04008902760E

ARCO

Bluewater Mill
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Grants, New Mexico 87020
Telephone 505 876 2211
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40-8902
X61225

December 22, 1993

RETURN ORIGINAL TO PDR, HQ.

Mr. Ramon E. Hall
Director
United States Nuclear Regulatory Commission
Uranium Recovery Field Office
Region IV
730 Simms Street, Suite 100
Golden, Colorado 80401

DOCKETED
DEC 30 1993
USNRC
MAIL SECTION
DOCKET CLERK

DEC 1993
RECEIVED

RE: LICENSE #SUA-1470
DOCKET #40-8902

Dear Mr. Hall:

This letter is a request to an amendment to ARCO's Source Material License #SUA-1470, for the following items:

1. Design modifications - Carbonate Tailings
2. Final design modifications - Main Tailings Impoundment South Toe Bench
3. Slope design modifications - Main Tailings Impoundment
4. Rock Specifications - Quarry and Scoring Criteria

Attached are the proposed modifications along with support documentation. As previously discussed with your staff the above referenced items are a result of final design investigations and discovery of unknown subsurface conditions during current reclamation activities.

Should you have any questions or wish to review this information with us please contact myself or Christopher Sanchez of my staff.

Sincerely,

R. S. Ziegler
Project Manager

Attachment

18-167

pc: CFG
SP
NP
CS

DESIGNATED ORIGINAL

Certified By C. Hood

DF02
1/1

94-0146

F:\DOCS\ZIEGLER\9312CAMEND.RSZ

40-8902

Design Modification Amendment Request

ARCO Bluewater Mill
Reclamation Plan

LICENSE NO. SUA-1470
DOCKET NO. 40-8902

December, 1993

w/ltr 12/22/93
94-0146

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1.0 DESIGN MODIFICATIONS - CARBONATE TAILINGS SURFACE AND COVER DESIGN

1.1 Introduction

ARCO proposes to make adjustments to the configuration, depth of radon cover and surface erosion protection on the Carbonate Tailings. Since approval of the reclamation plan ARCO has undertaken an exploration program to better identify the aerial extent of the Carbonate Tailings. The results of this exploration have identified the main body of Carbonate Tailings on the eastern side of the impoundment to be smaller than originally anticipated. The main body tailings has been defined as the area where tailings have significant depth. Many areas surrounding the impoundment were discovered to be shallow and uneven. Figure 1.1 illustrates the original boundary and the new boundary developed following the exploration program.

Two of the three Bluewater Mill disposal areas reside within the boundary of the Carbonate Tailings as shown in Figure 1.1. During decommissioning of the Mill these areas were filled with debris and soil. In determining the final design configuration for the Carbonate Tailings, ARCO has re-evaluated the cover requirements taking into account the layers of debris and soil. These modifications have been incorporated into the overall design of the Carbonate Tailings.

1.2 Relocation of Tailings

ARCO will relocate the existing shallow tailings outside the new Carbonate Tailings boundary into the main body of the tailings impoundment to the degree possible with conventional equipment. Tailings depths outside of the new boundary range from a few inches to approximately 3 feet. Relocation of the tailings to within the new boundary will eliminate the areas where placement of radon barrier and erosion protection would be difficult due to the irregular configuration of the tailings.

The new Carbonate Tailings boundary was established from log hole information collected along the perimeter of the impoundment. The log hole locations are shown on Figure 1.2 and profile information is attached in Appendix A. Relocated tailings will be placed in the northwest low lying areas within the new boundary prior to placement of radon barrier. The final proposed topographic surface is shown on drawing Figure 1.3. Approximately 25,000-cy of tailings will be relocated to locations within the new boundary.

The northwest area of the Carbonate Tailings are to receive radon cover to following the placement of the relocated tailings. A protocol for evaluation of the final cover over the north portion of the impoundment has been submitted in ARCO's Final Radon Barrier Design, ARCO Bluewater Mill Main Tailings Report dated December 1993. This area is to be reevaluated and the final radon cover depth placed.

1.3 Radon Barrier Design

Disposal Area #2 and Disposal Area #3 are within the boundary of the Carbonate Tailings. Each of the Disposal Areas have received a significant amount of debris and soil during the decommissioning of the Bluewater Mill. Tailings and process residues will be covered to attenuate radon to less than 20 $pCi/m^2/s$. Cover thickness calculation were completed using the computer RAECOM model utilizing the revised parameters contained in our December 1993 Final Radon Barrier Design Report and to account for the interstitial soils placed in the debris layers. The complete analysis is included in Appendix A of this report.

1.3.1 Disposal Area #2

Disposal Area #2 in the Reclamation Plan was divided into two major sections, the Carbonate Tailings South (Asbestos Disposal Area) and the Northern Area. The asbestos disposal area is geographically distinct from the remainder of the area in that it resides in a basalt depression as shown on Figure 1.1. The remainder of the disposal area is on the surface of the former Carbonate Tailings.

Carbonate Tailings South - Asbestos Disposal Area

This area has been reclaimed in accordance with the ARCO Reclamation Plan as amended by ARCO's May 9, 1991 request for license amendment. Approximately 7-feet of asbestos contaminated debris and interstitial fill was placed, followed by 12-feet of radon barrier. A soil/rock matrix is in place on the surface with rip-rap and filter on all 5:1 slopes. Drainage out of the basin is provided by a spillway cut through the adjacent basalt.

Disposal Area #2 - Northern Area

The northern area of Disposal Area #2 received two lifts of debris and soil, with depths of 5-feet and 2-feet respectively. Each lift of debris with interstitial soil has been covered with a 2-foot layer of engineered fill.

The RAECOM model for cover thickness requirement in this area was modified to include the two lifts of soil/debris and engineered fill on the disposal area. Input for the model is derived from parameters prepared by Rogers and Associates, the Roy F. Weston Report for ARCO's Reclamation Plan and ARCO's Final Radon Barrier Design Report, December 1993. A profile of current conditions is shown on Figure 1.4. The calculated model show that no additional cover is required in this area to meet the 20pCi/m^2/s radon flux.

1.3.2 Disposal Area #3

During decommissioning Disposal Area #3 received a 5-foot lift of debris and interstitial soil. A 2-feet layer of engineered fill has been placed over the debris/soil lift.

The RAECOM model input for cover thickness requirements was modified to include the lift of soil and debris material placed on the disposal area.

Input for the model is derived from parameters prepared by Rogers and Associates and Weston for ARCO's Reclamation Plan and Decommissioning Plan. A profile of current conditions is shown on Figure 1.5. The cover requirement as calculated by the RAECOM model for Disposal Area #3 is 2.4-feet.

Drawing 1.3 shows the modified surface configuration for the Carbonate Tailings which take into account the modified cover requirements.

1.4 Erosion Protection

Erosion protection requirements for the Carbonate Tailings have been reevaluated using the new boundary and adjusted topographic surface. The erosion parameters are the same as those contained in ARCO's Reclamation Plan.

1.4.1 Hydrology

Surface configuration design of the Carbonate Tailings provides for drainage from the center of the Tailings to the exterior edges in all directions. The area defined as the northeast quadrant has the largest area relative to the hydraulic length and thus becomes the critical design area. Hydraulic modeling was completed using the Corp. of Engineers HEC-1 computer program and the natural channels computer program which employs the Manning equation. Maximum discharge was calculated using the PMF event as previously determined in ARCO's Reclamation Plan.

The calculated maximum unit discharge for the northeast quadrant is 0.57-cfs. Peak surface velocity has been calculated at 2.15-feet/second. The maximum calculated velocity on the 5:1 slope is 4.84 feet/second.

1.4.2 Erosion Protection

Consistent with the rock sizing methods in ARCO's Reclamation Plan, the

Corp. of Engineers Method was used to size rock covers for the newly designed surface of the Carbonate Tailings. Erosion protection will consist of a 50/50 mixture soil/rock matrix over the entire surface. A d_{50} = 1½ inch rock will be used in the soil/rock matrix. Slope cover protection has not required any change to the rock size and filter proposed in the 1990 Reclamation Plan. Calculations for rock selection on the top surface soil/rock matrix and verifications of the slope rock sizing are shown in Appendix A.

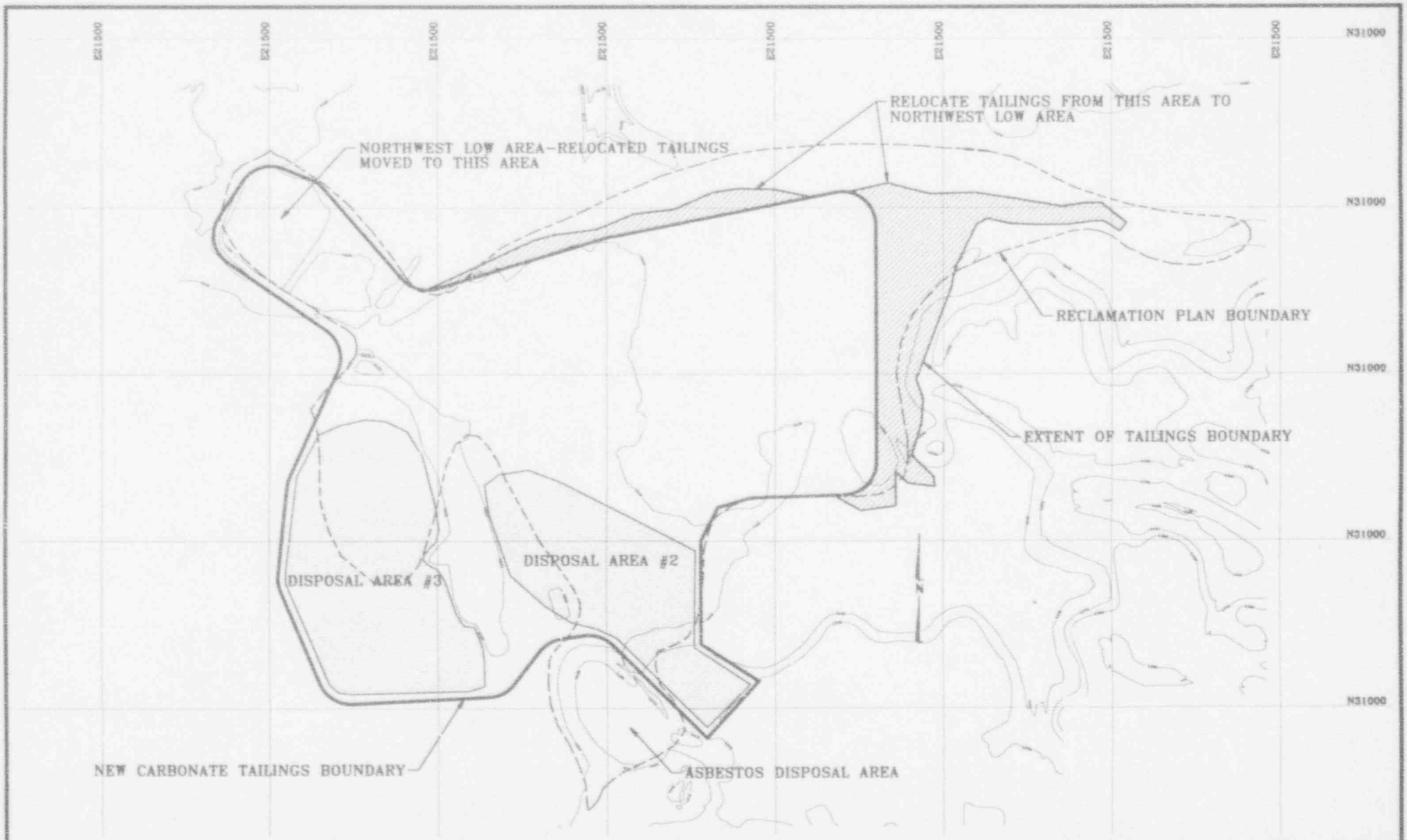

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FIGURE 1.1
CARBONATE TAILINGS
NEW & OLD BOUNDARY

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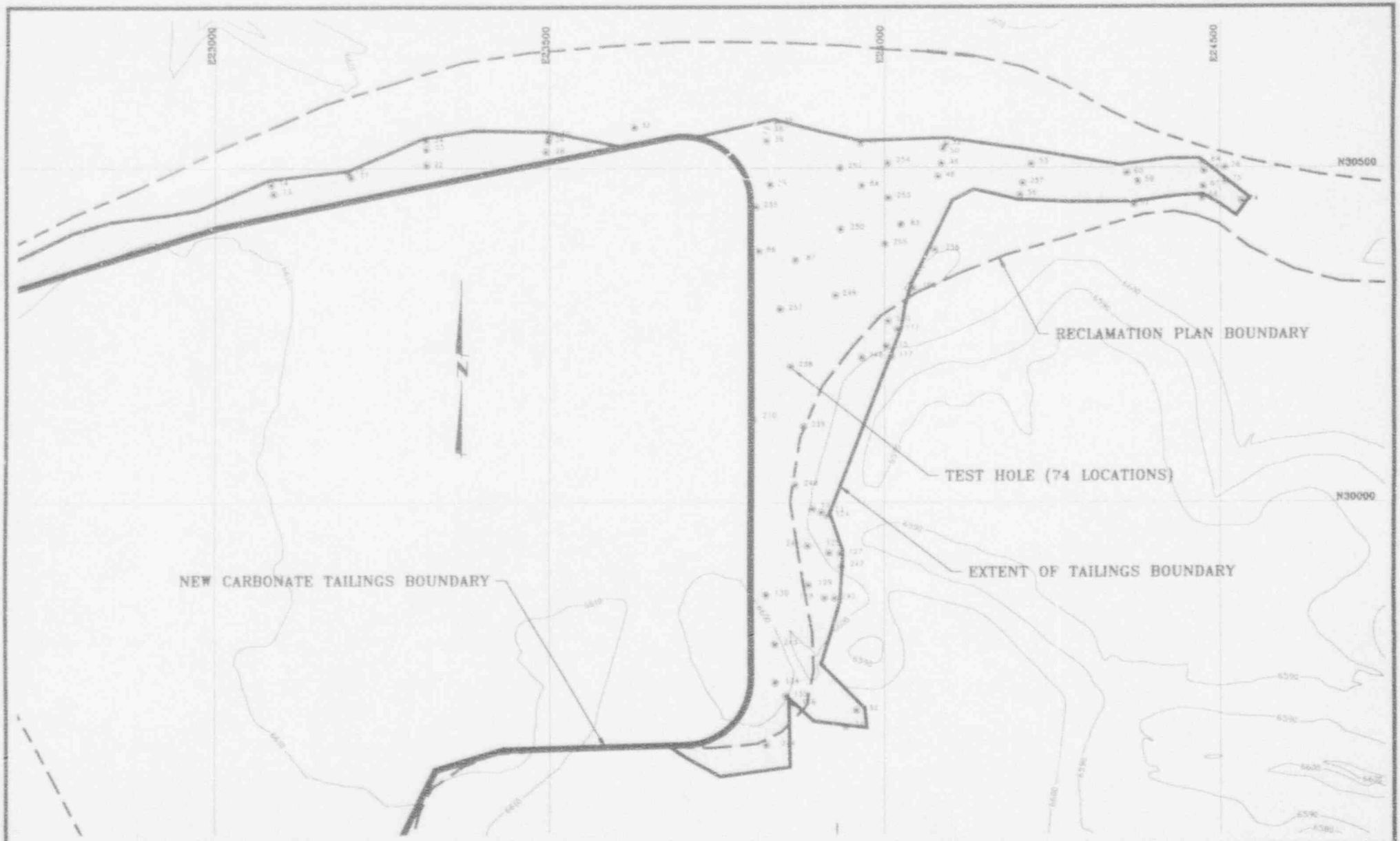

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FIGURE 1.2
CARBONATE TAILINGS
TEST HOLE LOCATIONS

ATLANTIC RICHFIELD COMPANY
BOOK CLIFF MINE

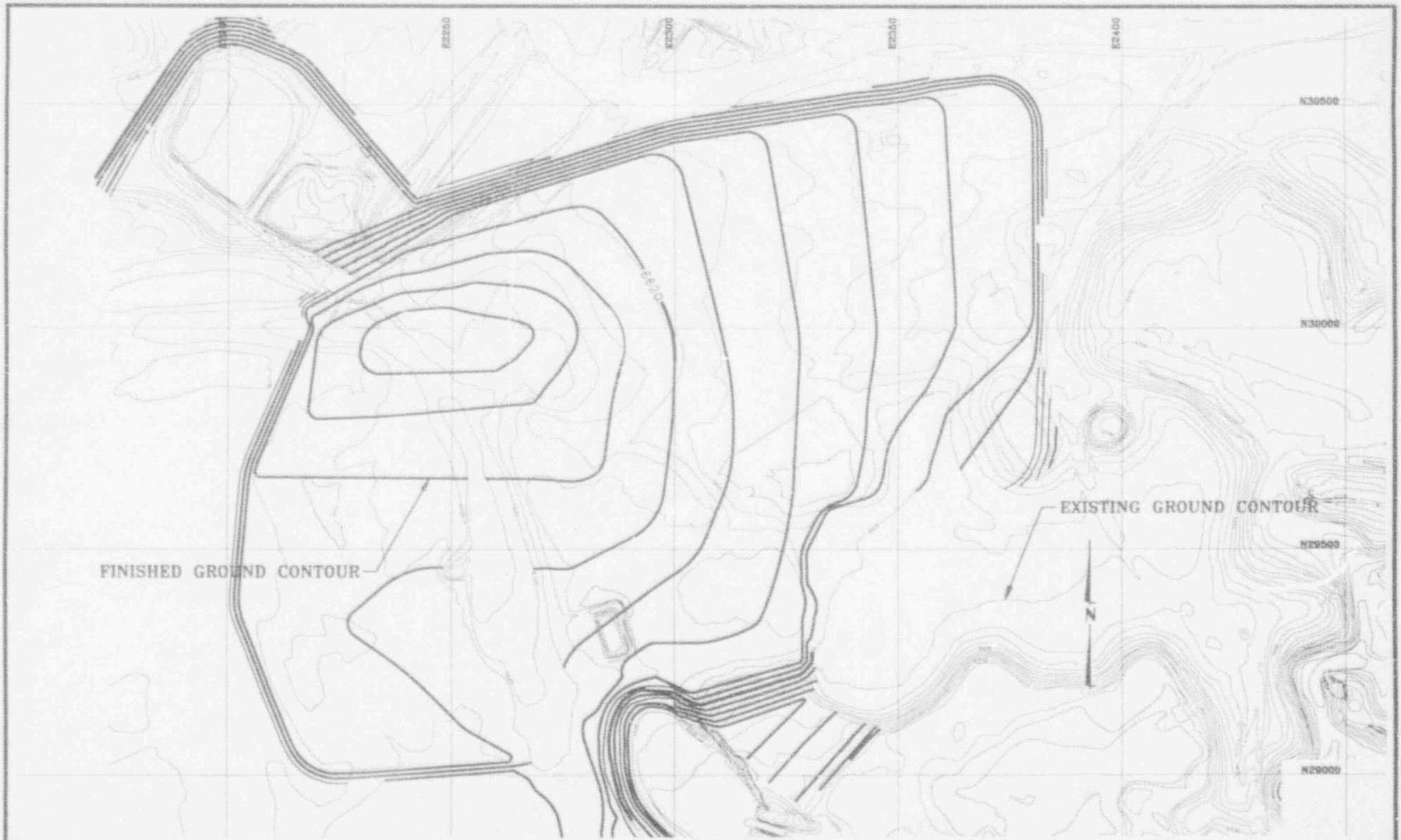

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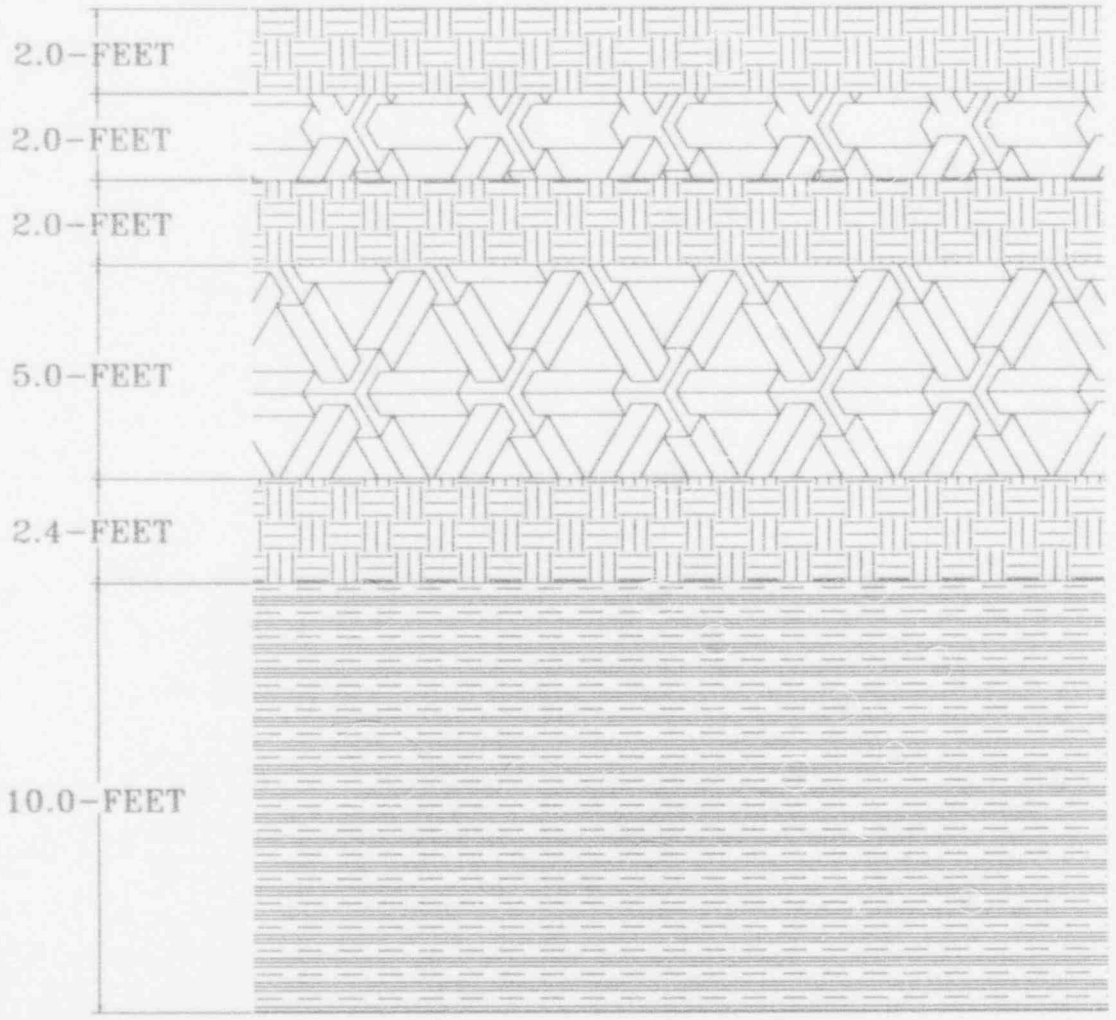
FIGURE 1.3
CARBONATE TAILINGS
FINAL TOPOGRAPHY

ATLANTIC RICHFIELD COMPANY



NUM.	DIVISION	NO.	DATE	REVISION	NO.

