97

Horizon	Percent Moisture Saturation	SAR
A11	41.74	.268
A12	33.83	.425
B21	36.74	2.170
B22	37.47	2.100
B3ca	35.89	.566
C	33.55	.689

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TABLE 9
SUFCO WASTEROCK DISPOSAL SITE
SAGEBRUSH COMMUNITY SPECIES LIST

Artemisia tridentata
Chrysothamnus viscidiflorus
Symphoricarpos oreophilus
Machaeranthera canescens
Elymus cinereus
Agropyron cristatum
Artemisia ludoviciana
Sisymbrium altissimum
Penstemon watsonii
Penstemon comarrhena
Poa sp.
Poa fendleriana
Elymus salinus
Castilleja linariifolia
Salsola iberica
Taraxacum officinale
Stellaria jamesiana
Juniperus scopulorum
Amelanchier utahensis
Heliomeris multiflora
Opuntia fragilis
Chenopodium leptophyllum
Eriogonum racemosum
Androsace septentrionalis
Oryzopsis hymenoides
Stipa comata
Stipa lettermanii
Agropyron spicatum
Allium acuminatum
Descurainia californica
Arabis holboellii
Cirsium sp.
Sphaeralcea coccinea
Chaenactis douglasii
Achillea millefolium
Aster chilensis
Gilia aggregata
Sambucus coerulea
Sitanion hystrix
Lupinus sericeus
Astragalus drummondii
Quercus gambelii
Cercocarpus ledifolius
Populus tremuloides
Orthocarpus tolmiei
Astragalus convallarius
Gutierrezia sarothrae
Vicia americana
Tragopogon sp.
Lappula occidentalis
Astragalus argophyllus

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TABLE 10
SUFCO WASTEROCK DISPOSAL SITE
MOUNTAIN BRUSH COMMUNITY SPECIES LIST

Agropyron spicatum
Astragalus drummondii
Symphoricarpos oreophilus
Amelanchier utahensis
Castilleja linariifolia
Vicia americana
Eriogonum racemosum
Artemisia tridentata
Bromus ciliatus
Cercocarpus montaum
Quercus gambelii
Machaeranthera canescens
Sitanion hystrix
Purshia tridentata
Cirsium wheeleri
Cercocarpus ledifolius
Poa secunda
Balsamorhiza sp.
Antennaria sp.
Chrysothamnus nauseosus
Taraxacum officinale
Pachystima sp.
Ozmorhiza sp.
Cowania mexicana
Astragalus argophyllus
Juniperus osteosperma

OLD

TABLE 11
SUFCO WASTEROCK DISPOSAL SITE
DISTURBED COMMUNITY SPECIES LIST

Salsola iberica
Sysimbrium altissimum
Atriplex rosea
Melilotus officinalis
Hordeum jubatum
Dactylis glomerata
Agropyron tricopherum
Heliomeris multiflora
Bromus inermis
Agropyron cristatum
Machaeranthera canescens
Medicago sativa
Lactuca scariola
Cirsium sp.
Penstemon sp.
Physaria acutifolia

OLD

APPENDIX B
VEGETATION MAP

VEGETATION AND SOILS OF THE PROPOSED WASTE ROCK DISPOSAL SITE, CONVULSION CANYON MINE, SOUTHERN UTAH FUEL COMPANY

Prepared for
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411 West 7200 South
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Attn: Mr. Keith Welch

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October 1983

Note: This report has been amended with the consultants' approval to reflect the Division concerns expressed in the Completeness Review dated October 6, 1987 under UMC 783.19. Portions of this report have been superseded by the December 1987 Soils Report.

the site, appropriate areas should be covered with at least 12 inches of topsoil. The topsoil should be scarified to prepare it for seeding. The following seed mix should then be broadcast over the area.

See Table 4.6.1-1 of the January 1988
application revision for the latest seed mix

Since the area to be reseeded is flat, the proposed seeding rate of 21.4 lbs per acre seems adequate. Previous experience with reseeding attempts show that similar rates provide good revegetation success. Cyclone-type seed spreaders will be used in all reseeding attempts.

It is recommended that a wet fiber mulch be applied at the rate of 2000 lbs per acre. No method of anchoring the mulch will be needed because of the flatness of the area.

REVEGETATION SUCCESS

Revegetation success and stabilization should be evaluated during the height of each growing season following initial seeding. Statistically acceptable techniques should be used in determination of percent cover, shrub density, and productivity.

It was originally intended that a reference area, located immediately north of the county road across from the disposal site, be used to measure revegetation success. However, a potential for lack of control of activity at this site has suggested a preference for using the baseline data method of evaluating revegetation success. This change has been coordinated with Division personnel.