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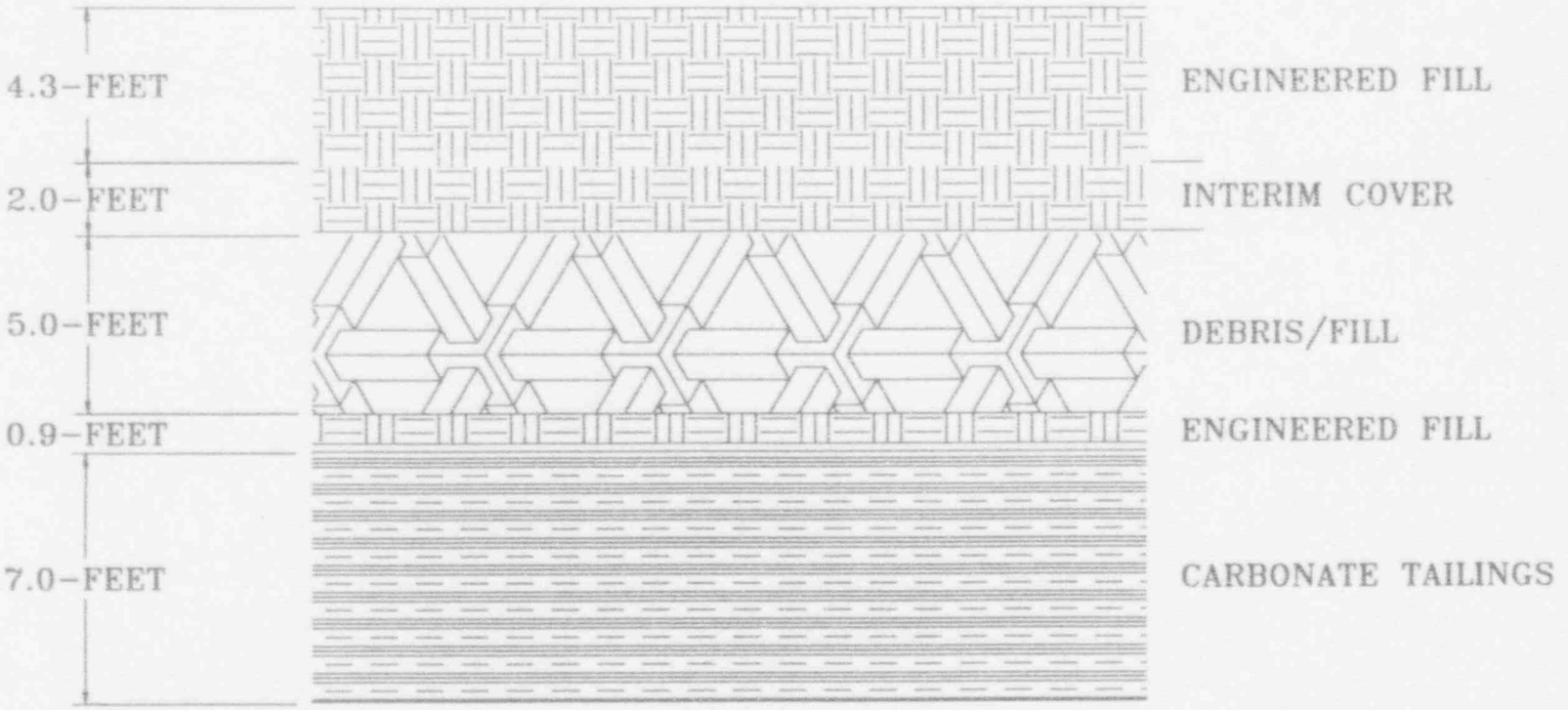
TYPICAL CROSS SECTION
DISPOSAL AREA #2
FIGURE 1.4

ATLANTIC RICHFIELD COMPANY
BOISE CASCADE CORP.

DRAWN BY:	SA
CHECKED:	SA
APPROVED:	CS
DATE:	12/93
HORIZ. SCALE:	NTS
VERT. SCALE:	NTS
CITATION:	



DATE	REVISION	BY	DATE	REVISION	BY

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TYPICAL CROSS SECTION
DISPOSAL AREA #3
FIGURE 1.5

ATLANTIC RICHFIELD COMPANY
BP ATLANTIC REGION

DRAWN BY	JSC
CHECKED	SA
APPROVED	CS
DATE	12/90
HORIZ. SCALE	NTS
VERT. SCALE	NTS

2.0 SOUTH BENCH - PLACEMENT OF RADON BARRIER AT TOE OF SOUTH DIKE MAIN TAILINGS IMPOUNDMENT

2.1 Introduction

The area south of the Main Tailings Impoundment at the toe of the 5:1 slope between Station 113+00 and Station 123+00 has been determined to contain tailings materials. Figure 2.1 provides a plan view of this area showing the extent of the tailings material. The tailings material found varies in thickness from several feet to over seventeen feet in depth. ARCO proposes to cover these areas with an approximately 3.4-feet of radon barrier, a depth similar to that designed for the Main Tailings Impoundment embankments in the original 1990 Reclamation Plan.

2.2 Radon Barrier

RAECOM models indicate that 1.2-feet of cover is the maximum cover this area requires to attenuate radon levels to NRC criteria. A depth of 3.4-feet has been placed over this tailings material which is consistent with the radon cover on the adjacent Main Tailings Impoundment embankment slopes. The log hole information for the south bench area and the RAECOM calculations for this area are attached in Appendix B. Radium concentrations used in the design of the cover were determined from field samples collected at several locations within the area. The physical properties of the tailings are similar to those found in the Old Acid Tailings. In addition, early aerial photographs indicate that deposits were made during the same period as the Old Acid Tailings. RAECOM calculations use the physical characteristics of the Old Acid Tailings with the measured radium concentrations of field samples taken. Figure 2.2 shows the complete design configuration of the South Bench. A typical cross section of the proposed South Bench is shown in Figure 2.3.

2.3 Erosion Protection

The top surface of the South Bench has been designed to meet stable slope criteria. The stable slope calculation is included in Appendix B with this report. Following

final grading the surface will receive 12 inches of topsoil and be seeded with the mixture contained in the ARCO Reclamation Plan. Universal Soil Loss Equation (USLE) calculations were completed on the top surface and are also included in this report. These USLE calculations show that 2.3 inches of material will be eroded during the 1000 year design life. A 5-foot wide apron, consisting of d_{50} = 2½ inch rock, will be constructed at the base of the Main Tailings Impoundment embankment to dissipate hydraulic energy from slope runoff. The 5:1 slopes around the edges of the South Bench will be protected with the same 6 inch depth of d_{50} = ½ inch filter rock and d_{50} = 2½ inch rock which will be placed on the Main Tailings Impoundment embankments. A 5 foot wide rock apron will be placed at the base of the 5:1 slopes to mitigate head cutting into the slope.

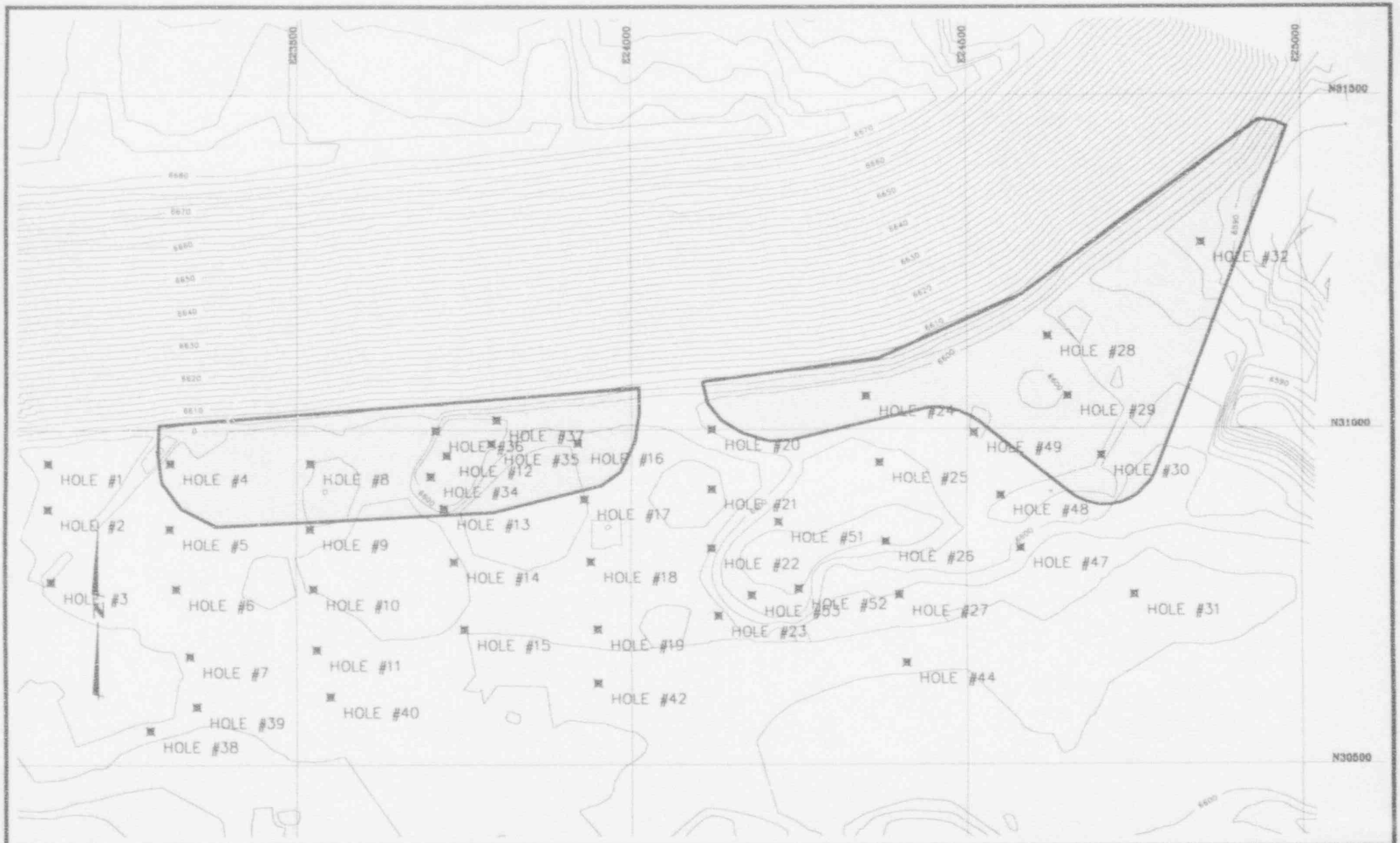

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FIGURE 2.1
SOUTH BENCH
EXTENT OF TAILINGS

ATLANTIC RICHFIELD COMPANY
BOOMERANG HILL

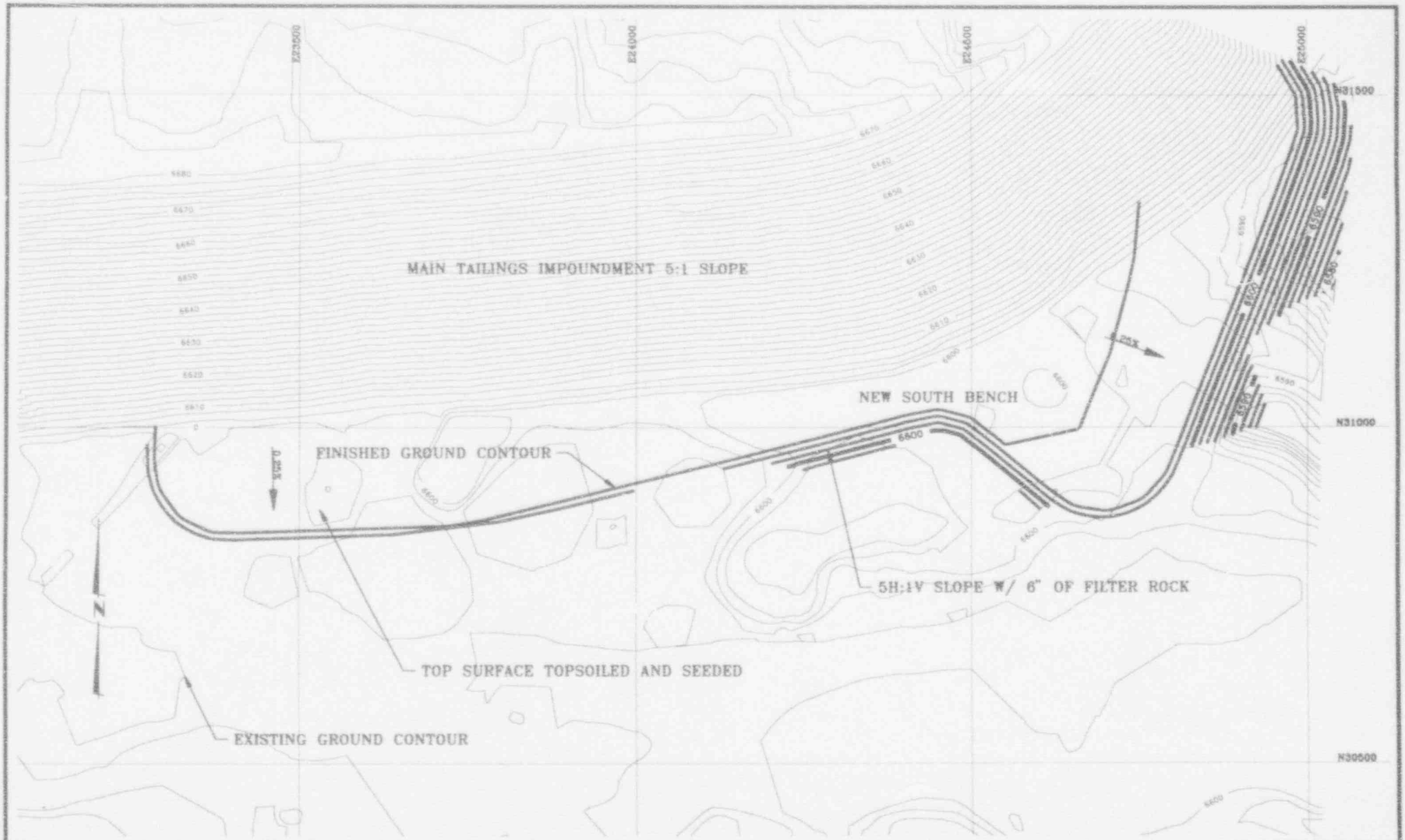

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FIGURE 2.2
DESIGN CONFIGURATION
SOUTH BENCH

ATLANTIC RICHFIELD COMPANY
HONEYMOON MILL

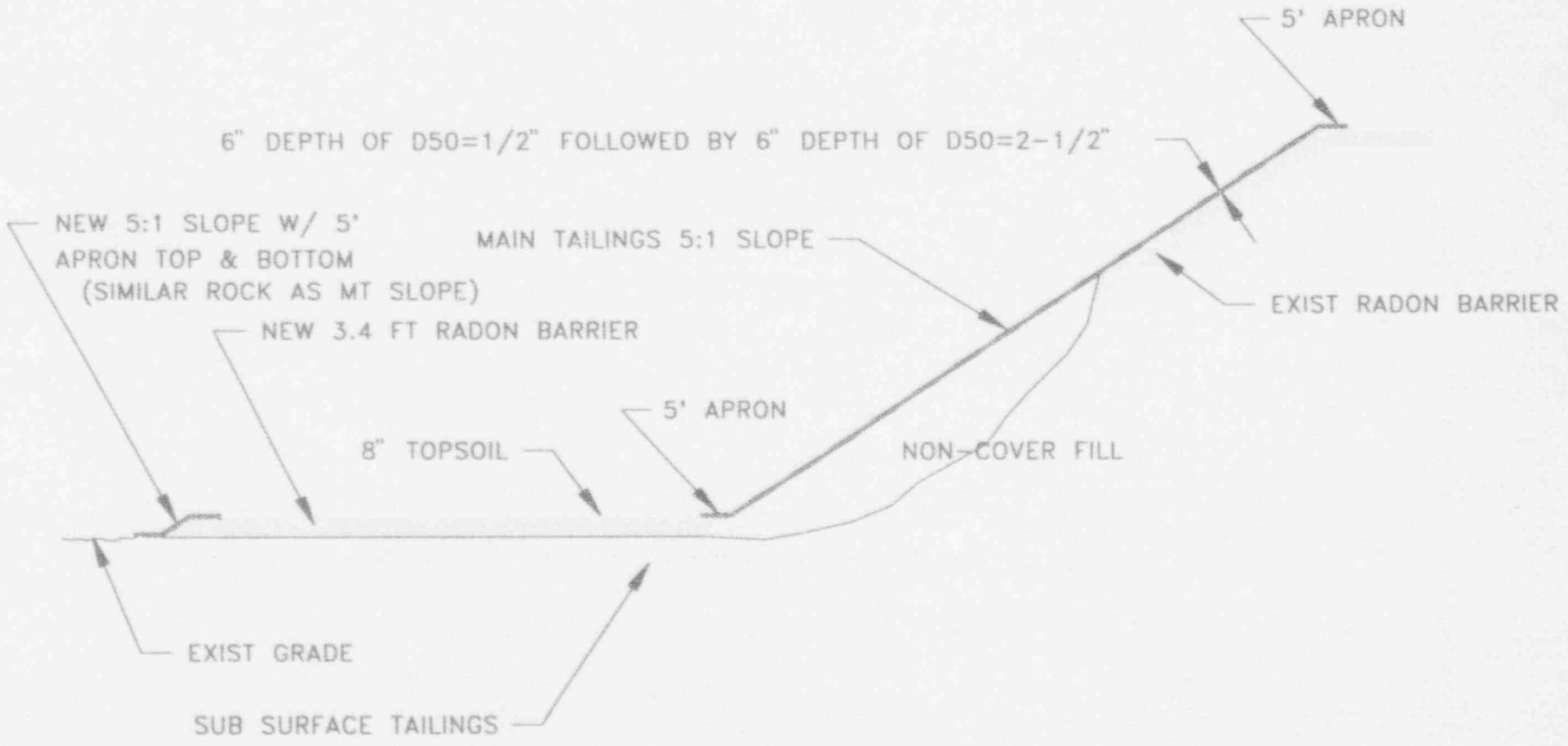

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FIGURE 2.3
TYPICAL CROSS SECTION
SOUTH BENCH

ATLANTIC RICHFIELD COMPANY
BOIES WATER MILL

3.0 SLOPE DESIGN MODIFICATION - NORTHEAST MAIN TAILINGS IMPOUNDMENT

3.1 Introduction

ARCO proposes to modify the Main Tailings Impoundment slope design contained in the 1990 Reclamation Plan between stations 75+00 and 86+00. (Figure 3.1) The 30 inch El Paso Natural Gas pipeline is to be relocated away from the present toe of the Main Tailings Impoundment at this location. The slope along the El Paso Natural Gas pipeline will be a cut and fill operation and extend over the former location of the El Paso right-of-way.

3.2 Slope Design

The slope will be modified from the 1990 Reclamation Plan to reduce the quantity of material excavated due to removal of the gas pipeline as shown on Figure 3.2. With no constraint on the slope toe from the El Paso right-of-way less cut is required to construct the reduced slope. The reclaimed slope geometry will remain 5 horizontal to 1 vertical. The slope geotechnical stability will be enhanced because of less cut into the tailings impoundment and will be similar to that of the Main Tailings slopes with cut/fill type construction. Slope geotechnical analysis of this area completed for the 1990 Reclamation Plan indicates the slope is stable under static and pseudo- static conditions.

3.3 Construction

Removal of material at the upper portion of the slope will consist of sand tailings and embankment soil. This material will be excavated and placed onto the Acid Tailings Impoundment and compacted to 95% of Maximum Dry Density (MDD) in compliance with Reclamation Plan specifications. The fill material at the slope toe will be soils obtained from the borrow site or the evaporation pond dikes, and compacted to 95% MDD. Radon barrier is to be constructed over the tailings exposed by excavation. The depth of radon barrier is to be 1.4 feet which meets specifications for the sand tailings proposed in ARCO's Final Radon Barrier Design

Report - December 1993. Figure 3.2 shows detail of the slope construction.

3.4 Erosion Protection

The slope will be protected by a rock cover similar to the slope spillway areas of the Main Tailings Impoundment. A 6 inch deep filter consisting of d_{50}=1/2 inch rock will be placed over the radon barrier. A 12 inch deep rip-rap cover will be constructed over the filter with d_{50}=5-inch rock. A protective apron of the same slope rock protection will be extended 10 feet at the toe of the slope and ten feet at the crest.

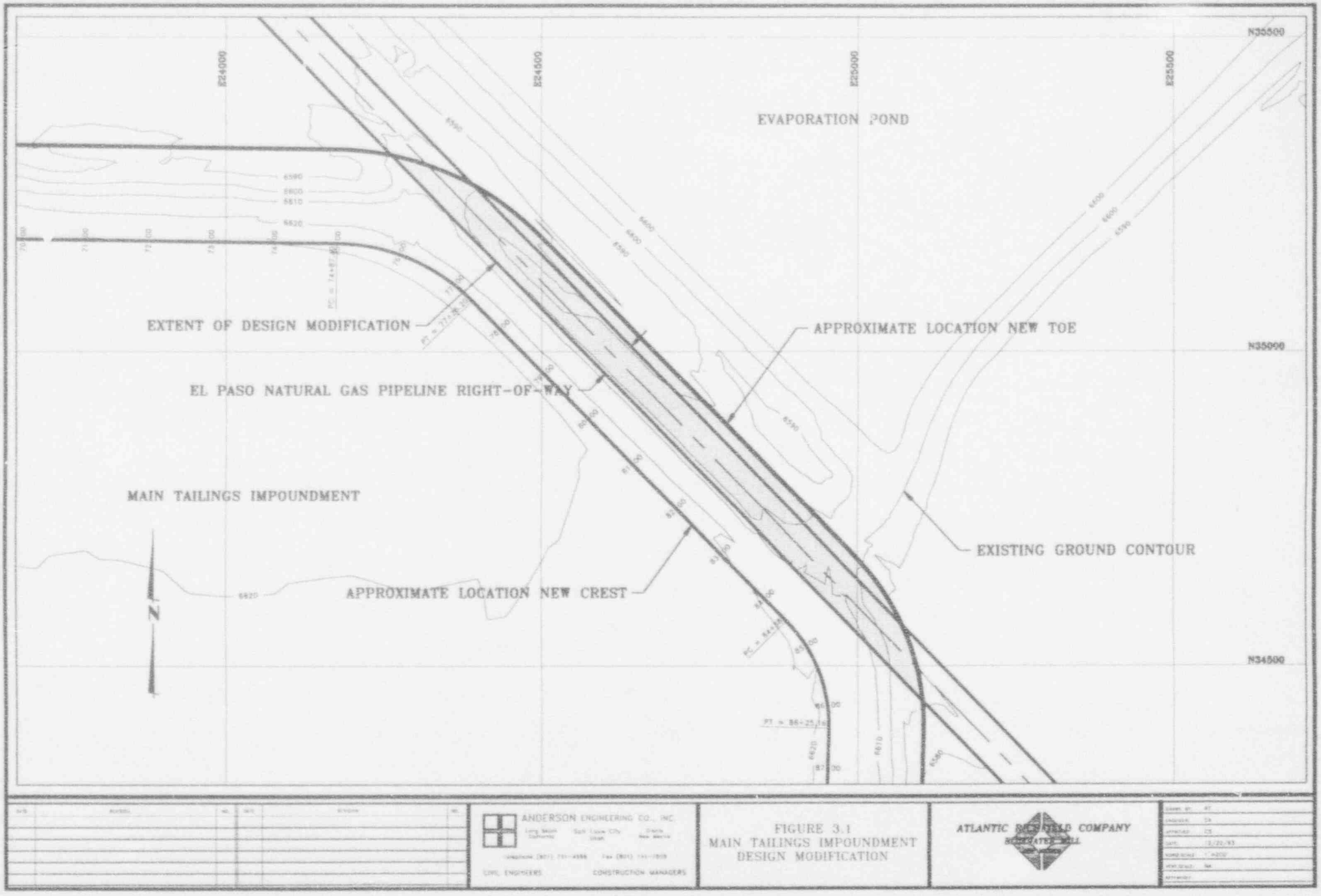

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FIGURE 3.1
MAIN TAILINGS IMPOUNDMENT
DESIGN MODIFICATION

ATLANTIC RICHFIELD COMPANY

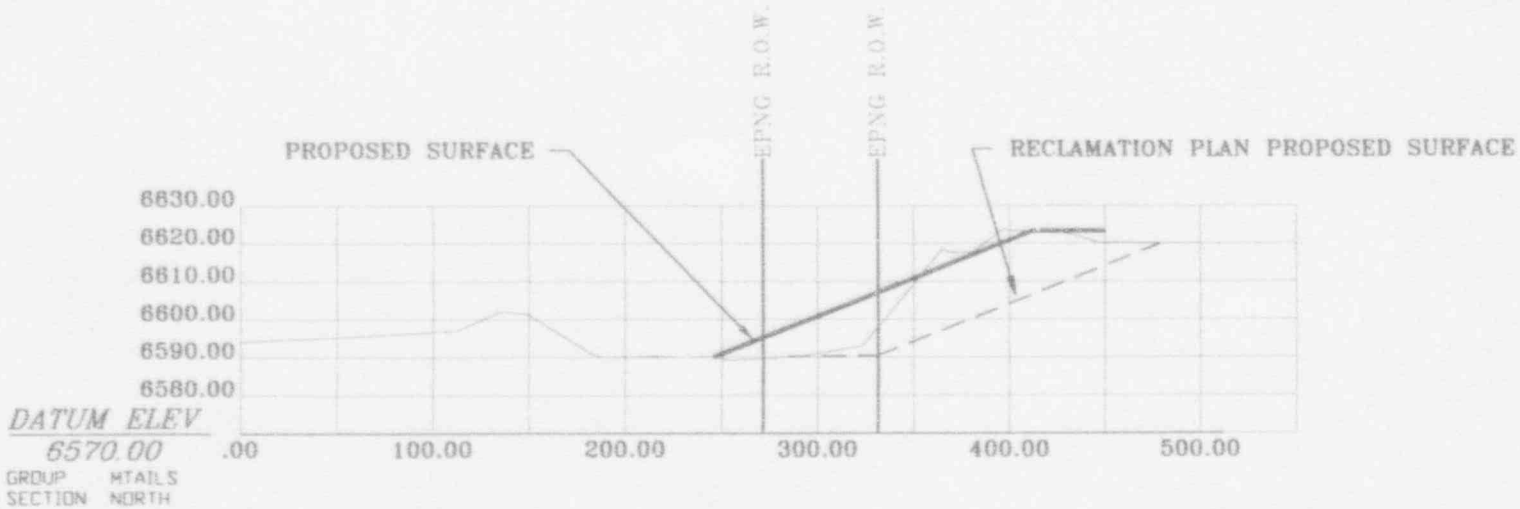

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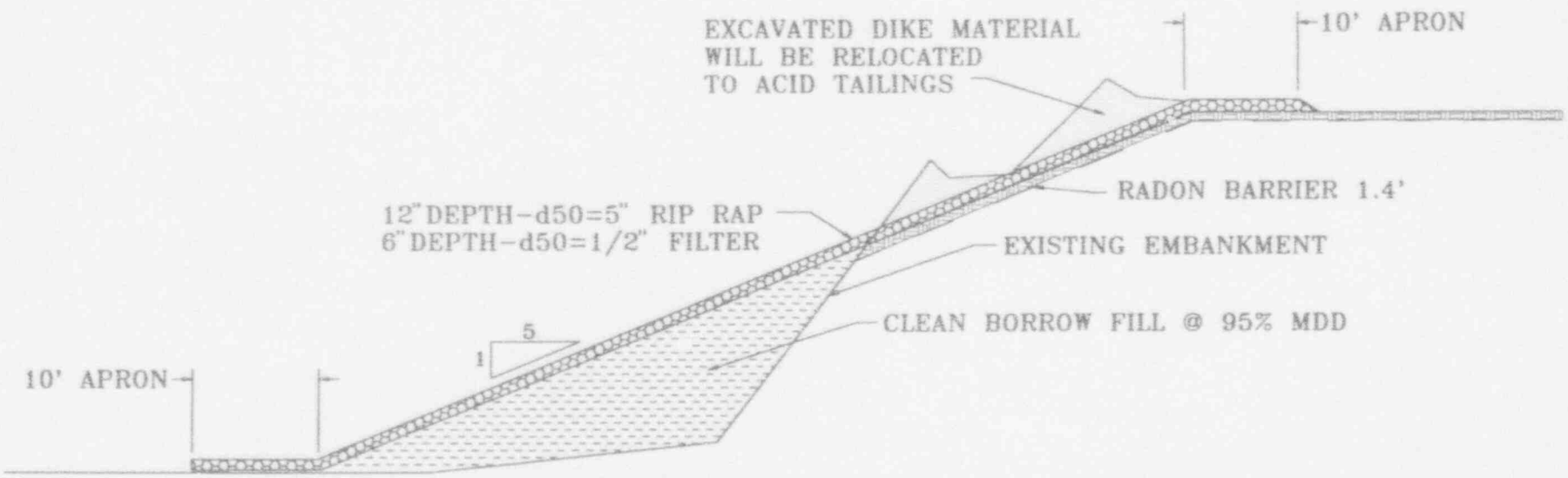
FIGURE 3.2
MAIN TAILINGS IMPOUNDMENT
TYPICAL SECTION

ATLANTIC RICHFIELD COMPANY
BOTTLE HOLE MILL
SAN JUAN COUNTY, NEW MEXICO

DRAWN BY	RC
ENGINEER	SB
APPROVED	CS
DATE	12/23/93
HORIZ SCALE	1"=100'
VERT SCALE	1"=100'
REVISIONS	



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CROSS-SECTION
SLOPE MODIFICATION
MAIN TAILINGS IMPOUNDMENT
FIGURE 3.3

ATLANTIC RICHFIELD COMPANY

4.0 ROCK SPECIFICATIONS - QUARRY AND SCORING CRITERIA

4.1 Introduction

The source of rock to be used for erosion protection at the Bluewater Mill has been changed from an onsite quarry to a quarry located approximately three miles east of the site on property owned by Homestake Mining Company.

ARCO is requesting that the rock material specifications be based on the Nuclear Regulatory Commission (NRC) total scoring criteria rather than individual hardness characteristic test results. This scoring criteria is to be applied to all rock products regardless of quarry location.

ARCO is also clarifying specifications for quality control of the soil/rock matrix to be used for erosion protection on the Main Tailings and the Carbonate Tailings Impoundments.

4.2 Rock Quarry

The new rock quarry is a high quality igneous rock from a local basalt flow. The preliminary inplace testing indicates the rock possesses the same properties as those of the ARCO proposed quarry as previously submitted in the Reclamation Plan. The averages for rock quality scoring from the new quarry site are shown on Table 4.1.

Rock testing from the new quarry indicates that from about 5 feet below the surface an overall score of greater than 80 can be met, which is more than adequate for the Bluewater Mill erosion protection products.

4.3 Specifications

Rock to be used for erosion protection must meet a minimum overall score of 65 for the $d_{50}=1.5$ inch, and $d_{50}=2.0$ inch products. The minimum score for the $d_{50}=5$ inch rock shall be 66 and a minimum score of 72 for the $d_{50}=2.5$ inch rock products. All

scoring will be derived in accordance with the Nuclear Regulatory Commission Final Staff Technical Position, Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites, August 1990. The test series will consist of Specific Gravity, Absorption, L. A. Abrasion (100 revolutions), Na_2SO_4 Soundness and Tensile Strength to determine the scoring of the erosion protection rock.

Table 4.2 describes the erosion protection rock size and minimum scoring for the respective reclaimed areas. Rock sizing calculations and gradations for each reclaimed area are shown in Appendix B to the 1990 Reclamation Plan and subsequent amendments. The test series indicated above and gradation tests shall be performed on the material at the crusher. For each gradation specified, tests will be made at 10,000 cy intervals or at a minimum of three times during production. The initial test shall be made prior to transportation of any material from the crusher. Where the quantity of a specific size material to be produced is less than 10,000 cy, one test series shall be completed at the beginning, approximately half-way through the run and one near the end.

4.4 Soil Rock Matrix Specifications

The soil/rock matrix is to be placed onto the top surface of the Main Tailings Impoundment and the Carbonate Tailings Impoundment as described in ARCO's approved Reclamation Plan. The following criteria and sequence will be utilized to evaluate the construction of the soil rock matrix.

1. Place rock onto the radon barrier surface at about two times (2x) the rock d_{50}.

2. Rock shall be visually inspected during placement for uniformity and proper gradation. Areas which indicate segregation shall be reworked to comply with specification requirements. Random gradation tests will be conducted to verify visual appraisals.

3. Place soil over rock at approximately four to six inches in depth.

4. Mix soil and rock by use of scarification equipment (example: disc or closely spaced small rippers). The scarification is to be in three directions; one 90° to the other and the third pass is to be at 45° and bisect the first two passes. Care will be taken to prevent disruption of the underlying radon barrier.

5. Soil and rock will be roller packed with a minimum of three passes to consolidate the soil and rock bed.

6. The soil rock matrix will be field tested for depth by use of the grid described in the approved Reclamation Plan. Measurements of rock, and soil depths will be made from test holes. One depth test hole will be taken for every 200,000 square feet.

7. Revegetation of the top surface soil/rock matrix will be performed following the procedures contained in the approved 1990 Reclamation Plan.

TABLE 4.1

ROCK QUALITY SCORING
HOMESTAKE'S MALPAIS BASALT QUARRY SITE (NE 1/4, 28/T12N/R10W)

Sample Number	Rock Type (1 = igneous)	Weighting Factor (WF)/Test Value (TV) / Score for: Specific Gravity g/cc	Absorption %	Sulfate Soundness % Loss	LA Abrasion % Loss	Schmidt Hammer SRU	Tensile Strength psi	
Averages For All Tested Samples								
Numbers of Samples tested =		21.00	21.00	21.00	9.00	3.00	12.00	
TV =		2.65	1.84	0.93	38.40	52.40	1111.00	
Score =		8.06	3.48	9.83	0.00	6.70	8.52	
Rating =		72.51	6.97	108.16	0.00	20.20	85.20	Rock Source Composite Rating, %, Using All
Maximum possible rating (MPR) =		90.00	20.00	110.0	10.00	30.00	100.00	Rock From 0' to 30' =
Rating in % MPR =		80.56	34.83	98.33	0.00	67.21	85.20	81.4
Averages For All Samples Below Highly Vesicular Zone(0'-5')								
Numbers of Samples tested =		17.00	17.00	17.00	9.00	3.00	12.00	
TV =		2.71	1.67	0.90	38.40	52.40	1111.00	
Score =		9.28	3.87	9.82	0.00	6.70	8.52	
Rating =		83.50	7.74	107.98	0.00	20.20	85.20	Rock Source Composite Rating, %, Using Only
Maximum possible rating (MPR) =		90.00	20.00	110.00	10.00	30.00	100.00	Rock From 5' to 30' =
Rating in % MPR =		92.78	38.68	98.17	0.00	67.21	85.20	84.6

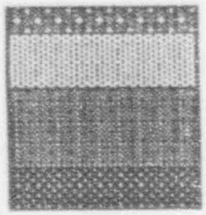
TABLE 4.2
EROSION PROTECTION ROCK SCORE

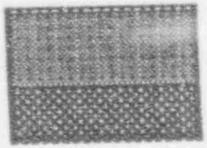
	Rock Size d_{50}		Minimum Quality Score *[2]
Main Tailings	Minimum Design *[1]	Reclamation Plan	
Top Surface (North)	0.5"	1.5"	65
Top Surface (South)	0.5"	2.0"	65
Slopes	2.0"	2.5"	65
Spillway	4.3"	5.0"	66
Carbonate Tailings			
Top Surface	.05"	1.5"	65
Slopes	2.3"	2.5"	72
Acid Tailings			
Slopes	0.5"	1.5"	65
Stockpile			
Slopes	0.5"	1.5"	65

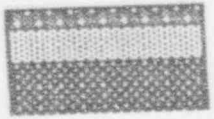
[1]* Corp. of Engineers Method for Top Surface, Stephenson Method for Slopes

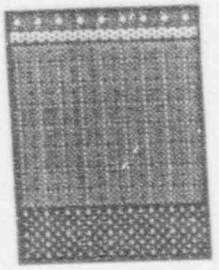
[2]* Minimum 65 score is required for critical areas, NRC 1990

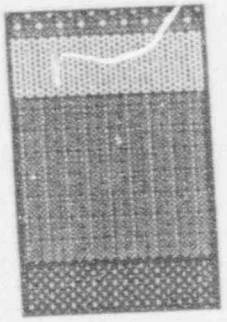
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

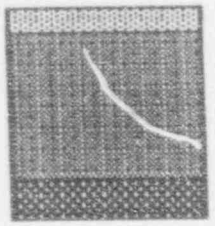
DEPTH	SYMBOL	DESCRIPTION	HOLE # 13-2
0	0.4		COVER MATERIAL
1	0.7		TAILINGS
	1.0		NATIVE SOIL
2			MALPAIS
3			
4			
5			
6			
7			
8			
9			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION		
DEPTH	SYMBOL	DESCRIPTION	HOLE # 14-2
0			
1.0		TRACE TAILINGS	
1		NATIVE SOIL	
		MALPAIS	
2			
3			
4			
5			
6			
7			
8			
9			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 17-2
0 0.2		COVER MATERIAL
0.5		TAILINGS
1		MALPAIS
2		
3		
4		
5		
6		
7		
8		
9		

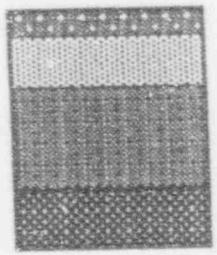
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION		
DEPTH	SYMBOL	DESCRIPTION	HOLE # 19-R
0			
0.2		COVER MATERIAL	
0.2		TAILINGS	
1			
2.1		NATIVE SOILS	
2			
3		MALPAIS	
4			
5			
6			
7			
8			
9			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 22-2
0 .04		COVER MATERIAL
.07		TAILINGS
1		
2 2.0		NATIVE SOIL
3		MALPAIS
4		
5		
6		
7		
8		
9		

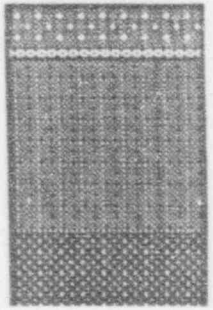
POTHOLE LOG		CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION	HOLE # 23-2
0 0.4		TAILINGS	
1 1.5		NATIVE SOIL	
2		MALPAIS	
3			
4			
5			
6			
7			
8			
9			

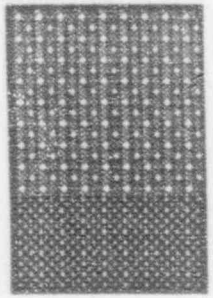
POTHOLE LOG		CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION	HOLE # 24-2
0 0.4		TAILINGS	
1 1.5		NATIVE SOIL	
2		MALPAIS	
3			
4			
5			
6			
7			
8			
9			

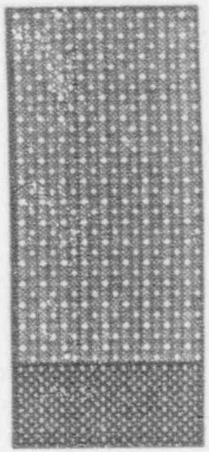
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH		SYMBOL	DESCRIPTION	HOLE # 28-2
0	0.4		COVER MATERIAL	
	0.7		TAILINGS	
1				
	1.4		NATIVE SOIL	
2				
			MALPAIS	
3				
4				
5				
6				
7				
8				
9				

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 29-2
0			
0.4		COVER MATERIAL TRACE TAILINGS	
1.0		NATIVE SOIL	
1		MALPAIS	
2			
3			
4			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 30-2
0		
1.0		COVER MATERIAL
1		MALPAIS
2		
3		
4		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 32-2
0		TRACE TAILINGS ON SURFACE
1 2.0		NATIVE SOIL
2		MALPAIS
3		
4		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 36-2
0			
0.4		COVER MATERIAL	
0.2		TAILINGS	
1			
2.5		NATIVE SOIL	
2			
3			
		MALPAIS	
4			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 38-2

0

0.3 COVER MATERIAL

0.5 TAILINGS

1

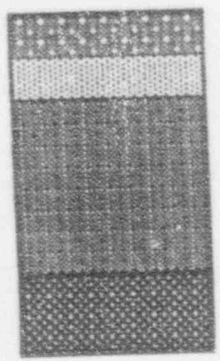
2.0 NATIVE SOIL

2

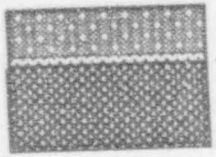
3 MALPAIS

4

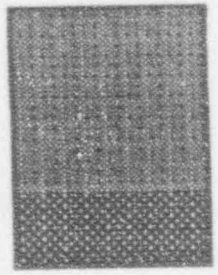
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 39-2



0
0.3 COVER MATERIAL
0.3 TAILINGS
NATIVE SOIL
1
1.0
MALPAIS
2
3
4

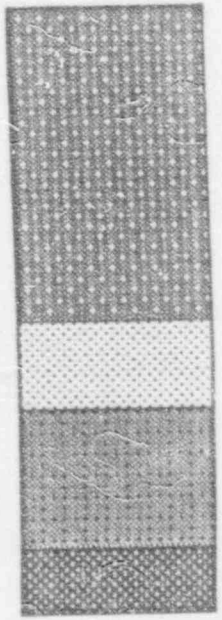
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 43-2
0		
0.4		COVER MATERIAL TAILINGS - TRACE ATOP ROCK MALPAIS
1		
2		
3		
4		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

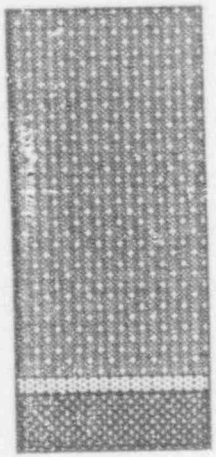
DEPTH	SYMBOL	DESCRIPTION	HOLE # 45-2
0			
1.0		COVER MATERIAL	
1		MALPAIS	
2			
3			
4			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 49-2 R

0
1
2 4.1 — COVER MATERIAL
3
4
1.1 — TAILINGS
5
6 1.7 — NATIVE SOIL
7 — MALPAIS
8
9

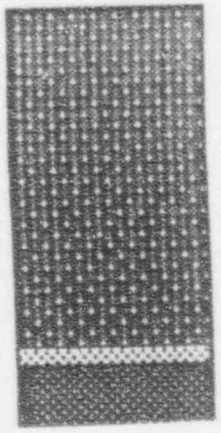


POTHOLE LOG		CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION	HOLE # 50-2
0			
0.4		HARD CLAY - BACKHOE REFUSED	
1			
2			
3			
4			

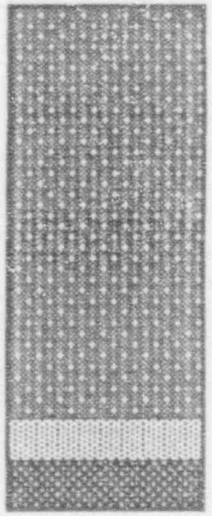
POTHOLE LOG		CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION	HOLE # 52-2
0			
1 2.0		COVER MATERIAL	
2 <0.1		TAILINGS - THIN LENS	
		MALPAIS	
3			
4			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

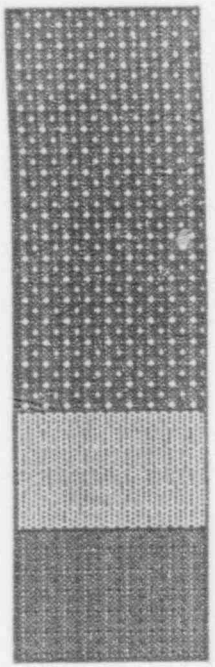
DEPTH	SYMBOL	DESCRIPTION	HOLE # 54-2
0			
1			
2	4.0	COVER MATERIAL	
3			
4		TAILINGS	
5		MALPAIS	
6			
7			
8			
9			



POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

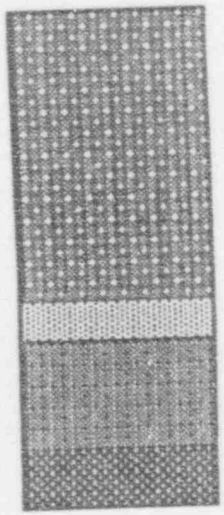
DEPTH	SYMBOL	DESCRIPTION	HOLE # 56-2
0			
1			
3.0		COVER MATERIAL	
2			
3			
0.4		TAILINGS MALPAIS	
4			
5			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 59-R
0			
1			
3.0		COVER MATERIAL	
2			
3			
0.9		TAILINGS	
4			
>1.0		NATIVE SOILS	
5			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 60-R

0



COVER MATERIAL

1

2.2

2

0.4

TAILINGS

NATIVE SOILS

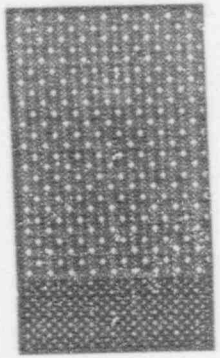
3

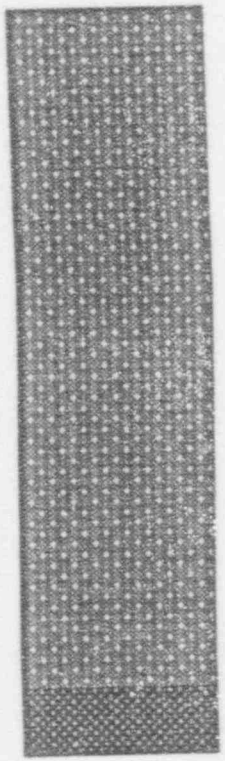
0.8

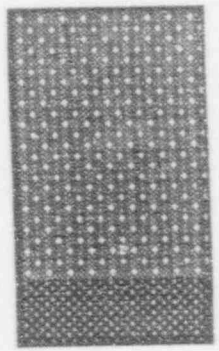
MALPAIS

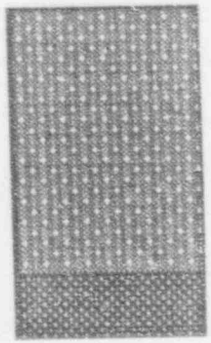
4

5

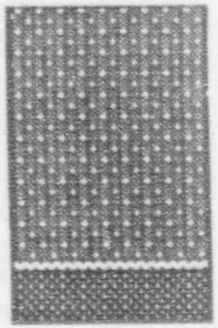
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 62-2
0		COVER MATERIAL
1 2.0		
2		MALPAIS
3		
4		
5		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 64-2
0		
1		
2		
5.0		COVER MATERIAL
3		
4		
5		MALPAIS

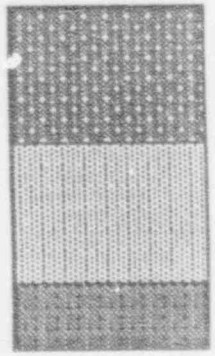
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 67-2
0		
1 2.0		COVER MATERIAL
2		MALPAIS
3		
4		
5		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 68-2
0		
1 2.0		COVER MATERIAL
2		MALPAIS
3		
4		
5		

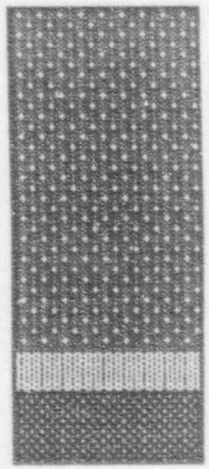
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 74-2
0		
1		COVER MATERIAL
3.0		
2		
3		TAILINGS
0.1		MALPAIS
4		
5		
6		
7		
8		
9		



POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 75-2
0			
1.0		COVER MATERIAL	
1			
1.0		TAILINGS	
2		NATIVE SOIL	
3			
4			
5			

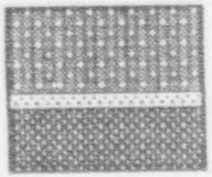
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 76-2

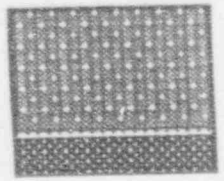


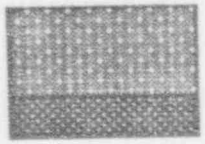
COVER MATERIAL

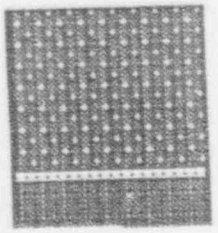
TAILINGS

MALPAIS

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION		
DEPTH	SYMBOL	DESCRIPTION	HOLE # 83-2
0			
1.0		COVER MATERIAL	
1 0.2		TAILINGS	
2		MALPAIS	
3			
4			
5			
6			
7			
8			
9			

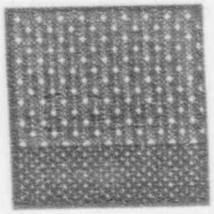
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 84-2
0		
1.5		COVER MATERIAL
1		TAILINGS (TRACE)
2		MALPAIS
3		
4		
5		
6		
7		
8		
9		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 85-2
0		
1.0		COVER MATERIAL
1		MALPAIS
2		
3		
4		
5		
6		
7		
8		
9		

POTHOLE LOG		CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION	HOLE # 86-2
0			
1 2.0		COVER MATERIAL	
2 0.1		TAILINGS NATIVE SOIL	
3			
4			
5			
6			
7			
8			
9			

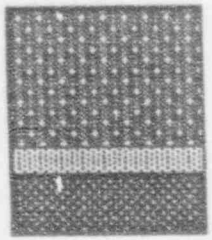
POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 87 -2
0			
1.0		COVER MATERIAL	
1			
1.0		TAILINGS	
2			
1.0		NATIVE SOIL	
3		MALPAIS	
4			
5			
6			
7			
8			
9			

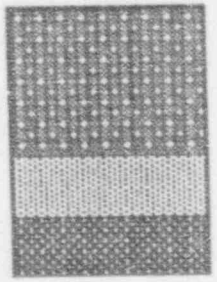
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 109-2
0		
1.0		COVER MATERIAL
1		MALPAIS
2		
3		
4		
5		

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

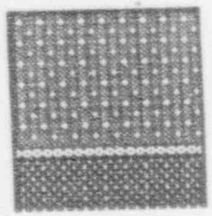
DEPTH		SYMBOL	DESCRIPTION	HOLE # 110-2
0				
	1.2		COVER MATERIAL	
1	0.3		TAILINGS	
			MALPAIS	
2				
3				
4				
5				
6				
7				
8				
9				

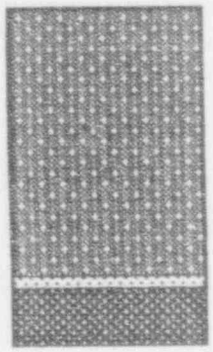
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 111-2
0		
1.0		COVER MATERIAL
1 0.3		TAILINGS
		MALPAIS
2		
3		
4		
5		

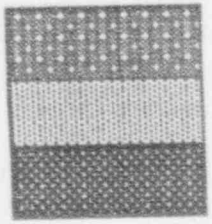
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 115-2
0			
1.2		COVER MATERIAL	
1			
0.5		TAILINGS	
		MALPAIS	
2			
3			
4			
5			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION		
DEPTH	SYMBOL	DESCRIPTION	HOLE # 117-2
0			
1	1.5	COVER MATERIAL	
2		TRACE TAILINGS MALPAIS	
3			
4			
5			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 121-2
0		
1.0		COVER MATERIAL
1		TRACE TAILINGS MALPAIS
2		
3		
4		
5		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 123-2
0		
1 2.0		COVER MATERIAL
2		TRACE TAILINGS MALPAIS
3		
4		
5		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 124-2
0		
0.5		COVER MATERIAL
0.5		TAILINGS
1		MALPAIS
2		
3		
4		
5		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 125-2

0

1.0 — COVER MATERIAL

1

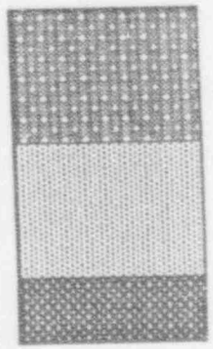
1.0 — TAILINGS

2 — MALPAIS

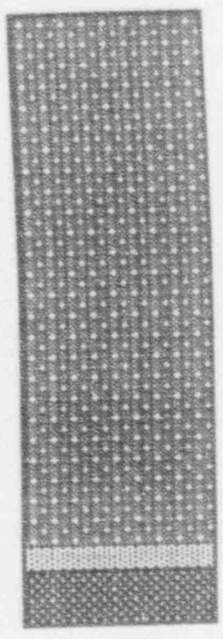
3

4

5



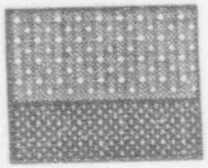
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 127-2



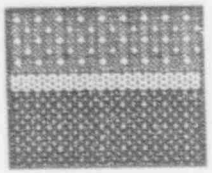
COVER MATERIAL

TAILINGS

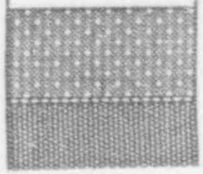
MALPAIS

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 128-2
0		
0.6		COVER MATERIAL
1		MALPAIS
2		
3		
4		
5		

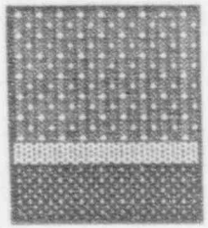
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 129-2
0			
0.5		COVER MATERIAL	
0.2		TAILINGS	
1		MALPAIS	
2			
3			
4			
5			

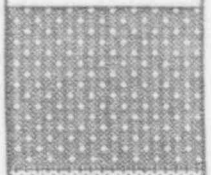
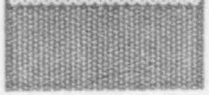
POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 130 -2
0			
1.2		COVER MATERIAL TRACE TAILINGS MALPAIS	
1			
2			
3			
4			
5			
6			
7			
8			
9			

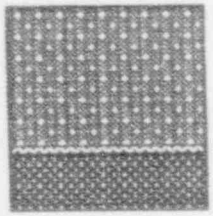
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

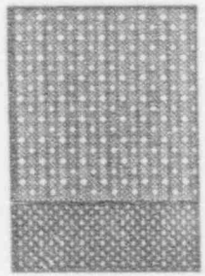
DEPTH	SYMBOL	DESCRIPTION	HOLE # 132-2
0			
1.0		COVER MATERIAL	
1	0.2	TAILINGS	
		MALPAIS	
2			
3			
4			
5			

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 134 -2
0			
1 2.0		COVER MATERIAL	
2			
1.0		TAILINGS	
3			
		MALPAIS	
4			
5			
6			
7			
8			
9			

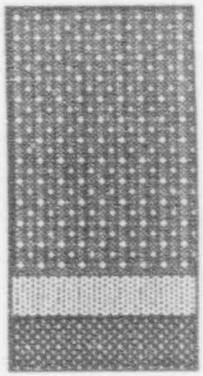
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 135-2
0			
1.0		COVER MATERIAL	
1		TRACE TAILINGS MALPAIS	
2			
3			
4			
5			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 136-2
0		
1	1.5 	COVER MATERIAL
2		MALPAIS
3		
4		
5		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 210-2

0

1 2.0  COVER MATERIAL

2 0.4 TAILINGS

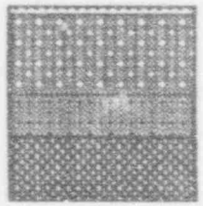
MALPAIS

3

4

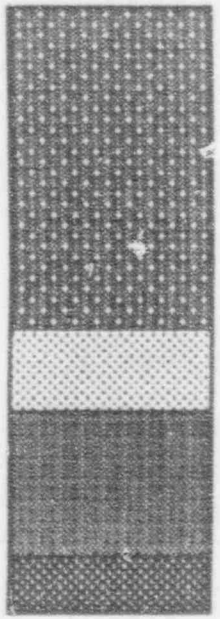
5

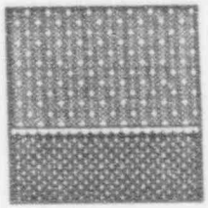
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 235
0		TRACE OF TAILINGS	
1.0		COVER MATERIAL	
1		NATIVE SOIL	
0.5		MALPAIS	
2			
3			
4			
5			
6			
7			
8			
9			

PC[illegible]LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

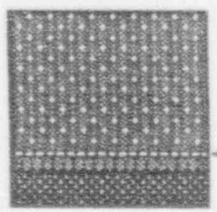
DEPTH	SYMBOL	DESCRIPTION	HOLE # 237
0			
1			
2	4.0	COVER MATERIAL	
3			
4			
5	1.0	TAILINGS	
6	2.0	NATIVE SOIL	
7		MALPAIS	
8			
9			



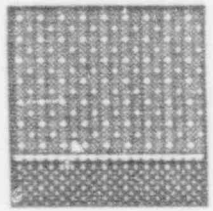
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 238
0		
1	1.5	 COVER MATERIAL
2		TRACE TAILINGS
3		MALPAIS
4		
5		
6		
7		
8		
9		

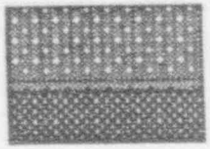
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 239
0			
1	1.6	COVER MATERIAL	
2	0.3	TRACE TAILINGS NATIVE SOIL MALPAIS	
3			
4			
5			
6			
7			
8			
9			

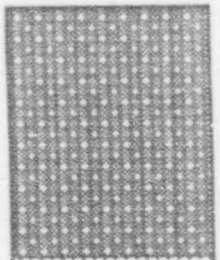


POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 240
0			
1	1.8		COVER MATERIAL
2	0.2		TAILINGS MALPAIS
3			
4			
5			
6			
7			
8			
9			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 241
0		
1.0		COVER MATERIAL WITH TRACE TAILINGS
1 0.2		NATIVE SOIL MALPAIS
2		
3		
4		
5		
6		
7		
8		
9		

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION

DEPTH	SYMBOL	DESCRIPTION	HOLE # 242
0			
1			
2	3.0		COVER MATERIAL
3			
4	0.7		TAILINGS
5	1.5		NATIVE SOIL
6			MALPAIS
7			
8			
9			

POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION	
DEPTH	SYMBOL	DESCRIPTION HOLE # 243

0

1 2.0 — COVER MATERIAL

2 0.4 — TAILINGS

0.2 — NATIVE SOIL

3 — MALPAIS

4

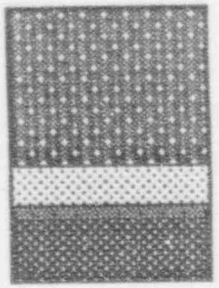
5

6

7

8

9



POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

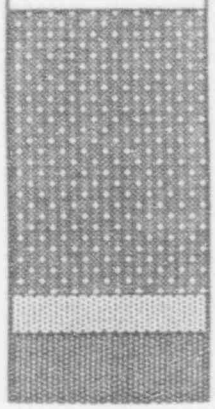
DEPTH		SYMBOL	DESCRIPTION	HOLE # 244
0				
1	2.0		COVER MATERIAL	
2	0.3		CLAY	
	0.5		TAILING SANDS	
3	0.3		NATIVE SOILS	
4			MALPAIS	
5				
6				
7				
8				
9				

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 246
0			
1	1.5	NATIVE SOILS	
2		MALPAIS	
3			
4			
5			
6			
7			
8			
9			

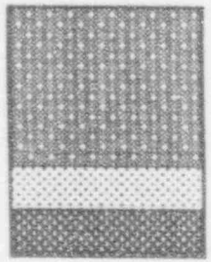
POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 247
0			
1			
2	3.5	COVER MATERIAL	
3			
4	0.5	TAILING SANDS	
		MALPAIS	
5			
6			
7			
8			
9			



POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

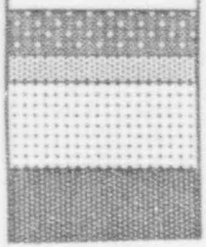
DEPTH	SYMBOL	DESCRIPTION	HOLE # 248
0			
1			
2	4.0	COVER MATERIAL	
3			
4	0.5	TAILING SANDS	
5		MALPAIS	
6			
7			
8			
9			

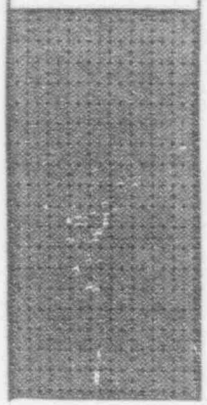
POTHOLE LOG	CARBONATE TAILINGS BOUNDARY INVESTIGATION		
DEPTH	SYMBOL	DESCRIPTION	HOLE # 249
0			
1	2.0		COVER MATERIAL
2	0.6		TAILINGS SANDS
3			MALPAIS
4			
5			
6			
7			
8			
9			

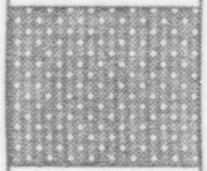
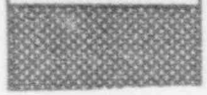
POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH		SYMBOL	DESCRIPTION	HOLE # 250
0				
1	1.5		COVER MATERIAL	
	0.3		TAILING SANDS	
2				
3	2.0		NATIVE SOILS	
4			MALPAIS	
5				
6				
7				
8				
9				

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 251
0			
0.6		COVER MATERIAL	
0.3		TAILING SANDS	
1			
1.1		NATIVE SOILS	
2			
		MALPAIS	
3			
4			
5			
6			
7			
8			
9			

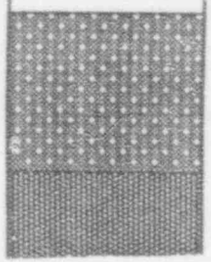
POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO	
DEPTH	SYMBOL	DESCRIPTION HOLE # 253
0 1 2 3 4 5 6 7 8 9		CLAY - STOPPED DIGGING @ 5.0' DUE TO EXTREME DENSITY
5.0		

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO	
DEPTH	SYMBOL	DESCRIPTION HOLE # 254
0		
1 2.0		COVER MATERIAL
2		
1.0		NATIVE SOILS
3		
		MALPAIS
4		
5		
6		
7		
8		
9		

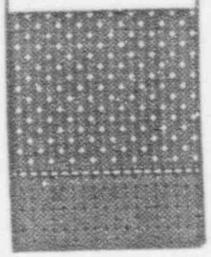
POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 255
0			
1.0		COVER MATERIAL	
1 0.3		TAILING SANDS	
2 1.5		NATIVE SOILS	
3		MALPAIS	
4			
5			
6			
7			
8			
9			

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH		SYMBOL	DESCRIPTION	HOLE # 256
0				
1	2.0		NATIVE SOILS	
2				
3			MALPAIS	
4				
5				
6				
7				
8				
9				

POTHOLE LOG	CARBONATE TAILS BOUNDARY INVESTIGATION INFO

DEPTH	SYMBOL	DESCRIPTION	HOLE # 257
0			
1 2.0		LOOSE COVER MATERIAL	
2		TRACE TAILINGS	
1.0		HARD CLAY - BACKHOE REFUSED	
3			
4			
5			
6			
7			
8			
9			

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231-428-9344

Engineers
Construction Managers

CALCULATION SHEET

JOB Radiological Survey SHEET NO. _____ CALC ~~App~~

CK'D BY _____ DATE 12/22/93 TITLE ~~DA#2~~ Source Term

Disposal Area #2

Radium Activity Calculations

Weston 11/87 Report

Calib Pit 2 $R_a\text{-}226\,(C_i) = 0.248 = 248(10^9)\text{-}pC_i$

Area $\approx 260{,}000\ ft^2$

5' debris $5(260{,}000) = 1{,}300{,}000\ ft^3$

2' debris $2(260{,}000) = 520{,}000\ ft^3$

$= 1.82(10^6)\ ft^3$

$= 1.68(62.4)(1.82(10^6)) = 190.8(10^6)\ lb$

$190.8(10^6)\ lb\left(\frac{453.6\ g}{lb}\right) = 86.6(10^9)\ gm$

$\frac{248(10^9)\ pC_i}{86.6(10^9)\ gm} = 2.86\ \frac{pC_i}{gm}$

TABLE 6-1

SOIL AND RADON SOURCE REGIONS AND
THEIR DEFINING PARAMETERS

Region	Effective[a] Present Source Thickness (feet)	Average[b] Radium Concentration (pCi/gram)	Average Radon Emanation Fraction	Average Long-Term Moisture (% dry wt)	Average Radon Diffusion Coefficient (cm^2/s)
Borrow Soil	---	2.7	---	9.5	0.018
Main Tailings-Sands	40	103-409	.20	8.0	0.025
Main Tailings-Mixed	15	242-538	.24	15.0	0.0085
Main Tailings-Slimes	9	424-522	.20	22.0	0.0011
Old Acid Tailings	4.7	2023-2214	.24	20.0	0.0010
East Carbonate T.	10	1030-1601	.30	20.0	0.0025
Carbonate T.	7	415-921			
South Carbonate T.	5	1963			
Evap. Ponds	.2-2	37-345	.17	9.5	0.0195
Stockpile Area	1	53	.41	9.5	0.036
Mill Area	7	22	.41	10.0	0.0164
Windblown (W-1 & W-2)	.5-4	34	.32	9.5	0.014
Windblown (W-3)	1	76.	.30	9.5	0.036

[a] Total thickness for old acid tailings, evaporation ponds, stockpile area, and windblown areas; extent of sampling for all other areas. Ranges shown for measured, non-uniform regions.

[b] Ranges show maximum variation in averaged vertical concentration profiles.

Table B.2 Carb Tails Pit 2 Source Term

Building	Ra-226 activity (Ci)	Th-230 activity (Ci)	Volume (m^3)
Carbonate Leach	0.05	0.062	212.6
Old Yellowcake	---	---	37.3
Acid Leach	0.01	0.113	69.5
Resin Pulp	0.18	0.40	1014.4
Counter Current	0.008	0.006	6.4
New Yellowcake	---	---	0.5
TOTAL	0.248	0.581	1340.7

22Dec93
DA#2

RAECOBPC.BAS

OUTPUT INFORMATION : 08:56:01 12-23-1993
BOTTOM FLUX = 0 pCi/m^2/sec
AIR CONC. = 0 pCi/l
AARE LAYER 1 FLUX = 276.13 pCi/m^2/s
NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
7	50.0	.3133	9.5	1	.2	1.84	0.00753	1.94	0.0	0.587
6	61.0	.341	9.5	1	.2	1.78	0.01390	2.22	4.5	0.633
5	61.0	.37	9.5	2.86	.3	1.68	0.01900	4.52	9.3	0.681
4	61.0	.341	9.5	1	.2	1.78	0.01390	8.21	13.6	0.633
3	152.0	.37	9.5	2.86	.3	1.68	0.01900	16.63	31.1	0.681
2	73.0	.341	9.5	1	.2	1.78	0.01390	90.28	118.1	0.633
1	213.0	.411	20	921	.3	1.38	0.00250	198.77	259.8	0.503

```
********************************* TOP ***********************************
*- 7 -* BORROW                                                          *
*************************************************************************
- 6 -* BORROW                                                           *
*************************************************************************
- 5 -* DEBRIS                                                           *
*************************************************************************
*- 4 -* BORROW                                                          *
*************************************************************************
- 3 -* DEBRIS                                                           *
*************************************************************************
*- 2 -* BORROW                                                          *
*************************************************************************
- 1 -* TAILINGS                                                         *
*************************************************************************
******************************** BOTTOM *********************************
```

no cover required

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Engineers
Construction Managers

CALCULATION SHEET

JOB Reclamation SHEET NO. _____ CALC ~~TDA~~

CK'D BY _____ DATE 12/22/93 TITLE ~~DA #3~~ Source Term

Disposal Area #3

Radium Activity Calculation

Weston Activity Calculation

Weston 11/87 Report

$Ra\text{-}226(Ci) = 0.082 = 82(10^9)\,pCi$

Area $= 340{,}000\ ft^2$

5' debris $\quad 5'(340{,}000\ ft^2) = 1.7(10^6)\ ft^3$

Ap grav. 1.68 $\quad 1.68(62.4)\,1.7(10^6) = 178.2(10^6)\ ft^3$

$178.2(10^6)\,lb\left(\frac{453.6\,g}{lb}\right) = 80.8(10^9)\,g$

$\frac{82(10^9)\,pCi}{80.8(10^9)\,g} = 1.02\,pCi/g$

TABLE 6-1

SOIL AND RADON SOURCE REGIONS AND
THEIR DEFINING PARAMETERS

Region	Effective[a] Present Source Thickness (feet)	Average[b] Radium Concentration (pCi/gram)	Average Radon Emanation Fraction	Average Long-Term Moisture (% dry wt)	Average Radon Diffusion Coefficient (cm^2/s)	
					0.00753	
Borrow Soil	---	2.7	---	9.5	0.018	1.84
Main Tailings-Sands	40	103-409	.20	8.0	0.025	
Main Tailings-Mixed	15	242-538	.24	15.0	0.0085	
Main Tailings-Slimes	9	424-522	.20	22.0	0.0011	
Old Acid Tailings	4.7	2023-2214	.24	20.0	0.0010	1.54
East Carbonate T.	10	1030-1601	.30	20.0	0.0025	
Carbonate T.	7	415-921				
South Carbonate T.	5	1963				
Evap. Ponds	.2-2	37-345	.17	9.5	0.0195	
Stockpile Area	1	53	.41	9.5	0.036	
Mill Area	7	22	.41	10.0	0.0164	
Windblown (W-1 & W-2)	.5-4	34	.32	9.5	0.014	
Windblown (W-3)	1	76.	.30	9.5	0.036	

[a] Total thickness for old acid tailings, evaporation ponds, stockpile area, and windblown areas; extent of sampling for all other areas. Ranges shown for measured, non-uniform regions.

[b] Ranges show maximum variation in averaged vertical concentration profiles.

Table B.3 pH Pond Pit 3 Source Term

Building	Ra-226 activity(Ci)	Th-230 activity(Ci)	Volume (m^3)
Sand Filter	0.00014	0.009	3.5
Solvent Extraction	0.028	0.080	90.4
Storage Tanks	0.054	0.742	502.7[a]
TOTAL	0.082	0.831	596.6

[a]Excludes 924 m^3 of water in the CCD storage tanks.

22DEC93
DA#3

RAECOBPC.BAS

UTPUT INFORMATION : 08:48:59 12-23-1993
BOTTOM FLUX = 0 pCi/m^2/sec
IR CONC. = 0 pCi/l
ARE LAYER 1 FLUX = 480.01 pCi/m^2/s
LAYER 5 ADJUSTED TO GIVE FLUX OF 20 pCi/m^2/s FROM LAYER 5

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
5	74.4	.3133	9.5	1	.2	1.84	0.00753	20.00	0.0	0.587
4	6.0	.341	9.5	1	.2	1.68	0.01390	36.77	88.5	0.654
3	152.4	.37	9.5	1.02	.3	1.68	0.01900	40.63	97.3	0.681
2	28.0	.375	9.5	1	.2	1.68	0.01980	273.46	382.2	0.685
1	305.0	.411	20	1601	.3	1.38	0.00250	370.06	369.2	0.503

```
********************************* TOP *********************************
*- 5 -* PROPOSED COVER                                                 *
***********************************************************************
*- 4 -* BORROW                                                         *
***********************************************************************
*- 3 -* DEBRIS                                                         *
***********************************************************************
*- 2 -* BORROW                                                         *
***********************************************************************
*- 1 -* TAILINGS                                                       *
***********************************************************************
******************************** BOTTOM ********************************
```

24 ft. required

ANDERSON Engineering Company, Inc.
4655 South 1900 West St.
Roy, Utah 84067
Telephone 801-731-4596

Southwest Office
P.O. Box 2
Grants, New Mexico 87020

Long Beach Office
231-428-9344

Engineers
Construction Managers

CALCULATION SHEET

JOB Eliminate SHEET NO. _____ CALC SA

CK'D BY _____ DATE 5/11/02 TITLE Calc Tails. Hydrol Calc Surface

Undeveloped Quadrant (Typical surface conditions)

hydraulic length = 1200 ft.

Sheet vs sheet flow - use unit width

Area (1) = 1200 ft²
= 0.0275 ac
= 4.3044 (10⁻⁵) mi²

Use 100 ft width 1200 (100) = 120,000
= .0043 mi²

$S_{ave} = \frac{6626 - 6610}{1200} = 1.33\%$

CN = 90

$S = \frac{1000}{90} - 10$
$= 1.11$

$L = \frac{\lambda^{0.8}(S+1)^{0.7}}{1900\sqrt{Y}} = \frac{1200^{0.8}(1.11+1)^{0.7}}{1900\sqrt{1.33}} = 0.22$ hr.

initial abstraction

$I_a = 0.2S$
$= 0.2(1.11)$
$= 0.22$

```
**********                                    **********
*                                  *          *                                  *
*   FLOOD HYDROGRAPH PACKAGE (HEC-1)   *      *   U.S. ARMY CORPS OF ENGINEERS   *
*         FEBRUARY 1981              *       * THE HYDROLOGIC ENGINEERING CENTER *
*       REVISED 02 AUG 88            *       *       609 SECOND STREET          *
*                                  *          *     DAVIS, CALIFORNIA 95616      *
* RUN DATE  09/28/1993  TIME  15:07:56 *      *         (916) 551-1748           *
*                                  *          *                                  *
**********                                    **********

X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X              X
XXXXXXX  XXXX    X       XXXXX  X
X     X  X       X              X
X     X  X       X     X        X
X     X  XXXXXXX   XXXXX        XXX

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                        HEC-1 INPUT                                        PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

*** FREE ***
             1          ID   CARBONATE TAILINGS-OPTION B-RUNOFF NORTHEAST QUAD
             2          IT       3       0       0     300       0       0
             3          IO       3

             4          KK    STG1
             5          BA  0.0043
             6          PH   .0001       0    4.68    6.79    9.98   11.58   12.28   13.47
             7          LS     .22      90       0
             8          UD     .22

             9          KK    STG2
            10          BA  0.0002
            11          UD  0.0045
```

```
          12          KK    CM12
          13          HC       2
          14          ZZ
```

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             FEBRUARY 1981             *
*          REVISED 02 AUG 88            *
*                                       *
*  RUN DATE  09/28/1993  TIME  15:07:56 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 551-1748               *
*                                       *
*****************************************
```

CARBONATE TAILINGS-OPTION B-RUNOFF NORTHEAST QUAD

```
  3 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          3  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1   0  ENDING DATE
                    NDTIME       1457  ENDING TIME
                     ICENT         19  CENTURY MARK

                  COMPUTATION INTERVAL      .05 HOURS
                      TOTAL TIME BASE    14.95 HOURS

        ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT
```

*** ***

****

```
          *           *
4 KK      *     STG1  *
          *           *
          *************

          SUBBASIN RUNOFF DATA

5 BA        SUBBASIN CHARACTERISTICS
              TAREA         .00  SUBBASIN AREA

            PRECIPITATION DATA

6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                  ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
            5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
             4.68    6.79    9.98   11.58   12.28   13.47     .00     .00     .00     .00     .00     .00

                                                STORM AREA =      .00

7 LS        SCS LOSS RATE
              STRTL         .22  INITIAL ABSTRACTION
             CRVNBR       90.00  CURVE NUMBER
              RTIMP         .00  PERCENT IMPERVIOUS AREA

8 UD        SCS DIMENSIONLESS UNITGRAPH
              TLAG         .22  LAG

                                                    ***

                                                UNIT HYDROGRAPH
                                            24 END-OF-PERIOD ORDINATES
                    1.      3.      6.      8.      8.      8.      6.      4.      3.      2.
                    2.      1.      1.      1.      0.      0.      0.      0.      0.      0.
                    0.      0.      0.      0.

        ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     STG1

         TOTAL RAINFALL =   13.47, TOTAL LOSS =    1.25, TOTAL EXCESS =   12.22

        PEAK FLOW     TIME                      MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     14.95-HR
      +   (CFS)       (HR)
                        (CFS)
      +      57.      3.25                  6.          2.          2.          2.
                      (INCHES)          12.224      12.225      12.225      12.225
                      (AC-FT)              3.          3.          3.          3.

                      CUMULATIVE AREA =     .00 SQ MI
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 9 KK     *      STG2  *
          *            *
          **************

             SUBBASIN RUNOFF DATA

 10 BA         SUBBASIN CHARACTERISTICS
                    TAREA         .00  SUBBASIN AREA

               PRECIPITATION DATA

  6 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
               ..... HYDRO-35 .....   ................ TP-40 ................   ............ TP-49 ............
               5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR    12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                4.68   6.79   9.98   11.58   12.28   13.47     .00     .00     .00     .00     .00     .00

                                              STORM AREA =      .00

  7 LS         SCS LOSS RATE
                    STRTL         .22  INITIAL ABSTRACTION
                   CRVNBR       90.00  CURVE NUMBER
                    RTIMP         .00  PERCENT IMPERVIOUS AREA

 11 UD         SCS DIMENSIONLESS UNITGRAPH
                    TLAG         .00  LAG

                                                    ***

                                                  UNIT HYDROGRAPH
                                               5 END-OF-PERIOD ORDINATES
               2.       1.       0.       0.       0.

    ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION     STG2

    TOTAL RAINFALL =   13.47, TOTAL LOSS =    1.25, TOTAL EXCESS =   12.22

  PEAK FLOW     TIME                              MAXIMUM AVERAGE FLOW
                                          6-HR       24-HR       72-HR     14.95 ...
+   (CFS)       (HR)
                        (CFS)
+       6.      3.05                        0.          0.          0.          0.
                      (INCHES)         12.225      12.225      12.225      12.225
                      (AC-FT)             0.          0.          0.          0.
```

CUMULATIVE AREA = .00 SQ MI

*** ***

```
          **************
          *            *
12 KK     *      CM12  *
          *            *
          **************
```

13 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

*** *** *** *** ***

HYDROGRAPH AT STATION CM12

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)			
57.	3.25	6.	2.	2.	2.
		(INCHES) 12.224	12.225	12.225	12.225
		(AC-FT) 3.	3.	3.	3.

CUMULATIVE AREA = .00 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	STG1	57.	3.25	6.	2.	2.	.00		
HYDROGRAPH AT	STG2	6.	3.05	0.	0.	0.	.00		
2 COMBINED AT	CM12	57.	3.25	6.	2.	2.	.00		

57/100 = 0.57 cfs/ft

*** NORMAL END OF HEC-1 ***

Comb Jacks
Side slopes
10-7-93

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 57
S (FT/FT) ? .2

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
100	10	.033			
200	10	.033			

RESULTS

Y= 10.12 FT
A= 11.78 SF
P= 100.00 FT
V= 4.84 FPS
F= 2.48 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

Curb Tests

9/24/93
Surface

NATURAL CHANNELS

ABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

(CFS) ? 57
(FT/FT) ? .0133

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	100	.033			
100	100	.033			

RESULTS

Y= 100.27 FT
A= 26.56 SF
P= 100.00 FT
V= 2.15 FPS
F= 0.73 SUB-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

Carb Tests
Surface

ROCK SIZING BASED ON CORP OF ENGINEERS METHOD

REF: Hydrualic Design of Flood Control Channels
(EM1110-2-1601, 7/1970)

Description of variables used in program

29-Sep-93 02:50 PM

gamma=unit weight of stone (Saturated Surface Dry, SSD)
velocity=mean local vertical velocity (feet/second)
theta=angle of repose of rock (internally set at 40 degrees)

INPUT VARIABLES					CALCULATED QUANTITIES		
gamma	velocity	D(50)	depth of flow	channel slope	local shear	design shear	factor of safety
(pcf)	(fps)	(inches)	(feet)	(ft/ft)	tau(o)	tau	(must be >1
162.24	2.15	0.5	0.27	0.0133	0.08	0.17	2.21
162.24	2.15	1	0.27	0.0133	0.11	0.33	3.13
162.24	2.15	1.5	0.27	0.0133	0.13	0.50	3.71
162.24	2.15	2	0.27	0.0133	0.16	0.67	4.12

Carb Tailings
Side Slopes

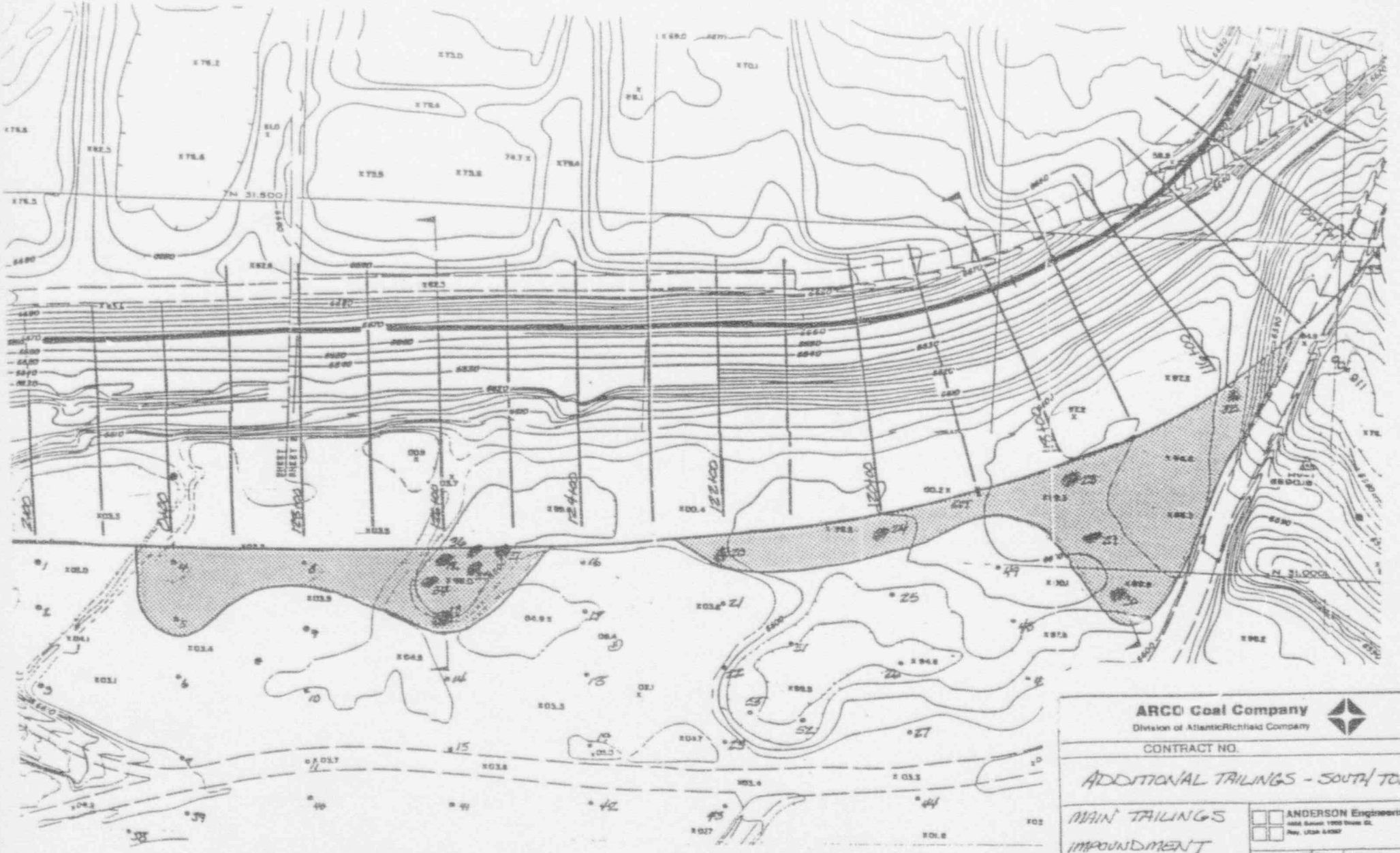
ROCK SIZING BASED ON THE STEPHENSEN METHOD

29-Sep-93 02:37 PM

q = unit discharge
theta = surface slope (degrees)
phi = angle of repose (degrees)
n = porosity of rip rap
C = 0.22 for pebble to 0.27 for crushed granite

INPUT VARIABLES						OUTPUT
q	theta	phi	n	sp. grav.	C	d(50) ft.
0.57	11.3	40	0.3	2.3	0.27	0.194239

= 2.3"



ARCO Coal Company
Division of AtlanticRichfield Company

CONTRACT NO.

ADDITIONAL TAILINGS - SOUTH TOE

MAIN TAILINGS IMPOUNDMENT

ANDERSON Engineering Co.

Drawn By: RMD | Approved:

LOG OF BOREHOLE PAGE 1 of ____

HOLE NUMBER 01

LOC. or COORDS. 2+20 +25' FROM TOE
GROUND ELEV. ____
ORIG. GROUND SURFACE ____
TOTAL DEPTH DRILLED ____
SAMPLING METHOD USUAL METHOD

DRILLING CONTRACTOR ____
RIG BUCKEYE - TRUCK
BIT 4 1/2"
CASING N/A
FLUID N/A

DATE START 8/5/91 FINISH 8/6/91
TIME ____
GEOPHYS LOG ____ YES ____
HOW LEFT BACKFILLED

LOCATION ____
LOGGED BY SS, BR
CLIENT ____
JOB NO. 4220

DEPTH	RET	LOSS	PENE RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0'				SANDY SOIL LIGHT BROWN		SANDY SOIL w/ BROKEN LIGHT GREY (LIMESTONE)
1.0'				CLAY TYPE SOIL - RED		CLAY SOIL RED LITTLE BROKEN ROCK
2.0'				LITTLE BLACK BASALT		BASALT ROCK BROKEN W/ INTER SOILS TO CLAY LOAM
2.5'				CONSOLIDATED ROCK		< .05 mr/hr EITHER HOLE APPEARS TO BE BKG NO CHANGE BETWEEN EITHER SIDE OF HOLE
						NO INTERFACE TRIGGER INTERVALS

LOG OF BOREHOLE

PAGE 2 of ____

HOLE NUMBER 02

LOC. or COORDS. 2+00 -

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD VISUAL, RDO mr

DRILLING CONTRACTOR IMC

RIG BACKHOE

BIT —

CASING —

FLUID —

	START	FINISH
DATE	8/5/91	8/6/91
TIME	____	____

GEOPHYS. LOG ___ YES ___ NO

HOW LEFT OPEN TO BE BACKFILLED

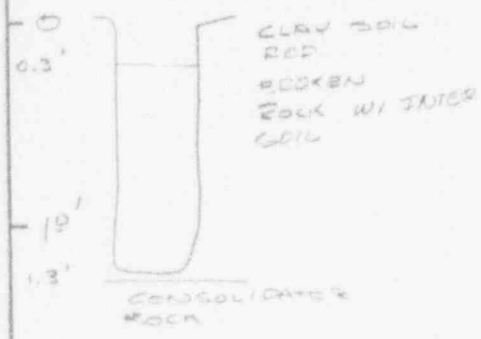
LOCATION ____

LOGGED BY R. L. EK

CLIENT ____

JOB NO. ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL
0					
0.3'					
19'					
1.3'					
20'					



DESCRIPTION

VEGETATION

CLAY LOAM SOIL — RED CLAY SOIL

BROKEN ROCK TO BASE OF HOLE - BASALT

BASALT ROCK W/ INTER SOIL, MIN CLAY CLAY

<0.05 mr/HR - BKG W/O CHANGE IN READING FROM 0 TO BASE OF HOLE

NO IDENTIFIABLE TAILINGS MATERIAL

LOG OF BOREHOLE

PAGE 2 of ____

HOLE NUMBER 013

LOC. or COORDS. 2+00

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD VISUAL / LEAD OF [illegible]

DRILLING CONTRACTOR IMC

RIG BACKHOE

BIT —

CASING —

FLUID —

	DUG START	FINISH
DATE	8/[illegible]/[illegible]	8/6/[illegible]
TIME	____	____

GEOPHYS. LOG ____ YES ____

HOW LEFT OPEN TO BE BACKFILLED

LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				0-0.6' SOIL CLAY		VEG.
						SHALLOW CLAY SOIL FAD - ZAD
1.0				CLAY BROKEN ROCK W/ SOIL		CLAY SOILS WITH BROKEN BASALT ROCK
						SIGNS OF [illegible] DEPOSITION IN SOILS
2.0						CLAY RED - [illegible]
						< 0.05 mr/HR = BKG FROM 0 - 2.4'
						NO VISABLE TAILINGS MATERIAL
4'				BROKEN ROCK W/ SOME BROKEN		SOLID ROCK WITH SOME BROKEN ROCK ON TOPPED AREA

LOG OF BOREHOLE PAGE 2 of ____

HOLE NUMBER 04

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD VISUAL (HAND AUGER)

DRILLING CONTRACTOR TMC

RIG BACKHOE

BIT —

CASING —

FLUID —

	LOG START	SURVEY FINISH
DATE	2/5/91	2/6/91
TIME	____	____

GEOPHYS. LOG ___ YES ___ NO

HOW LEFT OPEN TO BE BACKFILLED

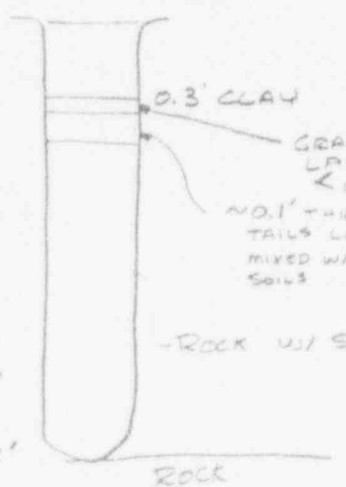
LOCATION ____

LOGGED BY ____

CLIENT ____

JOB NO. ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL
0					
1.2'					
2.2'					



DESCRIPTION

VEG

CLAY SOIL RED W/ NO ROCK

TAILS 0.25 MR/HR - GRAY → SANDY MATERIAL

BROKEN ROCK W/ INTERSOIL FINE CLAY LIGHT IN COLOR VERY LIGHT BROWN

BROKEN ROCK AND SOLID ROCK BASALT

0 - 0.3 FT 0.15 MR/HR
.0.4 TO .5 OR .6 0.1 MR/HR
0.6 TO BASE 0.1 MR/HR

TAILINGS IN HOLE NEAR SURFACE THIN LAYER

LOG OF BOREHOLE

PAGE 5 of ____

HOLE NUMBER 05

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

DEPTH DRILLED ____

SAMPLING METHOD VISUAL AND METER

DRILLING CONTRACTOR MC

RIG BACKHOE

BIT —

CASING —

FLUID —

	START	FINISH
DATE	8/5/91	8/6/91
TIME	____	____

GEOPHYS. LOG ___ YES ___ NO

HOW LEFT OPEN TO BE BACKFILLED

LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEGETATION
						RED CLAY — NO ROCK
0.5'						BROKEN ROCK W/ LIGHT COLORED SOIL MIXED THROUGHOUT TO FINE — MOSTLY CLAY TO THE BOTTOM
						Ca LAYER OVER ROCK IN BASE OF HOLE
						<0.05 mr/HR 0-0.5 FT
						OUTSIDE HOLE 0.1 TO 0.2 mr/HR
						THE HOLE HAS ELEVATED RAD READINGS BUT NO VISUAL TAILS

0 — CLAY < .1'

0.5' — BROKEN ROCK

Ca LAYER CONSOLIDATED ROCK

LOG OF BOREHOLE

HOLE NUMBER 06 PAGE 1 of ____

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD VISUAL / CAD

DRILLING CONTRACTOR TMC

RIG BACKHOE

BIT —

CASING —

FLUID —

	START	FINISH
DATE	8/5/91	8/6/91
TIME		

GEOPHYS. LOG YES

HOW LEFT OPEN TO BE BACKFILLED

LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG
						RED CLAY MATERIAL
						BROKEN BASALT ROCK IN LT BROWN
						MED TEX SOIL
1'						ROCK TO BROKEN ROCK AT BASE OF HOLE
1.1						
						<0.05 mr/HR 0-1.1'
2'						NO VISABLE TAILINGS MATERIAL

0-.2' CLAY

BROKEN ROCK, WI LIGHT COLORED SANDY SOIL

ROCK

LOG OF BOREHOLE

HOLE NUMBER 07 PAGE 1 of ____

LOC. or COORDS. ____
GROUND ELEV. ____
ORIG. GROUND SURFACE ____
TOTAL DEPTH DRILLED ____
SAMPLING METHOD VISUAL REC. METH

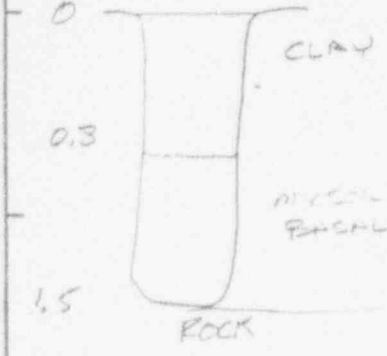
DRILLING CONTRACTOR T.I.S.
RIG BACK HOE
BIT —
CASING —
FLUID —

	START	FINISH
DATE	5/6/91	5/6/91
TIME		

GEOPHYS. LOG YES
HOW LEFT YES THEN BACKFILLED

LOGGED BY
LOCA
CLIE
JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG
						CLAY SOILS W/ LITTLE TO NO ROCK
						CLAY MATERIAL - RED IN COLOR
0.3						BASALT
						ROCK W/ INTER SOIL OF MED TEXTURE
						Cu DEPOSITS IN SOIL
						ROCK TO BROKEN BASALT ROCK BASE
1.5						0 < 0.5 mr/hr BKG 0-1.5'



LOG OF BOREHOLE

PAGE 5 of ____

HOLE NUMBER 05

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD USEAL RAD METER

DRILLING CONTRACTOR TMC

RIG PACK HOE

BIT ____

CASING ____

FLUID ____

	START	FINISH
DATE	[illegible]	2/6/91
TIME	____	____

GEOPHYS LOG ____ YES ____

HOW LEFT BACKFILL

LOGGED BY ____ LOCATION ____ CLIENT ____ JOB NO. ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG
						THIN LAYER OF TAILINGS - GRAY IN C
						0 - 0.2'
						RED CLAY SOIL W/ LITTLE ROCK (BASALT)
0.7'						ROCK AND BROKEN ROCK DARK GREY
10'						
						0 - 0.2' 0.25 MR/HR
20'						0.2 TO 0.5' 0.15 MR/HR
						MR/HR
						THIN TAILS LAYER NEED SURFACE

0 - 0.2 FT APPEARS TO BE TAILS

0.5' CLAY SOIL RED

LOG OF BOREHOLE

HOLE NUMBER 09 PAGE 1 of ____

LOC. or COORDS. ____
GROUND ELEV. ____
ORIG. GROUND SURFACE ____
TOTAL DEPTH DRILLED ____
SAMPLING METHOD VISUAL MR METER

DRILLING CONTRACTOR TMC
RIG BACKHOE
BIT —
CASING —
FLUID —

	START	FINISH
DATE	2/5/91	2/6/91
TIME	____	____

GEOPHYS LOG ___ YES ___
HOW LEFT TO BE BACKFILLED

LOCATION
LOGGED BY
CLIENT
JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				CLAY SOIL		VEG CLAY SOIL - RED
0.4				BROKEN ROCK W/ INTER SOIL - CLAY LIGHT BROWN		LT BRN SOIL MED-FINE TO MED-IN TEXT W/ BROKEN BASALT ROCK
1						
2						SOLID & BROKEN ROCK HOLE BASE
2.2				SOLID/CON ROCK		@ 2.2 <0.05 mr/hr NO VISABLE TAILINGS

LOG OF BOREHOLE

PAGE ____ of ____

HOLE NUMBER 10

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD VISUAL MT RAD METER

DRILLING CONTRACTOR TMC

RIG BACKHOE

BIT —

CASING —

FLUID —

	START	FINISH
DATE	2/5/91	2/6/91
TIME	____	____

GEOPHYS. LOG ____ YES ____

HOW LEFT BACKFILL

LOGGED BY DV

JOB NO. ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						BROKEN ROCK ON SURFACE - VEG
				CLAY SOIL RED		RED CLAY SOIL W/ LITTLE TO NO ROCK
1'				CA FELDSPAR WHITE		CA LAYER - THIN ABOUT 1" THICK
				CLAY SOIL		CLAY SOIL W/ SOME BROKEN ROCK
2'						BROKEN BASALT ROCK W/ INTER SOIL
				BROKEN ROCK W/ CLAY SOIL		LT BRN MOIST TEXT
3'						SOLID TO BROKEN BASALT ROCK BASE OF
						0 - 3.0' < 0.05 mr/HR
						DECREASED READ AS DEPTH INCREASED
						NO VISABLE TAILS
3.0						
ROCK						

LOG OF BOREHOLE

PAGE ____ of ____

HOLE NUMBER 11

LOC. or COORDS.	DRILLING CONTRACTOR TMC	START / FINISH
GROUND ELEV.	RIG BAC(K)HOE	DATE ____ / 8-8-91
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS LOG ____ YES ____
SAMPLING METHOD	FLUID	HOW LEFT OPEN

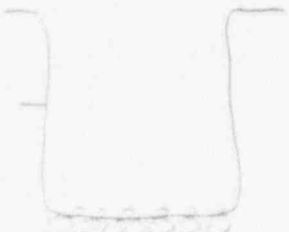
LOCATION

LOGGED BY [illegible]

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYMBOL	DESCRIPTION
0						NO VEGETATION ~/ NEXT TO ROAD
0.5'						0' - 0.5': LT BRN. FINE SANDY TEXTURE SOIL. TRACE GRAVEL
1.0'						0.5' - 1.0': REDDISH BROWN, CLAYEY SOIL. TRACE FINE GRAVEL
						1.0' / BOTTOM: BASALT COBBLES & FRACTURED SUB ANGULAR ROCK. SOME STAINED W/ CARBONATION OR CALCIFICATION. BEDDED IN REDDISH BROWN, CLAY/SAND MIXTURE



HOLE NUMBER 12 LOG OF BOREHOLE PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR TMC

RIG BACKHOE

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	5-8-91
TIME	___	___

GEOPHYS. LOG ___ YES ___

HOW LEFT OPEN

LOGGED BY MD / KECK

JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEGETATION
						0'-1.0' LT BROWNISH TAN SAND - SILT MIXTURE, APPEARS TO BE IMPORTED FILL MATERIAL, TRACE BASALTIC GRAVEL
1.0						1'-0"/BOTTOM: GREY FINE SAND WITH LT BROWN CLAY LUMPS, APPEARS TO BE TUFFACEOUS WITH WOOD.

LOG OF BOREHOLE

HOLE NUMBER 13 PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

DEPTH DRILLED ___

SAMPLING METHOD USUAL MY METER

DRILLING CONTRACTOR TMC

RIG BACKHOE

BIT —

CASING —

FLUID —

	START	FINISH
DATE	3/5/91	3/6/91
TIME		

GEOPHYS. LOG ___ YES

HOW LEFT BACKFILL

LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG.
						LT BRN MED TEX SOIL
						LIMESTONE - BLOCKY BROKEN TO BE CHANNEL IS MIXED INTO MED TEXT SOIL 0.4 - 1.6
1'						
						RED CLAY SOIL
						GRAY THICS MIXED W/ SOIL
2'						
						0-0.4' 0.8 mr/HR
						0.4 - 1.6 1.2 mr/HR
3'						1.6 - 3.0 2.5 mr/HR - GRAY THICS
						3.0 - 4.2 1.5 mr/HR
4'						
5'						

0.4' LIGHT COLORED MED TEXTURED SOIL - SOME W/ BROKEN LIME STONE (GRAVEL)

1.2 mr/HR

1.6

RED CLAY SOIL 2

THICS LAYER GRAY 2.5 W/ SOIL

RED CLAY LAYER

3.8'

BROKEN ROCK W/ SOIL

RED CLAY ON BOTTOM

4.2' TOTAL DEPTH NO ROCK

LOG OF BOREHOLE

HOLE NUMBER 14 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___
HOW LEFT ___

LOCATION
LOGGED BY
CLIENT
JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				CLAY SOIL & ROCK		
1.0'				BROKEN ROCK W/ LIGHT BROWN CLAY SOIL		< 0.05 mr/HR 0 - 2.3' NO TAILS VISABLE
2.0'						
2.3'				ROCK		

LOG OF BOREHOLE

HOLE NUMBER 15 PAGE ____ of ____

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

SAMPLING METHOD ____

DRILLING CONTRACTOR ____

RIG ____

BIT ____

CASING ____

FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS. LOG ____ YES ____ NO

HOW LEFT ____

LOCATION ____ LOGGED BY ____ CLIENT ____ JOB NO. ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
				CLAY SOIL RED		
0.8						
1.0'				BROKEN ROCK W/ LIGHT BROWN SOIL & CLAY		
1.7'				ROCK		
2.0'						

0 - 1.7' < 0.05 mr/HR DECREASING WITH DEPTH

NO VISIBLE TAILS

LOG OF BOREHOLE

HOLE NUMBER 16 PAGE ___ of ___

LOC. or COORDS. 126 +00 -25'
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

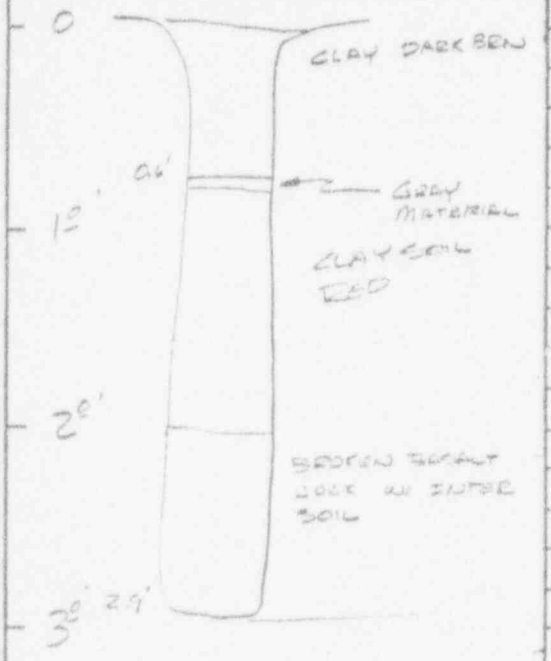
DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG YES ___
HOW LEFT ___

LOCATION
LOGGED BY
CLIENT
JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
1'						GRAY LAYER
2'						
3'						



BKG 0.08 SURFACE
<0.05 mr/HR DECREASE W/
DEPTH
GRAY LAYER 0.12

LOG OF BOREHOLE

HOLE NUMBER 17 PAGE ____ of ____

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS LOG ___ YES ___ N
SAMPLING METHOD	FLUID	HOW LEFT

LOGGED BY

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				CLAY SOIL		
0.4'						
1						
1.6						
2						0 – 2.4' 0.05 mr/hr
2.4				ROCK		

HOLE NUMBER 18 LOG OF BOREHOLE PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR ___

RIG ___

BIT ___

CASING ___

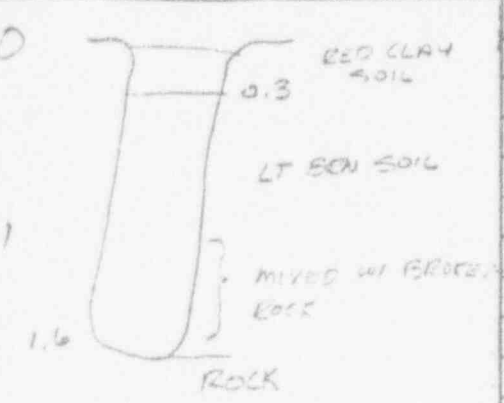
FLUID ___

	START	FINISH
DATE		
TIME		

GEOPHYS. LOG ___ YES ___

HOW LEFT ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



0 - 1.6' < 0.05 mr/H

LOCATION ___

LOGGED BY ___

CLIENT ___

JOB NO. ___

LOG OF BOREHOLE

HOLE NUMBER 19 PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR ___

RIG ___

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___

HOW LEFT ___

LOGGED BY ___

JOB NO. ___

DEPTH	RET	LOSS	PENE RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL
0.7						LT BRN SOIL W/ SOME WEATHERED ROCK
1.1						
1°						
2°						0-1.1' < .05 mr/HR

LOG OF BOREHOLE

HOLE NUMBER 20 THRU 25 PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG YES
SAMPLING METHOD	FLUID	HOW LEFT

LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY
0.4						LT BRN MIX W/ RED CLAY
0.6						
1						
2						0-0.6' < 0.07 MR/HR NO TAILS
						NOTE NEARBY HOLE @ N 121+00 - 41' CONTAINS TAILS @
0.4						0.3 @ 0.4' TO 0.8'
0.8						
2						

LOG OF BOREHOLE

HOLE NUMBER 21 - 25 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___
HOW LEFT ___

LOCATION ___ LOGGED BY ___ CLIENT ___ JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL SOME BROKEN BASALT
1						LT BRN W/ BROKEN BASALT
1.4				ROCK	BASALT	
2						0-1.4' < 0.05 mr/hr NO TAILS VISIBLE

LOG OF BOREHOLE

HOLE NUMBER 22 -[illegible] PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT

LOGGED BY

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED SOIL
						0.2 RED & LT BRN W/ BROKEN ROCK
1						1.0 RED SALT ROCK
2						

0 - 1.0 < 0.05 mr/HR
NO TAILS VISABLE

LOG OF BOREHOLE

HOLE NUMBER 23 PAGE ___ of ___

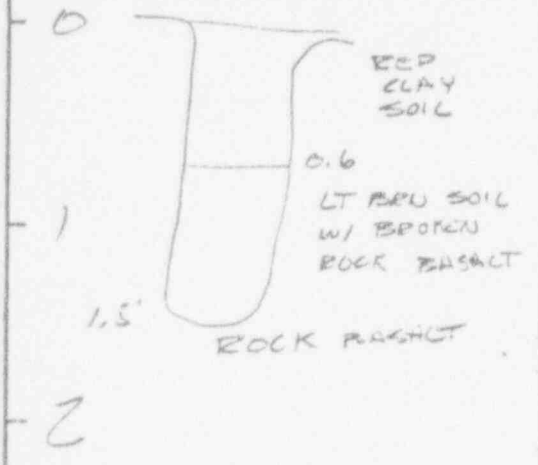
LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___ N
HOW LEFT ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



0-1.5' <0.05 mr/HR
NO THILS VISIBLE

LOGGED BY ___
JOB NO. ___

LOG OF BOREHOLE

HOLE NUMBER 24 PAGE ___ of ___

LOC. or COORDS. 120+00 -25	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				RED CLAY		
0.5				Ca LAYER		
1.0'				RED CLAY W LT BRN SOIL SOME BROKEN ROCK		
1.1				ROCK & BROKEN ROCK INTER BDS		
2.0'				HOT TO ROCK		

0-1.1 <0.1 in/HR

BOTTOM OF HOLE 0.12

NOT SURE OF TAILS CONTENT

LOGGED BY ___

JOB NO. ___

LOG OF BOREHOLE

HOLE NUMBER 25 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___
GEOPHYS. LOG	YES	
HOW LEFT	___	

LOCATION Riverbank Pit II
LOGGED BY ___
CLIENT ___
JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
						RED CLAY
0.7						LT BRN W/ BROKEN BASALT
						ROCK
1°						
						0 - 0.7' < 0.07 MR/HR
						N/O VISIBLE THKS
2°						

LOG OF BOREHOLE

PAGE ____ of ____

HOLE NUMBER 26

LOC. or COORDS. _____

GROUND ELEV. _____

ORIG. GROUND SURFACE _____

TOTAL DEPTH DRILLED _____

SAMPLING METHOD _____

DRILLING CONTRACTOR _____

RIG _____

BIT _____

CASING _____

FLUID _____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS LOG ... YES ___

HOW LEFT _____

LOCATION _____

LOGGED BY _____

CLIENT _____

JOB NO. _____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
1						
2						0-2.4 < 0.05 mr/HR
2.4				MIXED ROCK		NO VISIBLE PICS
3						

LOG OF BOREHOLE

PAGE ____ of ____

HOLE NUMBER 27

LOC. or COORDS. _____

GROUND ELEV. _____

ORIG. GROUND SURFACE _____

TOTAL DEPTH DRILLED _____

SAMPLING METHOD _____

DRILLING CONTRACTOR _____

RIG _____

BIT _____

CASING _____

FLUID _____

	START	FINISH
DATE		
TIME		
GEOPHYS. LOG	YES	
HOW LEFT		

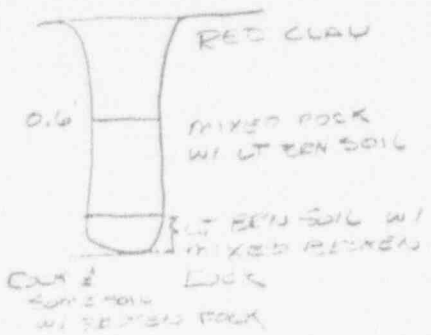
LOCATION _____

LOGGED BY _____

CLIENT _____

JOB NO. _____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
0.6						
1						
2						



0-1' < 0.05 inc/HR

No Drainage Hole

LOG OF BOREHOLE

HOLE NUMBER 28 PAGE ___ of ___

LOC. or COORDS. 113+30 — 25

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR ___

RIG ___

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___
GEOPHYS. LOG	___	___
HOW LEFT	___	

LOCATION ___ LOGGED BY ___

CLIENT ___ JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG
						RED CLAY SOIL NO ROCK
0.4						RED/GRAY SOIL MED TEXT
1.0						RED CLAY SOIL NO ROCK
1.8						LT BROWN MED TEXT SOIL NO ROCK
2.5						LT BROWN MED TO SANDY SOIL NO ROCK
2.9						GRAY TAILS
3.9						SURFACE <0.05 mr/HR PROFILE INCREASES W/ DEPTH
						GRAY 2.9-3.9' 1.2 mr/HR TAILS N 1' THICK

LOG OF BOREHOLE

PAGE ____ of ____

HOLE NUMBER 29

LOC. or COORDS. TOE - 125'

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD ____

DRILLING CONTRACTOR ____

RIG ____

BIT ____

CASING ____

FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____
GEOPHYS. LOG	____	____
HOW LEFT	____	____

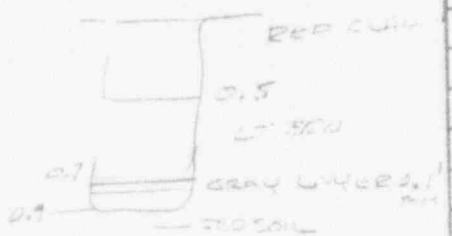
LOCATION Blueberry Hill

LOGGED BY ____

CLIENT ____

JOB NO. ____

DEPTH	RE-	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
						RED CLAY SOIL
						LT BRN SOIL W/ BROKEN PHYLLITE ROCK
						GRAY LAYER @ ~0.1' THICK
						RED SOIL W/ BROKEN PHYLLITE
						0 - 0.7 0.9 MIN/FT
						0.7 - 0.8' 0.15 MIN/IN GRAY LAYER
						BOTTOM 0.15 MIN/IN
						TAILS @ 1' TO 0.8'



LOG OF BOREHOLE PAGE ___ of ___

HOLE NUMBER 30

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___
HOW LEFT ___

LOCATION ___
LOGGED BY ___
CLIENT ___
JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
2.5						LT BROWN SILTY SAND
1.0'						LT BROWN SILTY SAND W/ NO ROCK
1.5						RED CLAY W/ SOME BROKEN ROCK
1.8						BASE BROKEN FLAT ROCK
2.0'						

0 TO 0.5 0.15 MR/HR
0.5 TO 1.5 0.40 MR/HR
1.5' TO 1.8 0.15 MR/HR

PIPE TO TAILS

HOLE NUMBER 51

LOG OF BOREHOLE

PAGE ____ of ____

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT

LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				RED CLAY		RED CLAY W/ BROKEN LIMESTONE
				BROKEN LIMESTONE		RED = 3-4"
1'						
				1.6'		
				LT BRN SOIL		LT BRN VERY FINE SOIL W/ LITTLE TO
2'						NO ROCK
				2.5'		
				RED CLAY		RED CLAY SOIL
3'						
4'				3.9'		NOT TO FOOT BASE
				NOT TO SOLID ROCK		
						3-3.9 <0.05 MR/HR
						NO VISIBLE TRACS

LOG OF BOREHOLE

HOLE NUMBER 32 PAGE ___ of ___

LOC. or COORDS. 116+00-25'
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___
HOW LEFT ___

LOCATION RIDGE
LOGGED BY ___
CLIENT ___
JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG.
						RED CLAY SOIL NO ROCK
1'				RED CLAY		
2'				20		GRAY TAILINGS MATERIAL NO ROCK
				GRAY MATERIAL		
3'						
4'				40 NOT TO SCALE		HOLE NOT COMPLETED TO EXIT FACE
						0-2' 0.1 mr/HR THICKER DEPTH
5'						2'-4' 0.9 mr/HR GRAY TAIL

LOG OF BOREHOLE

HOLE NUMBER 53 PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR TMC

RIG RACKWAE

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	8-8-91
TIME	___	___

GEOPHYS. LOG ___ YES ___

HOW LEFT OASIS

LOGGED BY ___ LOC ___

JOB NO. ___ LIEN ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0'						VEGETATION / SOIL & ROOTS
						0'-1.0': LT GREY SAND, TRACE ROOTS & CLAY LUMPS, VERY FINE, MOD. LOOSE
1.0'						1.0'-1.5': RED CLAY AND LT GREY SAND LENSES, VERY THIN, STRATIFIED, COARSE
						1.5'-2.1' LT GREY SAND, STRATIFIED WITH DARK DECOMPOSED ORGANIC, FINE
2.0'						2.1'-3.8' (3.7') VERY LT WOOD BROWN SAND, SOFT, MOD. FINE POORLY GRADED
3.0'						
3.8'						

LOG OF BOREHOLE

HOLE NUMBER 34 PAGE ____ of ____

LOC. or COORDS. LOW AREA
GROUND ELEV. ____
ORIG. GROUND SURFACE ____
TOTAL DEPTH DRILLED ____
SAMPLING METHOD ____

DRILLING CONTRACTOR ____
RIG ____
BIT ____
CASING ____
FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS ID? YES
HOW LEFT ____

LOCATION
LOGGED BY
CLIENT
JOB NO.

DEPTH	RET.	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				RED CLAY ALT LIGHT COLORED SOIL W/ BROKEN LIMESTONE ROCK MED TEXTURE		
1'						
2'				SLIMES TAILS GRAY		
3'				CLAY SOIL RED		
						BKG 0.1 mr/HR
						0-2' 0.1 TO 1.0 mr/HR .1 ON SURFACE
						2-2.5 ± 1.9 mr/HR
4'						2.5-6.1 0.6 mr/HR DERRICK IN BETWEEN AWAY FROM TAILS
5'						
				SOME BROKEN BASALT ROCK		
6'				6.1 BROKEN ROCK BASALT		

LOG OF BOREHOLE

HOLE NUMBER 35 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___
GEOPHYS LOG		YES /
HOW LEFT	___	

LOGGED BY ___ LOCATION ___ CLIENT ___ JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				THIN SOIL CLAY - RED		
1.0'				LIGHT BROWN ROCK W/ [illegible] TONED / REDDISH COLOR		
1.7'						
2.0'				TAILS [illegible]		
2.6				BROKEN ROCK W/ SOIL		
3.2'						

SURFACE < 0.05 mR/HR
0 - 1.7 0.2 mR/HR
1.7 TO 2.6 1.5 mR/HR

LOG OF BOREHOLE

HOLE NUMBER 36 PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR TMC

RIG RACKMOB

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	8.23
TIME	___	___

GEOPHYS. LOG ___ YES ___

HOW LEFT ___

LOCATION ___ LOGGED BY WARD/HECT

JOB NO. ___ CLIENT ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0'						LIGHT VEGETATION
0.2'						0'-0.2', BROWN SAND LOAM LOOSE
0.5						0.2'-1.2', VERY LT TAN SILTY SAND,
						STRATIFIED W TOP 0.5', LOWER PORTION
						NOT STRATIFIED, CONTAINING CALICHE
						GRAVEL AND POCKETS OF DARK BROWN SILT
1.0						LOAM SAND & LOAM.
1.2						
						1.2'-3.6', LIGHT TAN SILTY SAND, APPEARS
2.0						TO BE ALLUVIAL FILL STRATIFIED, TO
						FINE SUBANGULAR GRAINS
						3.6' (BOTTOM) FINE GREY SAND WITH LT. BROWN
						CLAY LOAM. ADDED TO 15 TOTAL
						WEIGHT OF SAMPLE
3.0						
3.6						

LOG OF BOREHOLE

HOLE NUMBER 37 PAGE ___ of ___

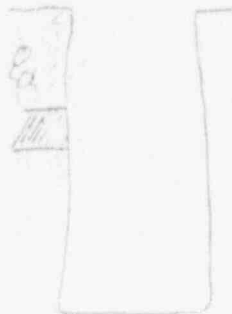
LOC. or COORDS.	DRILLING CONTRACTOR TMC	START / FINISH
GROUND ELEV.	RIG BACKHOE	DATE ___ / 8-...
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT OPEN

LOGGED BY MAD / ...

JOB NO.

CLIENT

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYMBOL	DESCRIPTION
0'						VEGETATION
						0'-0.5': SANDY BROWN GREY WITH GRAVEL & ROOTS
0.5' / 0.7'						0.5'-0.7': REDDISH GREY SAND DIKE, WITH DK BROWN CLAY LUMPS - TAILINGS
1.0'						0.7'-1.6' (BOTTOM): DK BROWN CLAYEY SAND Prob. Slimes APPEARANCE BUT NOT WET
1.6'						



LOG OF BOREHOLE

HOLE NUMBER 58 PAGE ____ of ____

LOC. or COORDS. ____
GROUND ELEV. ____
ORIG. GROUND SURFACE ____
TOTAL DEPTH DRILLED ____
SAMPLING METHOD ____

DRILLING CONTRACTOR ____
RIG ____
BIT ____
CASING ____
FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS. LOG ____ YES ____ NO
HOW LEFT ____

LOCATION ____ LOGGED BY ____ CLIENT ____ JOB NO. ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL NO ROCK
0.6'						
1						
						0-0.6' <0.05 mr/HR
						NO TAILS

HOLE NUMBER 39 LOG OF BOREHOLE PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG yes
SAMPLING METHOD	FLUID	HOW LEFT

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL
0.6						EOH
1						

0 - 0.6' @ 2.06 mR/HR

NO VISIBLE FILE

LOCATION

LOGGED BY

CLIENT

JOB NO.

HOLE NUMBER 40

LOG OF BOREHOLE

PAGE ____ of ____

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

TOTAL DEPTH DRILLED ____

SAMPLING METHOD ____

DRILLING CONTRACTOR ____

RIG ____

BIT ____

CASING ____

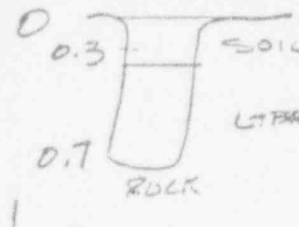
FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS. LOG -- YES

HOW LEFT ____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



1

2

0 - 0.7' < 0.05 mr/HR

NO VISIBLE TAILS

LOCATION ____

LOGGED BY ____

CLIENT ____

JOB NO. ____

HOLE NUMBER 41 LOG OF BOREHOLE PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

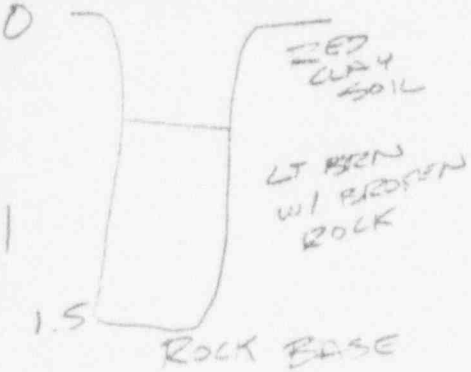
DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___
HOW LEFT ___

LOGGED BY ___
JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						
1						
2						
3						

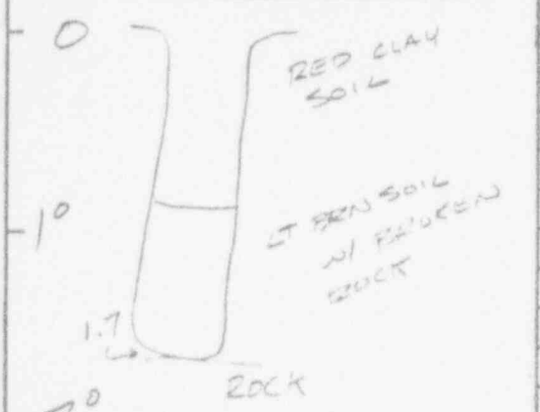


0-1.5' < 0.05 mr/hr
NO WATER TABLE

HOLE NUMBER 42 LOG OF BOREHOLE PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
[illegible] DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



0-1.7 < 0.05 mr/HR

NO TAILS VISIBLE

LOGGED BY ___ LOCATION ___ CLIE... JOB NO. ___

LOG OF BOREHOLE

HOLE NUMBER 43 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

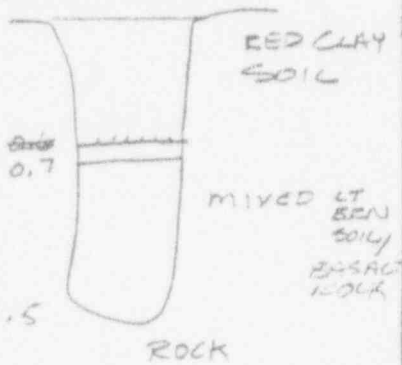
DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS LOG ___ YES ___ NO
HOW LEFT ___

LOCATION ___ LOGGED BY ___ JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL
0.7						MIXED LT BRN SOIL/ FRAG ROCK
1						
1.5				ROCK		
2						0-1.5' < 0.05 ppm IN HD N/D THICS VISIBLE



HOLE NUMBER 44

LOG OF BOREHOLE

PAGE ____ of ____

LOC. or COORDS. ____

GROUND ELEV. ____

ORIG. GROUND SURFACE ____

DEPTH DRILLED ____

SAMPLING METHOD ____

DRILLING CONTRACTOR ____

RIG ____

BIT ____

CASING ____

FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS. LOG ____ YES

HOW LEFT ____

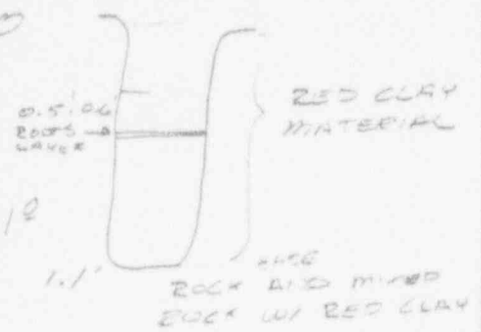
LOCATION

LOGGED BY

CLIENT

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



0 - 1.1 < 0.05 mr/HR

NO VISABLE TAILINGS

HOLE NUMBER 45 LOG OF BOREHOLE PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						VEG
						RED CLAY
						Ca LAYER
1'						LT BRN TIED TEXTURE SOIL W/ BROKEN FLINT
						0-1.2 <0.05 ppm HC
2'						NO TILES

LOCATION

LOGGED BY

CLIENT

JOB NO.

LOG OF BOREHOLE

HOLE NUMBER 46 PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GEOPHYS. LOG ___ YES ___
SAMPLING METHOD	FLUID	HOW LEFT

LOGGED BY ___ LOCATION ___ JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				RED CLAY		VEG RED CLAY SOIL
0.4				LT BRN MOIST WI BROKEN ROCK		
0.6				ROCK		LT BRN MED TO SOIL WI FRAGMENTS BROKEN ROCK
1						SOLID BROKEN BASALT FLT
2						D-0.6'<0.05 FIRM NO SAMPLE TAKEN

LOG OF BOREHOLE

HOLE NUMBER 47 PAGE ___ of ___

LOC. or COORDS.	DRILLING CONTRACTOR	START / FINISH
GROUND ELEV.	RIG	DATE
ORIG. GROUND SURFACE	BIT	TIME
TOTAL DEPTH DRILLED	CASING	GLOPH. LOG YES
SAMPLING METHOD	FLUID	HOW LEFT

DEPTH	RET	LOSS	PENE RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				RED CLAY		RED CLAY SOME BROKEN ROCK
0.6						ROCK AND SOME BROKEN FRACTURED W/ INTER SOIL LT BRN COARSE SOIL MED TEX
						0-0.6 <0.05 MR/HR NO VISABLE TRACS

LOGGED BY ___ CAT ___

JOB NO. ___ ENT ___

HOLE NUMBER 48

LOG OF BOREHOLE

PAGE ___ of ___

LOC. or COORDS. _____

GROUND ELEV. _____

ORIG. GROUND SURFACE _____

TOTAL DEPTH DRILLED _____

SAMPLING METHOD _____

DRILLING CONTRACTOR _____

RIG _____

BIT _____

CASING _____

FLUID _____

	START	FINISH
DATE		
TIME		

GEOPHYS. LOG ___ YES ___

HOW LEFT _____

LOGGED BY _____

JOB NO. _____

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL W/ SOME FRAGMENTS BASALT
0.6'						SOLID AND BROKEN BASALT ROCK W/ SOME INTER SOIL - MIXED LT BRN W/ RED CLAY
1.0'						0 - 0.6 < 0.05 MR/HR NO VISABLE TAILS
2.0'						

LOG OF BOREHOLE

HOLE NUMBER 49 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___
GEOPHYS. LOG	___	___
HOW LEFT	___	

LOCATION ___ LOGGED BY ___
CLIENT ___ JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						RED CLAY SOIL
1'						RED CLAY MIXED W/ LT BRN SOIL & LIMESTONE FROM BROKEN
2'						BROKE BALSALT DUE MACS SOLID ROCK
						0 - 1.2' < 0.05 MR/HR NO TAILS VISABLE

LOG OF BOREHOLE

HOLE NUMBER 50 PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR TM

RIG REVERSE

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	8-2
TIME	___	___

GEOPHYS. LOG ___ YES ___

HOW LEFT OPEN

LOCATION ___

LOGGED BY MD / AGE

JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0'						VEGETATION W/ SOME BASALT COBBLES ON SURFACE
0.6						0'-0.6': LT TAN SANDY LOAM, ROOTS, SOME ANGULAR GRAVEL, SUBANGULAR
0.8'						0.6' - 0.8': DARK BROWN CLAYEY SANDS, ANGULAR & SUBANGULAR COBBLES OF BASALT CLASTS, BROWN.

LOG OF BOREHOLE

HOLE NUMBER 51 PAGE ___ of ___

LOC. or COORDS. ___
GROUND ELEV. ___
ORIG. GROUND SURFACE ___
TOTAL DEPTH DRILLED ___
SAMPLING METHOD ___

DRILLING CONTRACTOR ___
RIG ___
BIT ___
CASING ___
FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS LOG YES
HOW LEFT ___

LOGGED BY ___
LOC ___
JOB NO. ___
CLIENT ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0						APPEARS UNDISTURBED - NO FILL
1'						
2'						
2.3						0-2.3' < 0.05 NO VISABLE TAILS
3'						
4'						

RED SOIL W/ SOME BROKEN ROCK

ON SOIL & MIXED ROCK

LOG OF BOREHOLE

HOLE NUMBER 52 PAGE ___ of ___

LOC. or COORDS. ___

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR ___

RIG ___

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ YES ___

HOW LEFT ___

LOGGED BY ___

JOB NO. ___

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION
0				RED CLAY W/ SOME BROKEN ROCK		UNDISTURBED - NO FILL
1'						
1.6				BROKEN MIXED ROCK SOIL		
2'						0-1.6' < 0.05 MR/HR
						NO VISABLE TRACS
3'						

LOG OF BOREHOLE

HOLE NUMBER 53 PAGE ____ of ____

LOC. or COORDS. ____
GROUND ELEV. ____
ORIG. GROUND SURFACE ____
TOTAL DEPTH DRILLED ____
SAMPLING METHOD ____

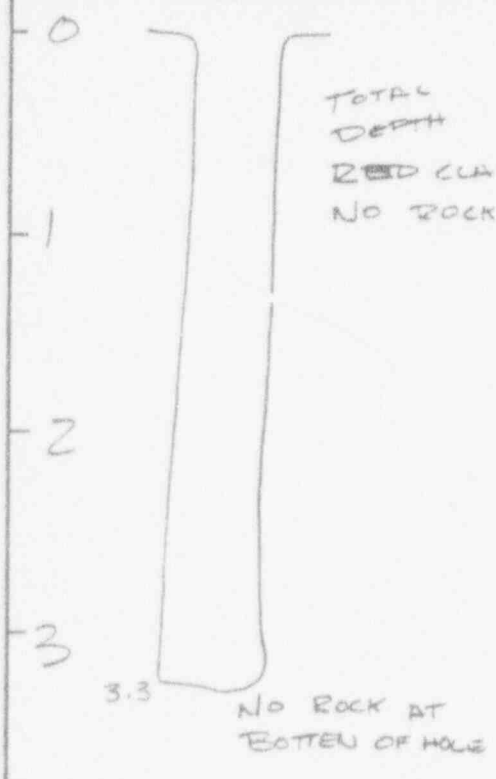
DRILLING CONTRACTOR ____
RIG ____
BIT ____
CASING ____
FLUID ____

	START	FINISH
DATE	____	____
TIME	____	____

GEOPHYS. LOG ____ YES ____
HOW LEFT ____

LOCATION
LOGGED BY
CLIENT
JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



0-3.3 < 0.05 mr/HR
NO TAILS

LOG OF BOREHOLE

HOLE NUMBER CUT 119+00 — PAGE ___ of ___

LOC. or COORDS. 119+00 + 20'

GROUND ELEV. ___

ORIG. GROUND SURFACE ___

TOTAL DEPTH DRILLED ___

SAMPLING METHOD ___

DRILLING CONTRACTOR ___

RIG ___

BIT ___

CASING ___

FLUID ___

	START	FINISH
DATE	___	___
TIME	___	___

GEOPHYS. LOG ___ Yes ___

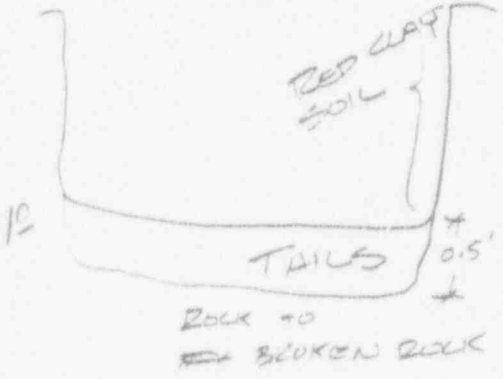
HOW LEFT ___

LOCATION

LOGGED BY

JOB NO.

DEPTH	RET	LOSS	PENE. RATE	ROCK TYPE	SYM-BOL	DESCRIPTION



0 - 10' ~~0.3 mr/hr~~ 0.09 mr/hr

TAILS 0.3 mr/hr

GRAY CHIPS TAILS

NOTE TAILS IN CUT @ 11+00

ANDERSON Engineering Company
4655 South 1900 West St.
Roy, Utah 84067
Telephone 801-731-4596

SAMPLING METHOD:
Hollow Stem Auger
Cuttings only

LOGGED BY:
J. HASTINGS

ARCO COAL COMPANY

BLUEWATER MILL

BORROW MATERIAL

BORING NO. Pit 88 B2-A

SHEET 1 OF 2

DATE STARTED: 7-10-91

DATE COMPLETE:

TOTAL DEPTH: 15'

SURFACE ELEV:

X: Y:

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
B2-1	2'			SC	Sandy clay soil
B2-2		10		SP	GRAY TAILINGS SAND - COARSE - MED
		21		SC	SANDY clay - light gray brown color
					GRAY TAILINGS SAND - almost gravel
					5-10' TAILINGS SAND - Light gray coarse to medium Poorly consolidated -
					NO RECOVERY
					Bottom of Hole at 15'

ANDERSON Engineering Company
4655 South 1900 West St.
Roy, Utah 84067
Telephone 801-731-4596

SAMPLING METHOD: Hollow Stem Auger - Core Barrel

LOGGED BY:

ARCO COAL COMPANY

BLUEWATER MILL

BORROW MATERIAL

BORING NO. 32-A

SHEET 2 OF

DATE STARTED: 9-10-91

DATE COMPLETE:

TOTAL DEPTH:

SURFACE ELEV:

X: Y:

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
	12-12				
		12			
				SP	Tailings SAND
	12-WT-13				Poorly-Graded - Some Clay or Silt by Binocular
		14			
		15			
	16-16	16			
		17			
		18			

ANDERSON Engineering Company
4655 South 1900 West St.
Roy, Utah 84067
Telephone 801-731-4596

SAMPLING METHOD: Hollow Stem Auger - Core

LOGGED BY: J. Martinson

ARCO COAL COMPANY

BLUEWATER MILL

BORROW MATERIAL

BORING NO. 29 A

SHEET 1 OF 1

DATE STARTED: 9-10-91

DATE COMPLETE: 9-10-91

TOTAL DEPTH: 8 FT

SURFACE ELEV:

X: Y:

SAMPLE NO.	SAMPLE DEPTH (ft)	DEPTH (ft)	SYMBOL	USC	DESCRIPTION
	0-2	1		SC	
		2		SW	SAND [illegible]
				SC-CL	[illegible] clay + [illegible]
	2-4	3		SP	
		4			NO RECOVERY
	4-6	5		SP	TAILINGS SAND
					[illegible] + TAILINGS SAND
		6			[illegible]
	6-8	7		SP	[illegible]
		8		CL	[illegible]

ARCO B1 WATER MILL
SOIL SAMPLE ROUTING LOG

Sample ID #	Description	Date Sampled	Tech	Date Sealed	Tech	1st Cnt Date	Tech	28 Day Count	Tech	QA/QC
91-262 S	28 I S.Toe 0-2'	9-10-91	RV	9-25-91	JT	10-1-91	ST	~~10-23~~ 10-24-91 ST	~~ST~~	
91-263 S	32 I ↓ ↓	↓	RV	↓	JT	↓	↓	10-24-91 ↓	↓	

Comments: Core Composite Samples from the South Toe (1ST set - I- taken)
Source Term Samples

Reviewed By: _____ ARCO RSO: _____ Date: _____

ARCO BLUEWATER MILL
SOIL SAMPLE ROUTING LOG

Sample ID #	Description	Date Sampled	Tech	Date Sealed	Tech	1st Cnt Date	Tech	28 Day Count	Tech	QA/QC
91-227S	S. Toe #24 Down to Malpais	8-20-91	RL/KS	9-19-91	RL/JT	9-21-91	SF	10-17-91	KS	
91-228S	#29 Above Tails				RL					
91-229S	#12 to Malpais				RL					
* 91-230S	#36 Tails				RL					
91-231S	#37 Down to malpais			9-20-91	RL/JT			10-18-91	KS	
91-232S	#28 Tails									
91-233S	#29 Tails									
91-234S	#13 Above Tails					SF NA				

Comments: * QA/QC Sample - South Toe Composites

Reviewed By: _____ ARCO RSO: _____ Date: _____

ARCO B. .ATER MILL
SOIL SAMPLE ROUTING LOG

Sample ID #	Description	Date Sampled	Tech	Date Sealed	Tech	1st Cnt Date	Tech	28 Day Count	Tech	QA/QC
91-235S	S. Toe #13 TAILS	8-20-91	KS/RL	9-20-91	JT/RL	9-23-91	KS	10-18-91	KS	
91-236S	#34 Below TAILS									
91-237S	#36 Below TAILS									
91-238S	#34 Above Tails									
91-239S	#28 Above Tails									
* 91-240S	#36 Above Tails									

Comments: * QA/QC Sample - South Toe Composites

Reviewed By: _____ ARCO RSO: _____ Date: _____

ARCO B. WATER HILL
SOIL SAMPLE ROUTING LOG

Sample ID #	Description	Date Sampled	Tech	Date Sealed	Tech	1st Cnt Date	Tech	28 Day Count	Tech	QA/QC
91-241-S	S. TOE #13 Tails Comp	8-20-91	RL/KS	9-20-91	JT/RL	9-23-91	KS	10-18-91	KS	
91-242-S	S. TOE #13 2' Below Tails	8-20-91	RL/KS	9-20-91	JT/RL	↓	↓	↓	↓	
91-243-S	S. TOE #30 0-2' To Malpais	8-20-91	RL/KS	9-20-91	JT/RL					
91-244-S	S. TOE #35 Tails Comp to Malpais	8-20-91	RL/KS	9-20-91	JT/RL	↓	↓			
91-245-S	S. TOE #35 0-2' above Tails	8-20-91	RL/KS	9-20-91	JT/RL	9-24-91	SF			
91-246-S	S. Toe #13, 28, 32 Top Comp	8-21-91	RL/JS	9-20-91	JT/RL	↓	↓			
11-247-S	S. Toe #23 0-2' To Malpais	8-21-91	RL/JS	9-20-91	JT/RL					
91-248-S	S. Toe #20 0-10" No Tails	8-21-91	RL/JS	9-20-91	JT/RL	↓	↓	↓	↓	

Comments: South Toe Composites

Reviewed By: _____ ARCO RSO: _____ Date: _____

done 9-23-91

ARCO BL[illegible] WATER MILL
SOIL SAMPLE ROUTING LOG

Samples 13, 28 + 32 TOP

Sample ID #	Description	Date Sampled	Tech	Date Sealed	Tech	ay Count	Tech	QA/QC
9-251 S,	#4 0-2', No TAILS	8-21-91	JS+RL	9-23-91	JT			
* 91-250 S	#5 0-1½', No TAILS							
91-249 S	#8 0-6", TAILS MIX SOIL							
91-248 S	#26 0-10", No TAILS			9-20-91	JT/RL			
91-247 S	#23 0-2' TO MAL/TAILS							
x	#13 TOP COMPOSITE		RL+KS					
91-246 S	#28 TOP COMPOSITE							
	#32 TOP COMPOSITE							

COMPOSITE. MIX EQUAL AMOUNTS TOGETHER AS ONE SAMPLE

N

A

Comments: Samples are from South toe of tails.
* QA/QC Sample

Reviewed By: _____ ARCO RSO: _____ Date: _____

Page 1 of 1

Bulk Samples

ARCO BLUEWATER MILL
SOIL SAMPLE ROUTING LOG

Sample ID #	Description	Date Sampled	Tech	Date Sealed	Tech	1st Cnt Date	Tech	28 Day Count	Tech	QA/QC
91-252 S	37 II D 2'-4'	9/10/91	VV	9-23-91	JT	9-30-91	KS	10-21-91	~~SF~~	
91-253 S	" 4-6			9-24-91	RL/JT			10-22-91	~~SF~~	
91-254 S	" 6-8			9-23-91	JT			10-21-91	~~SF~~	
91-255 S	" 8-10			9-23-91	JT			↓	↓	
* 91-256 S	" 10-12			9-24-91	RL/JT			10-22-91	~~SF~~	*
91-257 S	" 12-14			9-23-91	JT			10-21-91	~~SF~~	
91-258 S	" 14-16			9-24-91	RL/JT			10-22-91	~~SF~~	
91-259 S	" 16-18 Encountered bedrock @ 18'			9-23-91	JT			10-21-91	~~SF~~	
* 91-260 S	23 II 3'-5'			9-24-91	RL/JT			10-22-91	~~SF~~	*
91-261 S	" 5'-7' Encountered bedrock @ 7'			9-24-91	RL/JT	↓	↓	10-22-91	~~SF~~	

N A

Comments: Core Composite Samples (Source Term Samples) - South Toe
* QA/QC Samples (from 2nd set - II - taken)

Reviewed By: _____ ARCO RSO: _____ Date: _____

MCA Ra-226 Analy[redacted]on Soil Samples

#	Sample ID#	Sample Description	Sample Date	Field Tech.	Seal Date	Std. Wt. gms.	Samp. Wt. gms.	Count Date Initial/ 28-Day	Std. Cnt. Time	Samp. Count Time	ROI#1, Bi-214 609 kev BKG. COUNTS Area	BKG. COUNTS %Error	Std. Counts	Std. pCi/gm	SAMPLE COUNTS Area	SAMPLE COUNTS %Error	Ra226 (pCi/gm) Conc.	Ra226 (pCi/gm) Error*	Ra226 (pCi/gm) LLD	Lab Tech.
29	91-227S	Main Tails/Main Tails Toe Misc. Samples South Toe #24 0-2' Down to Malpais (Composite)	8-20-91	RL/KS	9-19-91	1200	1200	10-17-91	30	30	434	73	119960	100.0	23538	5	19.3	0.9	0.63	KS
30	91-228S	Main Tails/Main Tails Toe Misc. Samples South Toe #29 0-2' Above Tails to Malpais (Composite)	8-20-91	RL/KS	9-19-91	1200	1200	10-17-91	30	30	434	73	119960	100.0	13636	7	11.0	0.8	0.63	KS
31	91-229S	Main Tails/Main Tails Toe Misc. Samples South Toe #12 0-2' to Malpais	8-20-91	RL/KS	9-19-91	1200	1200	10-17-91	30	30	434	73	119960	100.0	169152	2	141.2	2.4	0.63	KS
32	91-230S	Main Tails/Main Tails Toe Misc. Samples South Toe #36 Tails Composite	8-20-91	RL/KS	9-19-91	1200	1200	10-17-91	30	30	434	73	119960	100.0	332233	1	277.6	3.3	0.63	KS
33	91-231S	Main Tails/Main Tails Toe Misc. Samples South Toe #37 0-2' Down to Malpais	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	43689	3	54.6	1.9	0.82	KS
34	91-232S	Main Tails/Main Tails Toe Misc. Samples South Toe #28 Tails Composite	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	424364	1	530.3	5.7	0.82	KS
35	91-233S	Main Tails/Main Tails Toe Misc. Samples South Toe #29 Tails Composite to Malpais	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	173927	2	217.3	3.6	0.82	KS
36	91-234S	Main Tails/Main Tails Toe Misc. Samples South Toe #13 Above Tails 0-2'	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	26649	4	33.3	1.5	0.82	KS
37	91-235S	Main Tails/Main Tails Toe Misc. Samples South Toe #13 Tails Composite	8-20-91	KS/RL	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	516054	1	644.9	6.3	0.82	KS
38	91-236S	Main Tails/Main Tails Toe Misc. Samples South Toe #34 Below Tails	8-20-91	KS/RL	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	15925	6	19.9	1.3	0.82	KS
39	91-237S	Main Tails/Main Tails Toe Misc. Samples South Toe #36 Below Tails	8-20-91	KS/RL	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	108138	2	135.1	2.8	0.82	KS
40	91-238S	Main Tails/Main Tails Toe Misc. Samples South Toe #34 Above Tails	8-20-91	KS/RL	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	12684	7	15.8	1.2	0.82	KS
41	91-239S	Main Tails/Main Tails Toe Misc. Samples South Toe #28 Above Tails	8-20-91	KS/RL	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	27673	4	34.5	1.5	0.82	KS
42	91-240S	Main Tails/Main Tails Toe Misc. Samples South Toe #36 Above Tails	8-20-91	KS/RL	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	6524	9	8.1	0.8	0.82	KS
43	91-241S	Main Tails/Main Tails Toe Misc. Samples South Toe #34 Tails Composite	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	1072792	1	1340.6	9.4	0.82	KS

Estimated Counting [redacted] at 95% CL

MCA Ra-226 Anal... on Soil Samples

#	Sample ID#	Sample Description	Sample Date	Field Tech	Seal Date	Std. Wt. gms.	Samp. Wt. gms.	Count Date Initial/ 28-Day	Std. Cnt. Time	Samp. Count Time	ROI#1, Bi-214 609 kev BKG. COUNTS Area	%Error	Std. Counts	Std. pCi/gm	SAMPLE COUNTS Area	%Error	Ra226 (pCi/gm) Conc.	Error*	LLD	Lab Tech.
44		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-242S	South Toe #13 2' Composite Below Tails	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	23545	5	29.4	1.5	0.82	KS
45		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-243S	South Toe #30 0-2' to Malpais	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	130729	2	163.3	3.1	0.82	KS
46		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-244S	South Toe #35 Tails Composite to Malpais	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	384398	1	480.3	5.3	0.82	KS
47		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-245S	South Toe #35 0-2' Above Tails	8-20-91	RL/KS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	6760	10	8.4	0.9	0.82	KS
48		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-246S	South Toe #13, 28, 32 Top Composite Equal Weight of Each	8-21-91	RL/JS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	23064	5	28.8	1.4	0.82	KS
49		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-247S	South Toe #23 0-2' to Malpais	8-21-91	RL/JS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	3322	17	4.1	0.8	0.82	KS
50		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-248S	South Toe #20 0-10" No Tails	8-21-91	RL/JS	9-20-91	1200	1200	10-18-91	20	20	35	784	80056	100.0	29788	4	37.2	1.6	0.82	KS
51		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-249S	South Toe #8 0-6" Tails Mix Soil	8-21-91	JS/RL	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	135577	2	111.8	2.1	-0.67	SF
52		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-250S	South Toe #5 0-1.5' No Tails	8-21-91	JS/RL	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	45870	3	37.6	1.3	-0.67	SF
53		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-251S	South Toe #4 0-2' No Tails	8-21-91	JS/RL	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	72780	3	59.6	1.6	-0.67	SF
54		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-252S	South Toe #32 2-4 Source Term	9-10-91	RV	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	192116	2	157.2	2.5	-0.67	SF
55		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-253S	South Toe #32 4-6' Source Term	9-10-91	RV	9-24-91	1200	1200	10-22-91	30	30	404	72	121964	100.0	389516	1	320.1	3.6	0.57	SF
56		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-254S	South Toe #32 6-8' Source Term	9-10-91	RV	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	424263	1	347.1	3.7	-0.67	SF
57		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-255S	South Toe #32 8-10' Source Term	9-10-91	RV	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	305694	1	250.1	3.1	-0.67	SF
58		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-256S	South Toe #32 10-12' Source Term (Rerun on 12-19-91, 91-388S)	9-10-91	RV	9-24-91	1200	1200	10-22-91	30	30	404	72	121964	100.0	299609	1	246.1	3.1	0.57	SF

Estimated Counting ... at 95% CL

MCA Ra-226 Analysis on Soil Samples

#	Sample ID#	Sample Description	Sample Date	Field Tech.	Seal Date	Std. Wt. gms.	Samp. Wt. gms.	Count Date Initial/ 28-Day	Std. Cnt. Time	Samp. Count Time	ROI#1, Bi-214 609 kev BKG. COUNTS Area	%Error	Std. Counts	Std pCi/gm	SAMPLE COUNTS Area	%Error	Ra226 (pCi/gm) Conc.	Error*	LLD	Lab Tech.
59		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-257S	South Toe #32 12-14' Source Term	9-10-91	RV	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	268368	1	219.6	2.9	-0.67	SF
60		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-258S	South Toe #32 14-16' Source Term	9-10-91	RV	9-24-91	1200	1200	10-22-91	30	20	404	72	121964	100.0	171400	2	211.4	3.7	0.85	SF
61		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-259S	South Toe #32 16-18' Source Term	9-[illegible]	RV	9-23-91	1200	1200	10-21-91	30	30	-39	881	122206	100.0	315334	1	258.0	3.2	-0.67	SF
62		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-260S	South Toe #28B 3-5' Source Term	9-10-91	RV	9-24-91	1200	1200	10-22-91	30	30	404	72	121964	100.0	337648	1	277.4	3.3	0.57	SF
63		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-261S	South Toe #28B 5-7'	9-10-91	RV	9-24-91	1200	1200	10-22-91	30	30	404	72	121964	100.0	595861	1	489.8	4.4	0.57	SF
64		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-262S	South Toe #28B 0-2'	9-10-91	RV	9-25-91	1200	1200	10-24-91	30	30	339	86	119780	100.0	29890	4	24.7	1.1	0.58	SF
65		Main Tails/Main Tails Toe Misc. Samples				1200	1200													
	91-263S	South Toe #32B 0-2'	9-10-91	RV	9-25-91	1200	1200	10-24-91	30	30	339	86	119780	100.0	1734	31	1.2	0.5	0.58	SF

Estimated Counting [illegible] at 95% CL

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ub South 1900 W
oy, Utah 84067
hone 801-731

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note

ANDERSON Engineering Company, Inc.
4655 South 1900 West St.
Roy, Utah 84067
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Southwest Office
P.O. Box 2
Grants, New Mexico 87020

Long Beach Office
231-428-9344

Engineers
Construction Managers

CALCULATION SHEET

JOB Bluewater SHEET NO. _____ CALC ~~SDA~~

CK'D BY _____ DATE 7DEC93 TITLE _____

South Beach

In-place Density

Avg Proc 116.8 lb/ft³

Avg Opt 12.2 %

3/2/93 40

Avg Sand Cone 115.0 lb/ft³ = 1.84 gr/cm³

Avg Opt. 12.0 %

TABLE 6-1

SOIL AND RADON SOURCE REGIONS AND
THEIR DEFINING PARAMETERS

Region	Effective[a] Present Source Thickness (feet)	Average[b] Radium Concentration (pCi/gram)	Average Radon Emanation Fraction	Average Long-Term Moisture (% dry wt)	Average Radon Diffusion Coefficient (cm^2/s)
Borrow Soil	---	2.7	---	9.5	0.018
Main Tailings-Sands	40	103-409	.20	8.0	0.025
Main Tailings-Mixed	15	242-538	.24	15.0	0.0085
Main Tailings-Slimes	9	424-522	.20	22.0	0.0011
Old Acid Tailings	4.7	2023-2214	.24	20.0	0.0010
East Carbonate T.	10	1030-1601	.30	20.0	0.0025
Carbonate T.	7	415-921			
South Carbonate T.	5	1963			
Evap. Ponds	.2-2	37-345	.17	9.5	0.0195
Stockpile Area	1	53	.41	9.5	0.036
Mill Area	7	22	.41	10.0	0.0164
Windblown (W-1 & W-2)	.5-4	34	.32	9.5	0.014
Windblown (W-3)	1	76.	.30	9.5	0.036

[a] Total thickness for old acid tailings, evaporation ponds, stockpile area, and windblown areas; extent of sampling for all other areas. Ranges shown for measured, non-uniform regions.

[b] Ranges show maximum variation in averaged vertical concentration profiles.

D:\pauwatx\design\rcc\da2dens.wk4

Disposal Area #2	Test No.	in-place wt	in-place mt	proc wt	proc mt
	7	110.6	17.0	114.7	15.4
	8	113	16.2	114.7	15.4
	9	112.4	16.5	114.7	15.4
	10	112.2	15.8	114.7	15.4
	11	114.7	14.1	114.7	15.4
	12	114.5	14.7	114.7	15.4
	13	111.8	16.6	114.7	15.4
	14	110.9	13.3	118.6	12.9
	15	112.5	15.4	118.6	12.9
	16	119.5	10.6	118.6	12.9
	17	110.7	13.4	118.6	12.9
	18	118.5	9.9	118.6	12.9
	42	115.2	12.6	118.6	12.9
	59	119.2	12.2	121	11.7
	60	117.5	12.1	121	11.7
	61	123.1	10.3	121	11.7
	62	119.5	9.9	121	11.7
	87	124.8	9	120	12.2
	88	121.9	9.7	120	12.2
	89	116.7	11.4	120	12.2
	90	122	11	120	12.2
	91	121.7	11.7	120	12.2
	103	121.9	10.2	122.2	10.5
	104	122.4	10.6	122.2	10.5
	105	120.7	9.5	122.2	10.5
	106	116.9	9.2	122.2	10.5
	107	121	9.9	122.2	10.5
	108	119.1	9.4	122.2	10.5
	111	121	10	122.2	10.5
	112	121	9.1	122.2	10.5
	113	123.1	9.1	122.2	10.5
	114	111.9	12.9	116.9	14
	115	113.2	12.9	116.9	14
	116	114.3	13.9	116.9	14
	117	112.5	13.1	116.9	14
	118	115.3	13.5	116.9	14
	119	115.1	13	116.9	14
	120	113.8	12.2	116.9	14
	121	114.3	13.3	116.9	14
	122	116.6	13.5	116.9	14
	123	113.6	13.1	116.9	14
	124	114.7	13.2	116.9	14
	125	112.8	12.4	116.9	14
	126	115.5	13.6	116.9	14
	127	116.3	12.5	116.9	14
	154	116.7	13.2	116.8	13.4
	155	119.5	13.1	116.8	13.4
	156	114.4	14.1	116.8	13.4
	157	119.7	12.2	116.8	13.4
	158	117.3	11.9	116.8	13.4
	159	116.9	12.7	116.8	13.4
	160	118.1	12.1	118.8	12.6
	161	119.8	12.2	118.8	12.6
	162	118.9	12.8	118.8	12.6
	163	119.3	12.5	118.8	12.6
	164	117.2	13.1	118.8	12.6
	165	117.8	12.1	118.8	12.6
	166	120	10.8	121.5	11.5
	167	120.2	11.8	121.5	11.5
	168	119	12.3	121.5	11.5
	195	117	11.7	119.1	12.3
	196	120.4	12.5	119.1	12.3
	214	122.7	11.2	119.5	12.5
	215	118.9	13.5	119.5	12.5
	216	116.9	11.5	119.5	12.5
	217	119.5	12.7	119.5	12.5
	230	119.7	11.6	120	13
	231	119.4	11.1	120	13
	233	114.7	12.2	119.1	12.3
	234	119.3	11.3	118.5	13.1
	235	116.7	12.7	119.5	12.7
	236	118.1	12.8	119.5	12.7
	237	112.7	12.4	120.6	12.4
	238	113.3	11.5	120.6	12.4
	239	119.1	11.9	120.6	12.4
	241	111.2	16.4	120.6	12.4
	242	116.9	13.1	120.6	12.4
Average		117.1	12.3	118.8	12.8

Asbestos Pit	Test No.	in-place wt	in-place mt	proc wt	proc mt
	128	112.1	12.9	116.7	12.3
	129	113.6	12.1	116.7	12.3
	130	115	13.2	116.7	12.3
	131	113.1	12.7	116.7	12.3
	132	118.6	13.2	123.6	10.8
	133	116.5	12.7	123.6	10.8
	134	116.1	13.2	123.6	10.8
	142	118.1	11.8	123.6	10.8
	143	117.9	10.9	123.6	10.8
	150	121.2	12	123.6	10.8
	151	119.7	12.3	123.6	10.8
	174	117.8	10.9	120.1	12.5
	175	114.6	14.8	120.1	12.5
	176	116.7	14.3	120.1	12.5
	177	119.5	10.9	120.1	12.5
	178	118	11.9	120.1	12.5
	179	117.9	15	120.1	12.5
	180	118.5	12.4	120.1	12.5
	181	115.1	13.6	120.1	12.5
	182	113.2	14.5	120.1	12.5
Average		116.5	12.8	120.6	11.9

Disposal Area #3	Test No.	in-place wt	in-place mt	proc wt	proc mt
	92	112.3	14.9	116.2	14.4
	93	116.8	13.4	116.2	14.4
	94	112.7	15.2	116.2	14.4
	95	110.8	15.9	116.2	14.4
	96	112.4	14	116.2	14.4
	97	109.8	14.5	116.2	14.4
	98	116.2	14	116.2	14.4
	99	116.1	12.8	116.2	14.4
	100	118.3	9.4	122.2	10.5
	101	120.1	9.7	122.2	10.5
	102	116	9.2	122.2	10.5
	218	120.6	11.3	119.4	12.6
	219	119	11	119.4	12.6
	220	117.7	10.7	119.4	12.6
	221	119.6	10.8	119.4	12.6
	222	117.9	12.4	119.4	12.6
	223	116.9	11.4	119.4	12.6
	224	111.6	11.5	121.1	12.1
	225	118.1	11.2	121.1	12.1
	226	114.6	13.1	121.1	12.1
	227	114.6	12.1	121.1	12.1
	228	120.3	10.7	121.1	12.1
	229	121.8	13.2	121.1	12.1
	243	116.3	13.4	119.1	12.9
	244	117.7	11.3	119.1	12.9
	245	115	12.9	119.1	12.9
	246	118.1	12.9	119.1	12.9
	247	116.9	13	119.1	12.9
	248	117.2	12.9	119.1	12.9
	249	119	12.9	119.1	12.9
	250	123.4	11.8	119.1	12.9
	251	114.6	14.5	119.1	12.9
	252	121.1	10.8	119.1	12.9
	253	119.1	11.8	119.1	12.9
	254	123.5	12.6	119.2	12.5
	255	116	12.6	119.2	12.5
	256	120.6	12.8	119.2	12.5
	257	117.7	10.6	119.2	12.5
	258	119.4	12	119.2	12.5
	259	119.8	12.8	119.2	12.5
	260	122.6	12.5	119.2	12.5
	261	115.8	11.9	119.8	13
	262	120.8	9.4	119.8	13
Average		117.4	12.3	119.1	12.8

ST203

RAECOB#C.BAS

UT INFORMATION : 07:35:55 12-09-1994
OTTOM FLUX = 0 pCi/m^2/sec
IR CONC. = 0 pCi/l
BARE LAYER 1 FLUX = 4.75 pCi/m^2/s
O OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
2	0.0	.3133	9.5	1	.2	1.84	0.00753	4.75	0.0	0.587
1	20.3	.411	20	37.2	.24	1.59	0.00100	4.75	0.0	0.427

********** TOP **********
- 2 - COVER *
****
- 1 -* SO BENCH TAILINGS *
****
********** BOTTOM **********

No Cover Required

ST283

RAECOBPC.BAS

UTPUT INFORMATION : 17:09:03 12-09-1994
OM FLUX = 0 pCi/m^2/sec
IR CONC. = 0 pCi/l
ARE LAYER 1 FLUX = 85.16 pCi/m^2/s
NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
3	61.0	.411	20	24.1	.24	1.59	0.00100	1.58	0.0	0.427
2	91.4	.411	20	317.1	.24	1.59	0.00100	25.83	159.6	0.427
1	61.0	.411	20	490.9	.24	1.59	0.00100	15.52	372.7	0.427

********** TOP **********
- 3 -* 0-2 TAILINGS *
****
- 2 - 2-5' TAILINGS *
****
- 1 -* 5-7' TAILINGS *
****
********** BOTTOM **********

No COVER REQUIRED

ST 29 P3

RAECOBPC.BAS

PUT INFORMATION : 11:57:24 12-09-1994
OM FLUX = 0 pCi/m^2/sec
IR CONC. = 0 pCi/l
ARE LAYER 1 FLUX = 22.87 pCi/m^2/s
NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
3	50.0	.3133	9.5	1	.2	1.842	0.00753	9.00	0.0	0.587
2	15.2	.411	20	11	.24	1.59	0.00100	11.89	15.3	0.427
1	15.2	.411	20	217.4						
					.24	1.59	0.00100	15.61	64.1	0.427

********** TOP **********
- 3 -* COVER *
****
- 2 -* 0-0.5' TAILINGS *
****
- 1 -* 0.5-1' TAILINGS *
****
********** BOTTOM **********

No Cover Required

ST 30B

RAECOBPC.BAS

UT INFORMATION : 10:02:36 12-09-1994
OTTOM FLUX = 0 pCi/m^2/sec
IR CONC. = 0 pCi/l
ARE LAYER 1 FLUX = 28.19 pCi/m^2/s
AYER 2 AJUSTED TO GIVE FLUX OF 20 pCi/m^2/s FROM LAYER 2

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
2	37.2	.3133	9.5	1	.2	1.842	0.00753	20.00	0.0	0.587
1	54.9	.411	20	163.4						
					.24	1.59	0.00100	23.67	24.3	0.427

********** TOP **********
- 2 -* COVER *
****
- 1 -* 0-1.8' TAILINGS *
****
********** BOTTOM **********

$$\frac{37.2\,\text{cm}}{2.54\,\text{cm}}\left(\frac{1\,\text{in}}{12\,\text{in}}\right) = 1.2\,\text{ft}.$$

GT32B

RAECOBPC.BAS

PUT INFORMATION : 11:50:32 12-09-1994
OM FLUX = 0 pCi/m^2/sec
IR CONC. = 0 pCi/l
ARE LAYER 1 FLUX = 48.12 pCi/m^2/s
NO OPTIMIZATION APPLIED

L	THICK (cm)	POR	MOIST (%)	SOURC (pCi/g)	E.F.	DENS (g/cm^3)	DIFF COEF	FLUX (pCi/m^2/s)	CONC. (pCi/cm^3)	MIC
7	20.0	.3133	9.5	1	.2	1.842	0.00753	1.83	0.0	0.587
6	61.0	.411	20	1.2	.24	1.59	0.00100	0.89	5.8	0.427
5	61.0	.411	20	157.3	.24	1.59	0.00100	0.88	150.7	0.427
4	61.0	.411	20	320.5	.24	1.59	0.00100	0.11	298.2	0.427
3	61.0	.411	20	347.6	.24	1.59	0.00100	-0.51	320.0	0.427
2	61.0	.411	20	250.3	.24	1.59	0.00100	-8.38	278.4	0.427
1	213.4	.411	20	275.3	.24	1.59	0.00100	1.66	246.8	0.427

********** TOP **********
- 7 -* COVER *
****
- 6 - 0-2' TAILINGS *
****
- 5 -* 2'-4' TAILINGS *
****
- 4 -* 4'-6' TAILINGS *
****
- 3 - 6'-8' TAILINGS *
****
- 2 -* 8'-10' TAILINGS *
****
- 1 - 10'-17'* TAILINGS * ASSUMED DEPTH BASED ON TOPOG *
****
********** BOTTOM **********

No Cover Required

ANDERSON Engineering Company, Inc.
4655 South 1900 West St.
Roy, Utah 84067
Telephone 801-731-4596

Southwest Office
P.O. Box 2
Grants, New Mexico 87020

Long Beach Office
231-428-9344

Engineers
Construction Managers

CALCULATION SHEET

JOB Bluewater SHEET NO. _____ CALC ~~SDA~~

CK'D BY _____ DATE 10 Dec 93 TITLE Erosion -

USLE Calculations for South Bench

K = 40 Table 5.1 NUREG 4620

Assume topsoil similar to Composite #9 in ARCO Rec. Plan

% silt and very fine particle (0.002 mm – 0.1 mm) = 13%

% sand (0.1 mm – 2 mm) = 68%

% organic = assume 1%

k = 0.08 from Fig 5.1 NUREG 4620

$$LS = \frac{650 + 450s + 65s^2}{10{,}000 + s^2} \left(\frac{L}{72.6}\right)^m$$

L = 500 ft. m = 0.2 (NUREG 4620, Table 5.2)

s = 0.25 %

$$LS = \frac{650 + 450(.25) + 65(.25)^2}{10{,}000 + 0.25^2} \left(\frac{500}{72.6}\right)^{.2} = 110(10^{-3})$$

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Grants, New Mexico 87020

Long Beach Office
231-428-9344

Engineers
Construction Managers

CALCULATION SHEET

JOB Blind Canyon SHEET NO. 2/2 CALC AA

CK'D BY _____ DATE 10 Dec 93 TITLE _____

Assume disked topsoil VM = 1

$$A = FKLS(VM)$$

$$= 40(0.08)(110(10^{-3}))(1)$$

$$= 350(10^{-3}) \frac{\text{tons}}{\text{acre}}\text{-yr.}$$

$$= 0.35 \frac{\text{tons}}{\text{acre-yr}}\left(\frac{2000\text{ lb}}{\text{ton}}\right)\text{acre-yr.}$$

Assume loose condition

$.70(119.3) = 83.5\text{ lb/ft}^3$

$$= 700 \frac{\text{lb}}{\text{yr-acre}}\left(\frac{\text{ft}^3}{83.5\text{ lb}}\right)\left(\frac{\text{acre}}{43560\text{ ft}^2}\right)$$

$$= 190(10^{-6})\text{ ft/yr.}$$

Assume 1000 yr. design

$$= 1000\text{ yr.}\left(190(10^{-6})\frac{\text{ft}}{\text{yr.}}\right) = 190(10^{-3})\text{ ft} = 2.3\text{ in.}$$

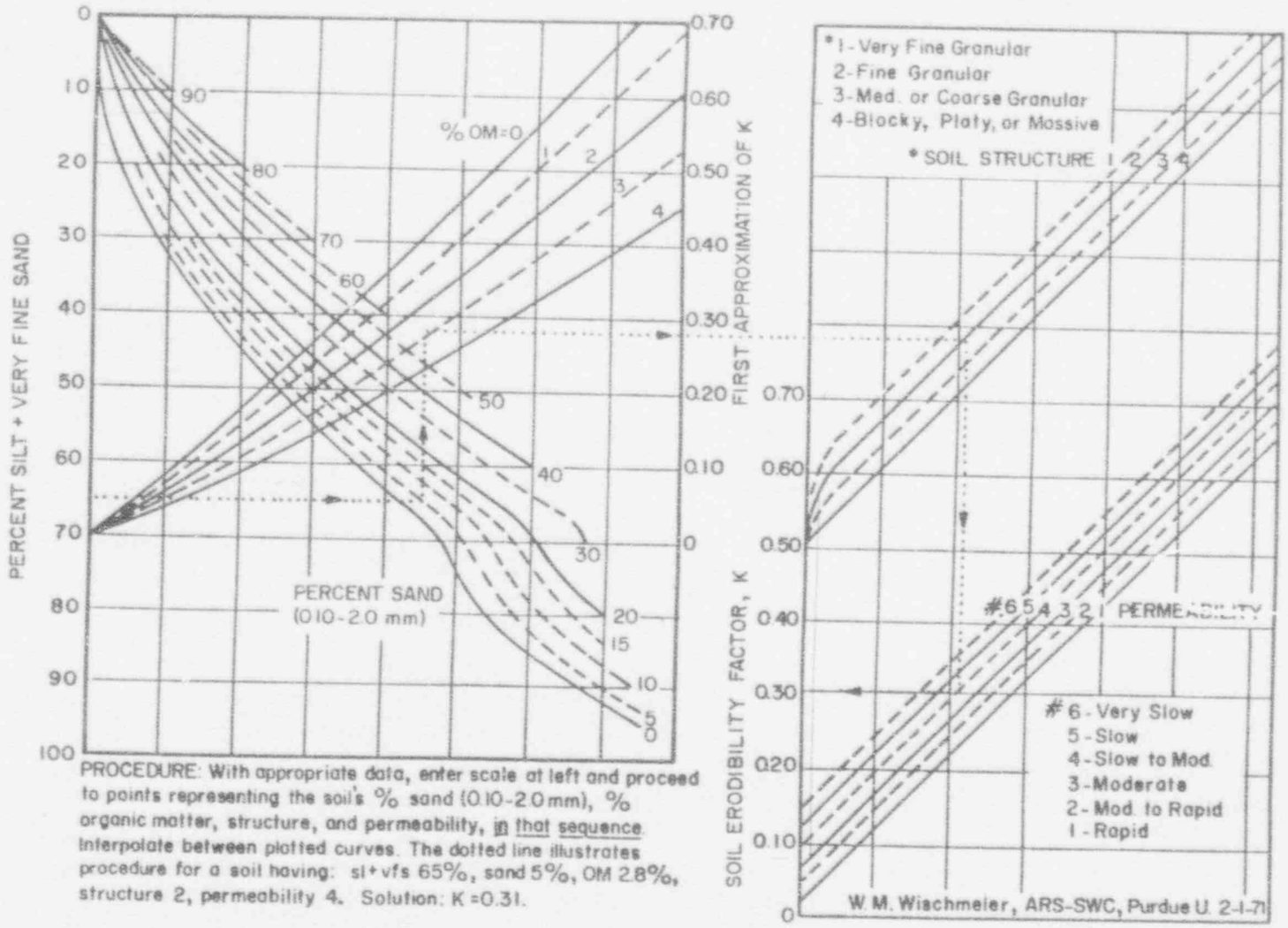
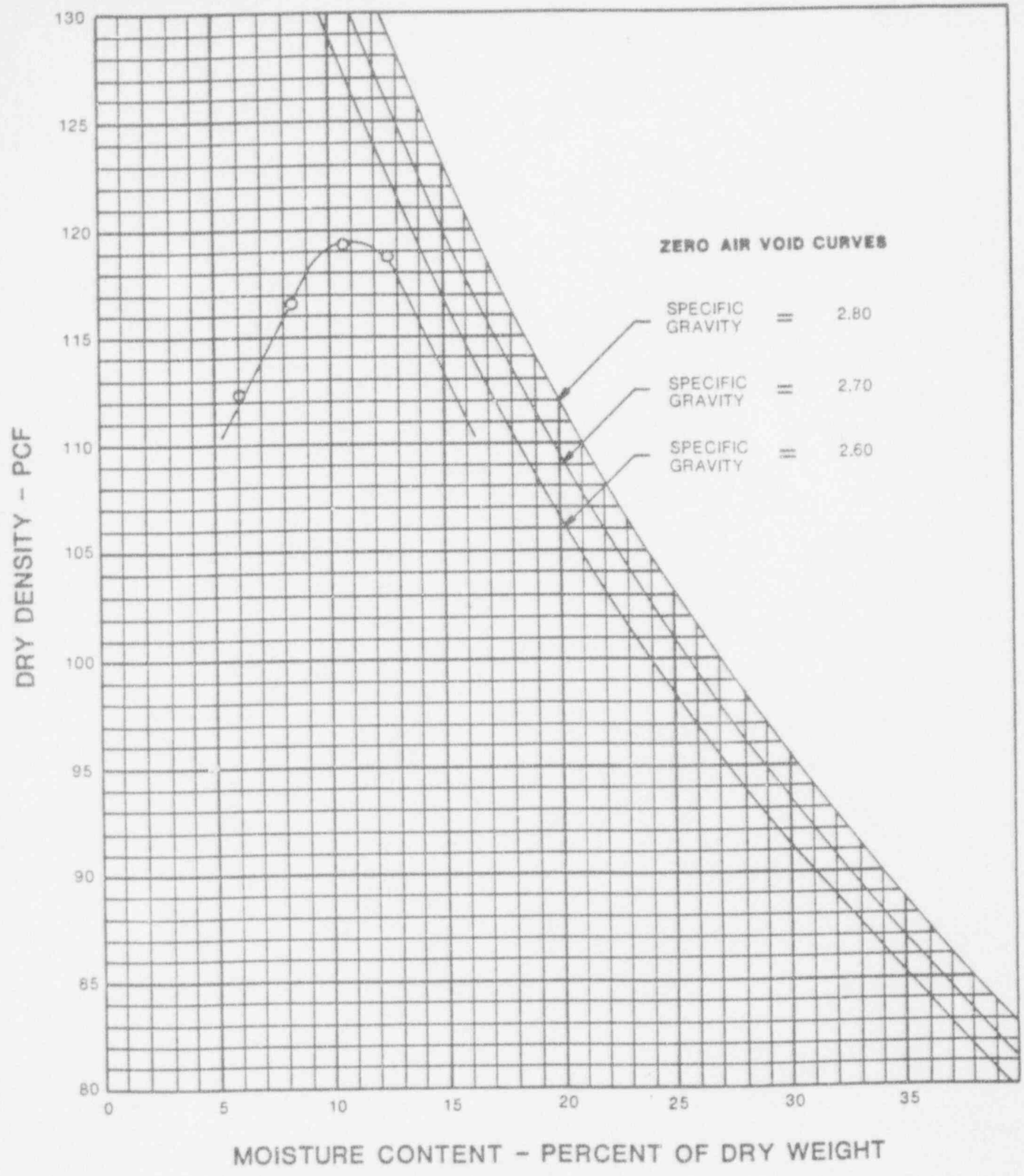


Fig. 5.1. Nomograph for determining soil erodibility factor *K. Source:* after Wischmeier et al., 1971.



LOCATION : Composite #9			MOISTURE-DENSITY RELATIONSHIPS
HOLE NO. :	DEPTH :	SAMPLE NO. : B-17	
SOIL DESCRIPTION : Silty sand			Chen & Associates
MAX. DRY DENSITY : 119.3 PCF	OPT. MOIST. CONTENT : 11.0 %		PROCEDURE : ASTM D 698-78 Method A
LIQUID LIMIT :	PLASTICITY INDEX : Nonplastic		JOB NO. : 1 633 87 / FIG. NO. 15
GRAVEL : 0 %	SAND : 78 %	SILT AND CLAY (-200) : 20 %	DATE : August 5, 1987

5.1.2.1 The Rainfall and Runoff Factor (R)

As noted by previous research at Los Alamos National Laboratory (Nyhan and Lane, 1983), the R factor as used in the MUSLE is often misinterpreted only as a rainfall factor. In reality, it must quantify both the raindrop impact and provide information on the amount and rate of runoff likely to be associated with the rain. More specifically, the R factor is described in terms of a rainfall storm energy (E) and the maximum 30-minute rainfall intensity (I_{30}). Generalized R factors applicable to the interior western United States are given in Table 5.1. For R factors in specific areas of the United States, it is recommended that erosion index distribution curves be obtained from local SCS offices.

Table 5.1. Generalized Rainfall and Runoff (R) Values.

State	Eastern Third	Central Third	Western Third
N. Dakota	50 - 75	40 - 50	40
S. Dakota	75 - 100	50	40
Montana	30 - 40	20	20 - 50
Wyoming	30 - 50	15 - 30	15 - 25
Colorado	75 - 100	40 - 50	20 - 40
Utah	20 - 30	20 - 50	15 - 40
New Mexico	75 - 100	40 - 50	20 - 40
Arizona	20 - 50	20 - 50	25 - 40

5.1.2.2 The Soil Erodibility Factor (K)

The soil erodibility factor (K) recognized the fact that the erodibility potential of a given soil is dependent on its compositional makeup, which in turn reflects the grain size distribution of the soil. To predict soil erodibility, five soil characteristics that include the percent silt and fine sand, percent sand greater than 0.1 mm, percent organic material, general soil structure and general permeability are determined. The K factor is then found by using the Wischmeier nomograph presented in Figure 5.1.

The makeup of the various soil fractions presented in Figure 5.1 is based on separating sand and silt at the 0.1 mm size. This differs from the Unified Soil Classification System which uses the No. 200 sieve size (0.075 mm) for the separation between sand and silt. The value to enter Figure 5.1 with should be the percentage of material finer than 0.1 mm in size, not the percentage passing the No. 200 sieve. Also, the determination of the Soil Erodibility Factor (K) as shown on Figure 5.1 does not specifically reference the percentage of clay (finer than 0.002 mm) contained in the material. The percentage of silt plus very fine sand to be used for Figure 5.1, therefore, is the percentage of material contained between 0.002 mm and 0.1 mm.